December 2010

SURPRISE
ARIZONA

Flood Control District of Maricopa County

HAPPY VALLEY DESIGN CONCEPT REPORT

RBF CONSULTING

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SUMMARY REPORT

December 2010

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EXECUTIVE SUMMARY

Project Objectives

The Happy Valley Design Concept Report (DCR) project objectives were as follows:

1) Establish the hydrologic baseline conditions,
2) Systematically evaluate and update existing area hydrology studies,
3) Develop and evaluate preliminary alternatives for flood hazard mitigation, and
4) Advance the identified Preferred Alternative that is Project Stakeholder acceptable and that is regionally beneficial, equitable, and cost effective.

Project Background

The Project Study Area is located within the Wittmann Area Drainage Master Study/Plan area and consists of approximately 6,800 acres (10.6 square miles) of land area bounded by Jomax Road to the north, McMicken Dam Outlet Channel to the south, one quarter mile west of 163rd Avenue along the west boundary, and approximately ½ mile east of the Dysart Road alignment to the east. However, the contributing watershed is 230 square miles to the study area and results in a flood hazard that covers most of the study area as Zone A as shown on the existing FEMA Flood Insurance Rate Maps (FIRM).

Additionally, the Wittmann Area Drainage Master Study Update (WADMSU) hydrology which was completed in July 2005, attempted to establish the existing conditions hydrology, but did not include or contemplate the Happy Valley Wash/berm in its analysis/modeling. This feature is of significant size and has diverted flows along the Happy Valley Road section line for the purpose of capturing sheet flows to protect the Luke AFB auxiliary field since its construction in approximately 1942. This omission has caused interpretation and implementation problems to determine the actual existing conditions and how to mitigate the flood hazards identified on the FIRM.

The Wittmann Area Drainage Master Plan (WADMP) which was completed in June 2009 utilized the existing conditions hydrology from the WADMSU, but recommended a regional facility in the study area to mitigate the flooding hazards.

Project Purpose

The Flood Control District of Maricopa County (FCDMC) and the City of Surprise jointly identified the need to systematically evaluate the existing and differing hydrologic studies and previously

conducted alternatives analysis of the Happy Valley Wash. The purpose and intent of the Happy Valley DCR project is to evaluate the current differences in approach with the various hydrology studies in the area and to develop a regional solution that brings the greatest benefit to the greatest number of stakeholders in a cost effective manner.

Stakeholder Interests and Conflicts

The planned development projects situated north of the Happy Valley Wash patterned their drainage reports after the WADMSU hydrology, whereby the Happy Valley Wash is not recognized. Their studies concluded that all flows should return to their southerly historic flow patterns.

The planned development projects south of the existing Happy Valley Wash took exception to this approach. Representatives to the south suggest that the WADMSU incorrectly omitted the wash from the analysis and that although the berm along the south side of the Happy Valley Wash is not a certified levee, the wash itself has existed since 1942 and the capacity of that wash should be a contributing factor in capturing a portion of the upstream flows and thereby reducing the downstream regulatory floodplain burden.

Alternative Analysis and Preferred Alternative Development

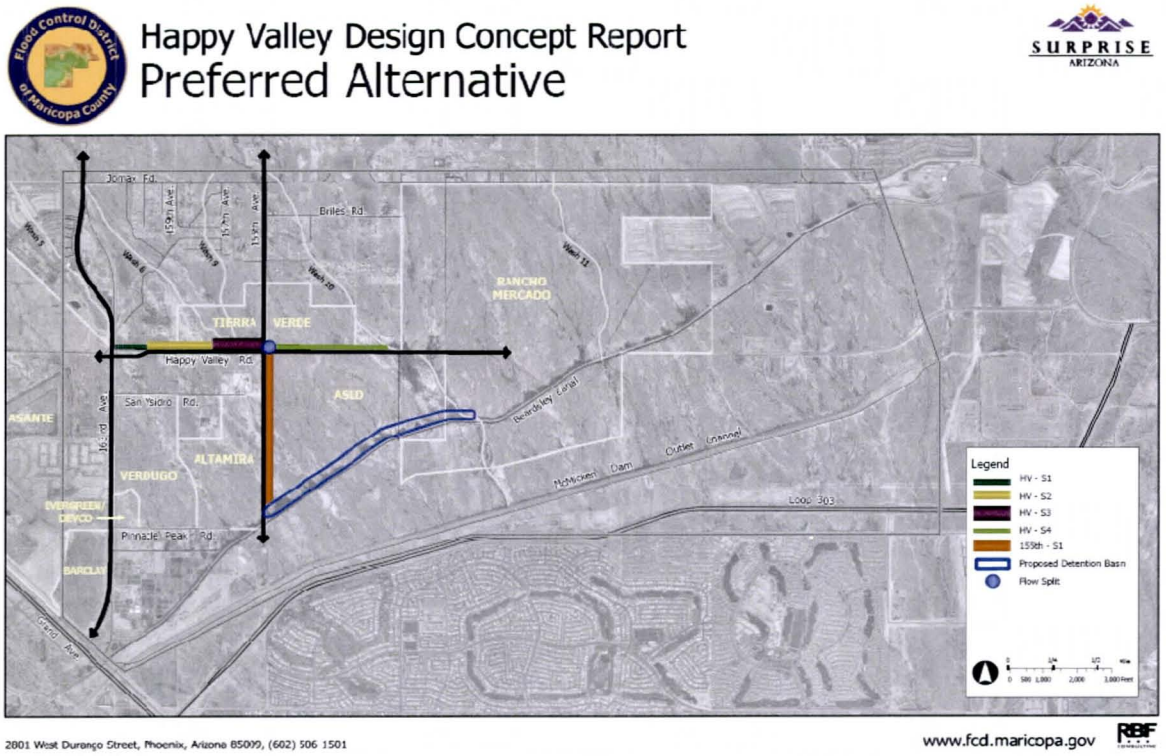
The Happy Valley DCR process has included over 15 months of hydrological and hydraulic analyses, a Stakeholder site visit, nine Stakeholder Meetings of review and comment at key project milestones, and analysis or five (5) Proposed Alternatives. The Project Stakeholders unanimously selected a Preferred Alternative generally based on the following criteria:

1) The Alternative Eliminates or Significantly Reduces Floodplain
2) The Alternative Complements Community Character
3) The Alternative Minimizes Construction Costs/Achieves Regional Synergies
4) The Alternative Maximizes Operation and Maintenance Efficiencies

The Preferred Alternative represents the smallest floodplain footprint of the alternatives studied while maximizing the amount of developable property for the vast majority of the stakeholders. The Preferred Alternative also closely resembles the original Wittmann ADMP preferred alignment and is described as follows:

The Happy Valley DCR Preferred Alternative – *Flow Split with Basin*, consists of a series of improved conveyance channels running along the north side of the planned Happy Valley Road and the east side of 155th Avenue. One detention basin is proposed to be located at the

southerly terminus of 155th Avenue just north of the Beardsley Canal as shown on the following graphic.



The improved conveyance channel along the north side of Happy Valley Road expands in size and capacity as it collects contributing flows from Washes 5, 6, and 9 as it flows easterly from 163rd Avenue to 155th Avenue. Three conveyance channel sizes/sections make up this one mile length of channel. Section 3 of the Happy Valley Channel is the largest and carries approximately 2,450 cfs.

A designed flow split at 155th Avenue would direct approximately 1,730 cfs or 70% of the flows south (an approximate representation of historic flow patterns without the berm in place) into a new conveyance channel proposed along the east side of 155th Avenue. The remaining 30% flows (approximately 720 cfs) will continue in a smaller improved conveyance channel extending from the flow split at 155th Avenue to the terminus of the improved conveyance channel section at its confluence with Wash 10. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal.

The 155th Avenue Channel outlets into an approximate 53-acre detention basin that would attenuate flows and bleed off larger events along the northerly edge of the Beardsley Canal towards the existing overchute. Contributing 100-year flows from both the Happy Valley

Channel and the detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU.

It should be noted that the Project Stakeholders expressed a desire of still deferring to the "No Action Alternative" in the event that the project cannot be implemented due to funding or timing constraints.

The opinion of probable cost identifies a low and high range of probable costs to construct the flood mitigation facilities identified in the Preferred Alternative. The low estimate total project cost for the Happy Valley DCR is $14,083,155. The upper end cost estimate is $19,852,902.

Future Considerations

The Preferred Alternative has been developed to conceptual plans to demonstrate that the concept is feasible for future design. Additional design and analysis will be necessary to complete the final design of the Preferred Alternative. The future design may differ from the conceptual plans provided as part of this project. As the Happy Valley Channel is carried forward from the DCR stage to the design and implementation stages, the Happy Valley DCR identified a series of items that warrant additional investigation and study that were beyond the scope and objective of this Happy Valley DCR project. These items include:

1. Determination of Precise Happy Valley Channel and Happy Valley Road Alignment Locations
2. HEC-RAS Analysis of Preferred Alternative
3. Permissible Velocities
4. Channel ROW Survey
5. Additional Soils Analysis
6. Re-evaluation Detention Basin vs. 155th Avenue Overchute
7. Beardsley Canal Overchute Analysis
8. Community Entrance Road Locations and Use as Grade Control Structures
9. Project Phasing Opportunities
10. Channel Buffer Widths
11. Collaboration with ASLD
12. Define Pro Rata Share/Funding Responsibilities of Construction Costs

Project Implementation

Continued collaboration among the District, City of Surprise, and Project Stakeholders will be necessary to successfully move this project through the design and construction stages that collectively meet the stated project objectives.

ACKNOWLEDGEMENTS

The Flood Control District of Maricopa County and the City of Surprise would like to acknowledge the dedication and commitment of the Project Stakeholders who persevered through numerous meetings and data analysis conducted over the 17 month planning process. Without their oversight and guidance, this project could not have succeeded. The Project Stakeholders include the following:

Ricardo Aguirre, CVL
Stuart Barney, Evergreen DevCo
Don Breeding, Maricopa Water District
Charlie Caldwell, William Lyon Homes
Kevin Kammerzell, Atwell Group
Paul Kroff, Woodside Homes
Hal Marron, DEI Professional Services
Phil Miller, PM Consultants
Manny Patel, ASLD
Brian Rahal, DEI Professional Services
Anthony Sumner, Sandbox Development Consultants
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CD with Digital Files

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CHAPTER 1 – INTRODUCTION

1.1 PROJECT STUDY AREA AND BACKGROUND

The Project Study Area consists of approximately 6,800 acres (10.6 square miles) of land area bounded by Jomax Road to the north, McMicken Dam Outlet Channel to the south, one quarter mile west of 163rd Avenue along the west boundary, and approximately ½ mile east of the Dysart Road alignment to the east. The watershed that contributes flows and was included in this report covers over 230 square miles. See Figure 1.1 for the Project Study Area boundary.

The Project Study Area includes five developer interests with individual development plans at varying stages of the development process. The Arizona State Land Department (ASLD) also holds a considerable parcel in Trust and is located east of the Alta Mira property. Please refer to the Data Collection chapter for more detail on the property ownership in the Project Study Area.

The Project Study Area is situated within the area covered by the Wittmann Area Drainage Master Study Update (WADMSU) that was completed in July 2007 as well as the Wittmann Area Drainage Master Plan (WADMP) completed in June 2009.

The existing FEMA floodplain per the Flood Insurance Rate Maps (FIRM) within the Study Area is predominantly characterized as Zone A floodplain. The Zone A floodplain is situated along Wash 5 East, Wash 6 East, Wash 9 East, Wash 10 East, and Padelford Wash. An extensive swath of Zone A FEMA floodplain blankets a significant portion of the southern half of the Project Study Area primarily due to the ponding effects of the Beardsley Canal and McMicken Dam Outlet Channel. A concentration of Zone AE exists at the terminus of the McMicken Dam Outlet Channel as it discharges into the Agua Fria River. Refer to Figure 2.2 for additional reference.

1.2 PROJECT NEED AND PURPOSE

The Flood Control District of Maricopa County (FCDMC) and the City of Surprise jointly identified the need to systematically evaluate existing and differing hydrologic studies and previously conducted alternatives analysis of the Happy Valley Channel. The purpose and intent of the Happy Valley Design Concept Report (DCR) project is to evaluate the differing approaches to the various hydrology studies in the area and to develop a regional solution that brings the greatest benefit to the greatest number of stakeholders in a cost effective manner. This would be accomplished through the review and refinement of existing hydrology studies, creation of a new hydrology study, development of multiple alternatives, refinement of those alternatives through stakeholder guidance, selection of a Preferred Alternative, and creation of a cost estimate and 15% conceptual design plans for the Preferred Alternative.

1.3 PROJECT SCOPE

The core milestones defining the Happy Valley DCR process include the following:

1. Data Collection and Review,
2. Creation of New Hydrology and Hydraulic Studies and Refinement of Older Hydrology and Hydraulic studies,
3. Utilize Stakeholder involvement to determine a series of Proposed Alternatives, including "No Action"
4. Development and Analysis of Alternative Drainage Concepts,
5. Refinement of Alternative Drainage Concepts into One Preferred Alternative,
6. Development of Opinion of Probable Costs,
7. Identify and Define Regional Cost Synergies and Efficiencies, and
8. Creation of 15% Conceptual Plans

1.4 PROJECT OVERVIEW

The Happy Valley DCR project is providing professional planning, engineering, and landscape architecture services to develop a DCR to assist Project Stakeholders in developing a regionally beneficial and equitable solution for flood mitigation facilities in the Project Study Area.

The Happy Valley DCR process includes the following processes:

1. Data Collection and Review,
2. Creation of New Hydrology and Hydraulic Studies and Refinement of Older Hydrology and Hydraulic studies,
3. Meetings and Coordination with Project Stakeholders,
4. Development and Analysis of Proposed Alternative Drainage Concepts,
5. Refinement of Proposed Alternative Drainage Concepts into One Preferred Alternative,
6. Development of Opinion of Probable Costs (low and high),
7. Identify and Define Regional Cost Synergies and Efficiencies, and
8. Creation of 15% Conceptual Plans

RBF received existing hydrologic studies prepared by Entellus for the Wittmann ADMSU completed in June 2005, by CVL for the Tierra Verde project, and from DEI on behalf of the Verdugo and Asante projects. The HEC-1 analysis updated the Wittmann ADMSU model to reflect existing conditions and to modify some deficiencies as identified by DEI through their separate modeling in the Project Study Area on behalf of a developer stakeholder.

The WADMSU was completed in July 2007 and the existing condition hydrology did not include or contemplate the Happy Valley Wash/berm in its analysis/modeling. Zone AE floodplains were delineated north of the Happy Valley Wash (limits of the AE study) and the Zone A remains south of the Happy Valley Wash.

The WADMP was completed in June 2009. The WADMP utilizes the existing conditions hydrology from the WADMSU. The WADMP conducted a visual character assessment, identified flood control alternatives, selected a preferred alternative, and looked at various wash and channel hydraulics. The preferred alternative developed in the WADMP did identify the Happy Valley Channel as a component of the preferred alternative.

The Tierra Verde drainage report/CLOMR request dated October 2007 was prepared by CVL. The report's hydrology modeling is patterned after the WADMSU hydrology where the Happy Valley Wash is not acknowledged. The report suggests that drainage in the area be returned to its historic flows by modifying the floodplain to redirect the flows of Wash 6 East to be combined with the Wash 9 East flows, ultimately discharging at Happy Valley Road (alignment) just west of the 155th Avenue alignment.

Tierra Verde has a letter from the USACE indicating that there are no regulatory waters of the United States and therefore the project is not subject to the provisions of Section 404 of the Clean Water Act.

The Verdugo and Alta Mira projects (formerly known together as "Pinnacle Peak Estates") conducted a drainage study completed in June 2008 prepared by DEI. This report basically suggests that the WADMSU incorrectly omitted the channel from the analysis and that although the berm along the south side of the Happy Valley Channel is not a certified levee, the channel itself has existed since 1942 and the capacity of that channel should be a contributing factor in capturing a portion of the upstream flows and thereby reducing the downstream regulatory floodplain burden. The DEI report then assessed the berm and non-berm conditions and updated the area hydrology model to demonstrate what they purport to be a more accurate assessment of the existing conditions hydrology in the study area.

After a period of analysis of the existing hydrology conditions described above as well as the preliminary data collection by the project consultant team, Project Stakeholders became

engaged in the process in earnest beginning in July 2009. Over the course of the next 15 months, a total of 11 Project Stakeholder Meetings plus a site visit were conducted at key milestones in the planning process.

On July 22, 2009, RBF representatives conducted an initial site visit of the project study area. The field reconnaissance included a number of photographs and notations to obtain a preliminary understanding of the Happy Valley Wash characteristics and other variables influencing the study area. Figure 2.4 illustrates a few select photographs that give preliminary indication of the channel character.

In October 2009, the Stakeholders met to review the preliminary hydrology report findings and discuss concerns and differences of opinion with respect to methodology. By December 2009, the Stakeholders met to review an extensive series of Preliminary Alternatives that were then distilled into five (5) Proposed Alternatives for more specific analysis.

Through the first four months of 2010, three Stakeholder Progress Meetings were conducted to review the updates to the hydrology modeling and conceptual development of the Proposed Alternatives. Separate meetings were held with the ASLD and Maricopa Water District to enhance their understanding of the project objectives and seek their input that would influence the development of the Proposed Alternatives.

In June 2010 the Proposed Alternatives Report was distributed to all Project Stakeholders for their review. This report identified five (5) Proposed Alternatives, including a unique "No Action Alternative" that represented what individual Stakeholder improvements would be required if each Stakeholder had to construct each of their respective improvements in the absence of regional cooperation. Each Proposed Alternative consisted of a different set of flood hazard mitigation facilities designed to give the Stakeholders a broad review of the various approaches to achieving the project objectives.

On August 9, 2010, a Project Stakeholder Meeting was held. The purpose of the meeting was to review and evaluate the five Proposed Alternatives and recommend one Preferred Alternative. The Happy Valley DCR project objective was to select a Preferred Alternative that provided regional efficiencies that were beneficial and equitable for the maximum number of stakeholders. Under that premise, the Project Team evaluated each of the alternatives generally using the following criteria:

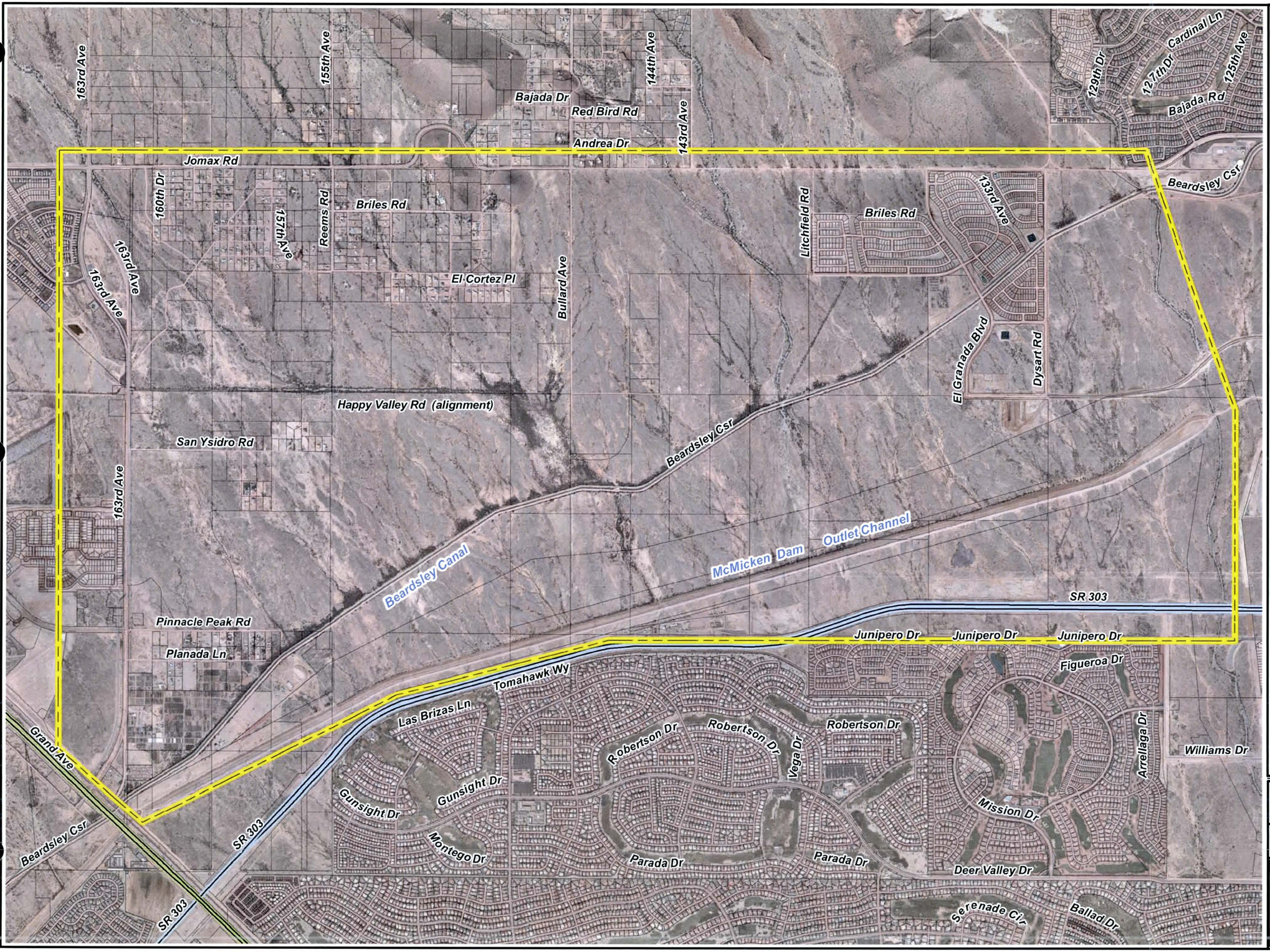
1. Alternative Eliminates or Significantly Reduces Floodplain
2. Alternative Complements Community Character
3. Alternative Minimizes Construction Costs/Achieves Regional Synergies
4. Alternative Maximizes Operation and Maintenance Efficiencies

The Project Stakeholders recognized that there wasn't a single perfect solution and that each alternative had certain advantages and disadvantages. The Project Stakeholders recommendation of the Preferred Alternative attempted to achieve maximum equity and efficiency for the "greater good".

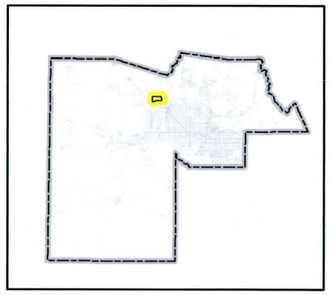
After a review of the five Proposed Alternatives generally utilizing the four criteria above, the Project Stakeholders recommended Proposed Alternative #1 as the Preferred Alternative. The Project Stakeholders noted that this Preferred Alternative is the most efficient in reducing the existing floodplain, which was a central objective throughout the Happy Valley DCR process. Simply put, the Preferred Alternative represents the smallest floodplain footprint of the alternatives studied while maximizing the amount of developable property for the vast majority of the stakeholders. The Preferred Alternative closely resembles the original Wittmann ADMP preferred alignment. A complete description of the Preferred Alternative, including cost estimates, refined hydrology studies, opportunities and constraints, 15% conceptual plans, and further considerations for design and construction is provided in Chapter 5.

On December 13, 2010, the Final Stakeholder Meeting was conducted with the purpose of reviewing the updated hydrology and providing final comments and suggestions on the contents of the Preferred Alternative Report. Much of the focus of the comments of this meeting focused on specifics relating to the hydrology study findings as well as added consideration for future design and implementation of the project.

Figure 1.1 – Project Study Area



Flood Control District of Maricopa County



Happy Valley DCR

Legend

Study Area Limits

0 500 1,000 2,000 Feet

1 inch = 2,000 feet

Project Study Area

RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

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PHOENIX, ARIZONA 85053-7550
602-467-2200 FAX 602-467-2201 www.RBF.com

Flood Control District of Maricopa County

SURPRISE ARIZONA

DRAFTED	CHECKED
MCK	KJK

PROJECT NUMBER 45104030

DATE 12.22.10

FIGURE 1.1

File: H:\PDATA\45104030\GIS\Data Collection Report\HV DCR_Property Ownership.mxd

CHAPTER 2 – DATA COLLECTION

2.1 HAPPY VALLEY DCR DATA COLLECTION AND FINDINGS

This section of the Happy Valley DCR is intended to describe the data collection efforts, provide an exhaustive listing of all data materials received from the stakeholders and agencies. A considerable amount of background information was gathered, including extensive reports and data materials from the FCDMC relative to the Wittmann ADMP, ADMSU, and associated files and documents, extensive information from developer stakeholders with property within the study area and the City of Surprise. This report also outlines observations gathered at the project site visit.

2.2 DATA SOURCES

An extensive amount of information was sought and received from a variety of project stakeholders and government agencies. Some information was provided first hand from project stakeholders, supplemental information was also derived via email or through websites to complement the primary data sources. These stakeholders include:

- Flood Control District of Maricopa County
- City of Surprise
- FEMA
- Maricopa County Assessor Department
- Maricopa County Planning and Development
- Maricopa Association of Governments
- DEI Professional Services
- Coe and Van Loo Consultants, Inc.
- CMX Engineering
- Sandbox Development Consultants

2.3 DATA TYPES OBTAINED

The data received was provided in a variety of different formats. Table 2.3, *List of Collected Reports and Electronic Files* identifies and summarizes the data obtained and data types associated with each report, map or piece of data received. A few examples of the various data types include:

- GIS Database Layers
- Aerial Photography

- Area Topography
- Site Visit Photos
- Flood Insurance Rate Maps
- Land Ownership Data
- PDF Files of many varieties
- Hydrology and Hydraulic Models and Reports
- Land Use Plans
- Preliminary Plats
- Conceptual Roadway Plans
- CLOMR Request
- Site Plans
- Landscape Inventory and Analysis
- Scenery and Recreation Resource Assessment
- Flood Protection Methods
- Flood Protection Structure Types
- Policies for the Aesthetic Treatment and Landscaping of Flood Control Projects

2.4 Preliminary Findings of Fact

2.4.1 Property Ownership

The Study Area includes five developer interests with individual development plans at varying stages of the development process. Each of these are explained in greater detail in Section 2.4.6. See Figure 2.1 for further illustration. Additional individual property owners also are located along the Happy Valley wash alignment and have been identified as well. The Arizona State Land Department also holds a considerable parcel in Trust and is located east of the Alta Mira property.

2.4.2 Existing Floodplain

The existing FEMA floodplain per the Flood Insurance Rate Maps (FIRM) within the Study Area is predominantly characterized as Zone A floodplain. The Zone A floodplain is situated along Wash 5 East, Wash 6 East, Wash 9 East, Wash 10 East, and Padelford Wash. An extensive swath of Zone A FEMA floodplain blankets a significant portion of the southern half of the Study Area primarily due to the ponding affects of the Beardsley Canal and McMicken Dam Outlet Channel. A concentration of Zone AE exists at the terminus of the McMicken Dam Outlet Channel. Please see Figure 2.2 for additional reference.

2.4.3 GIS Database, Topography, and Aerial Photography

The FCDMC provided their most recent GIS database, topography, and aerial photography for the Study Area. This information was useful for a variety of applications relative to aerial surveys, assessing development trends, and evaluating potential changes to hydrologic modeling.

2.4.4 Hydrologic Reports and Models

RBF received existing hydrologic studies prepared by Entellus for the Wittmann ADMSU in June 2005, by CVL for the Tierra Verde project, and from DEI on behalf of the Verdugo and Asante projects. The HEC-1 analysis was updated to reflect existing conditions and to modify some deficiencies as identified by DEI through their separate modeling in the Study Area on behalf of a developer stakeholder.

The Wittmann Area Drainage Master Study Update (WADMSU) was completed in July 2007 and that the existing condition hydrology did not include or contemplate the Happy Valley Wash/berm in its analysis/modeling. Zone AE Floodplains were delineated north of the Happy Valley Channel (limits of the AE study) and the large area of Zone A remains south of the Happy Valley Wash.

The Wittmann Area Drainage Master Plan (WADMP) was completed in June 2009. The WADMP utilizes the existing conditions hydrology from the WADMSU. The WADMP conducted a visual character assessment, identified flood control alternatives, selected a preferred alternative, and looked at various wash and channel hydraulics. The preferred alternative developed in the WADMP did identify the Happy Valley Channel as a component of the preferred alternative but also identifies regulatory floodplain south of the Happy Valley Channel.

The Tierra Verde drainage report/CLOMR request is dated October 2007 and was prepared by CVL. The report's hydrology modeling is patterned after the WADMSU hydrology whereby the Happy Valley Channel is not acknowledged. The report suggests that drainage in the area be returned to its historic flows by modifying the floodplain to redirect the flows of Wash 6 East to be combined with the Wash 9 East flows, ultimately discharging at Happy Valley Road (alignment) just west of the 155th Avenue alignment. Tierra Verde has a letter from the USACE indicating that there are no regulatory waters of the United States and therefore the project is not subject to the provisions of Section 404 of the Clean Water Act.

The Verdugo and Alta Mira projects (formerly known together as "Pinnacle Peak Estates") conducted a drainage study completed in June 2008 and was prepared by DEI.

This report suggests that the WADMSU incorrectly omitted the channel from the analysis and that although the berm along the south side of the Happy Valley Channel is not a certified levee, the channel itself has existed since 1942 and the capacity of that channel should be a contributing factor in capturing a portion of the upstream flows and thereby reducing the downstream regulatory floodplain burden. The DEI report then assessed the berm and non-berm conditions and updated the area hydrology model to demonstrate what they purport to be a more accurate assessment of the existing conditions hydrology in the study area.

2.4.5 Site Visit

On July 22, 2009, RBF representatives conducted an initial site visit of the project study area. The field reconnaissance included a number of photographs and notations to obtain a preliminary understanding of the Happy Valley Channel characteristics and other variables influencing the study area. Figure 2.4 illustrates a select few photographs that give preliminary indication of the channel character. Many areas within the entire Study Area were observed, many of the notable areas include:

- Existing culverts at Happy Valley Channel and 163rd Avenue
- Existing conditions of the Happy Valley Channel west of 163rd Avenue
- Contributing washes and retention on the Desert Oasis property, just west of 163rd Avenue
- Happy Valley Channel at multiple intervals from 163rd Avenue, east to the ASLD property line (fence)
- The confluence of the Happy Valley Channel with Wash 6 East and Wash 9 East
- Happy Valley Channel as it turns southwardly at the Bullard Avenue alignment and confluence with Wash 10 East
- The Happy Valley Channel overchute of the Beardsley Canal
- The Padelford Wash overchute of the Beardsley Canal on the Rancho Mercado property
- Existing culverts at the Jomax Rd/163rd Avenue intersection

Please refer to Figure's 2.4 and 2.5 for additional illustration of the points of interest along the site visit as well as photographs illustrating the channel character.

2.4.6 Existing Development Plans in the Study Area

Altamira

- 178 acres, 534 single family detached and cluster units proposed
- PAD zoning application currently under city review

Please see Figure 2.6 for reference to the Altamira proposed land use plan.

Rancho Mercado

- Zoning approved from city for approximately 5,000 residential units
- Had a preliminary plat for approximately 1,000 lots that is on hold pending the outcome of this study

Please see Figure 2.7 for reference to the Rancho Mercado approved land use plan.

Tierra Verde West and East

- Tierra Verde East (Voyager) – zoned for 259 residential units, has an approved preliminary plat and has final plat and construction drawings submitted and under city review.

- Tierra Verde West (Woodside) – zoned for 295 lots with an approved preliminary plat and has final plat and construction drawings submitted and under city review.

The property developer has noted that Happy Valley Road is necessary to the development of Tierra Verde and to Rancho Mercado and must be taken into account in this study. Please see Figure 2.8 for reference to the Tierra Verde approved preliminary plat.

Verdugo

- Recently received zoning approval from the city for up to 641 residential units with supporting Neighborhood Commercial and Professional Office land use components.

Please see Figure 2.9 for reference to the Verdugo approved land use plan.

Evergreen DevCo

Evergreen DevCo owns the commercial corner at the northeast corner of 163rd Avenue and Pinnacle Peak Road and Walgreens has purchased a pad on the site.

2.4.7 Landscape Aesthetics and Multi-Use Opportunities

Significant information has been obtained that enables the Project Team to identify a multitude of landscaping and multi-use opportunities within the Study Area. The City of Surprise Parks and Trails Master Plan identifies two (2) proposed neighborhood parks in

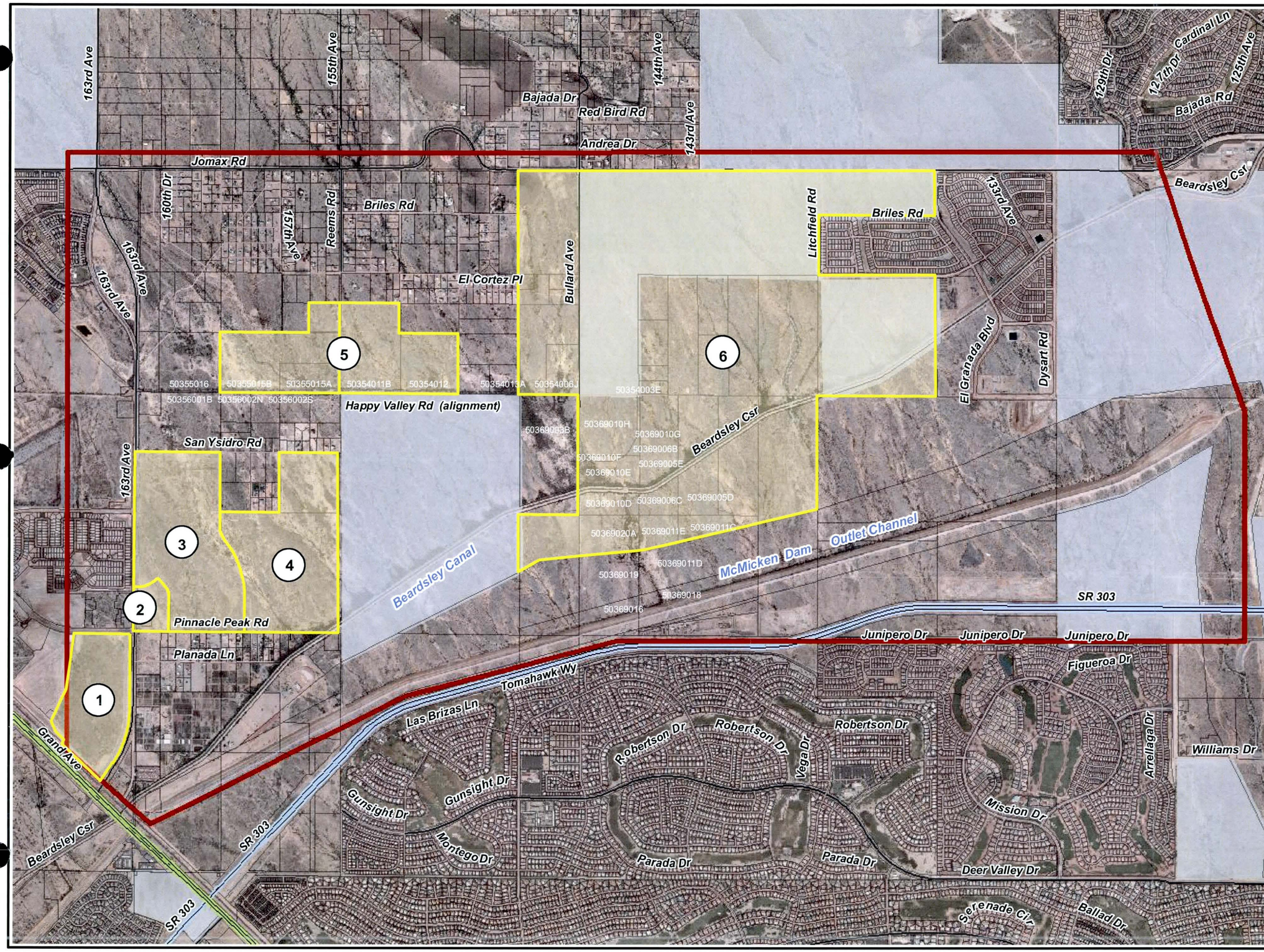
the study area. See Figure 2.10 for additional reference. The Parks and Trails Master Plan also identifies a series of local trails and a regional trail in the Study Area. This information may be found at Figure 2.11. The Surprise Parks and Trails plan also provides a matrix of trail development standards that calls for the construction of 6-foot concrete trails for local trails. These trail development standards are found under Table 2.4.

Planned future scenic resource compatibility information derived from the Wittmann ADMP has been obtained and is found at Figure 2.12. The plan identifies compatibility rankings that will be factored into the preparation of the preliminary and proposed alternatives for this project.

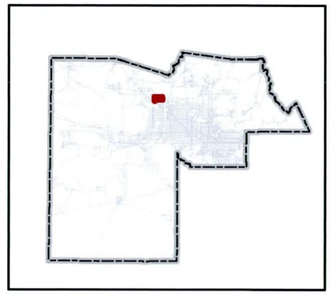
A recreation inventory of the Wittmann ADMP project area has also been collected and will be instrumental in the evaluation process in developing the preliminary and proposed alternatives. This information can be found at Figure 2.13.

The Landscape Inventory and Analysis (LIA) for the Happy Valley DCR Study Area was provided by the FCDMC and will prove extremely beneficial in developing landscape aesthetics and compatible multi-use opportunities. The existing landscape character for this Study Area is illustrated in Figure 2.14. The future landscape character areas that consist primarily of the Suburban Lower Bajada and Suburban Valley Plains character units are shown on Figure 2.15.

Figure 2.1 – Property Ownership



Flood Control District of Maricopa County



Happy Valley DCR

Legend

- Study Area Limits
- Property Ownership
- Parcels
- Bureau of Land Mgmt.
- Private Land
- State Trust Land

1. Barclay
2. Evergreen / Devco
3. Verdugo
4. Altamira
5. Tierra Verde
6. Rancho Mercado

0 500 1,000 2,000 Feet

1 inch equals 2,000 feet

Happy Valley DCR
Property Ownership

RBF CONSULTING
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16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
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Flood Control District of Maricopa County
SURPRISE ARIZONA

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MCK	KJK

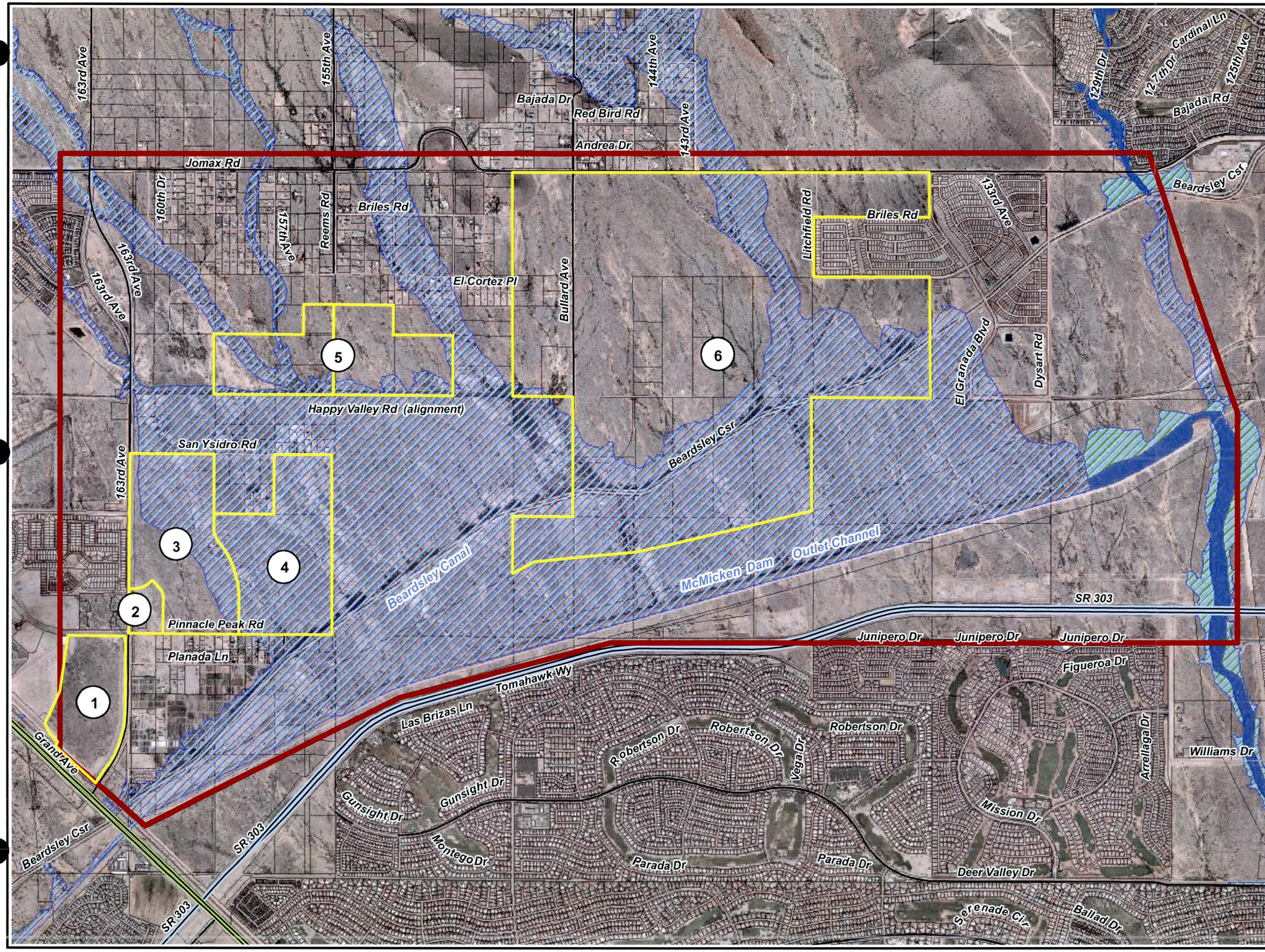
PROJECT NUMBER 45104030

DATE 10.14.09

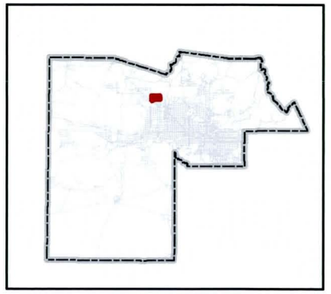
FIGURE —

File: H:\PDATA\45104030\GIS\Data Collection Report\HV DCR_Property Ownership.mxd

Figure 2.2 – Existing FEMA Floodplain



Flood Control District of Maricopa County



Happy Valley DCR

Legend

- Study Area Limits
- Property Ownership
- Parcels

FEMA Floodplain

Zone

- A
- AE
- FW
- X1

1. Barclay
2. Evergreen / Devco
3. Verdugo
4. Altamira
5. Tierra Verde
6. Rancho Mercado

0 500 1,000 2,000 Feet

1 inch equals 2,000 feet

Happy Valley DCR
Existing FEMA Floodplain

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DATE 10.14.09

FIGURE —

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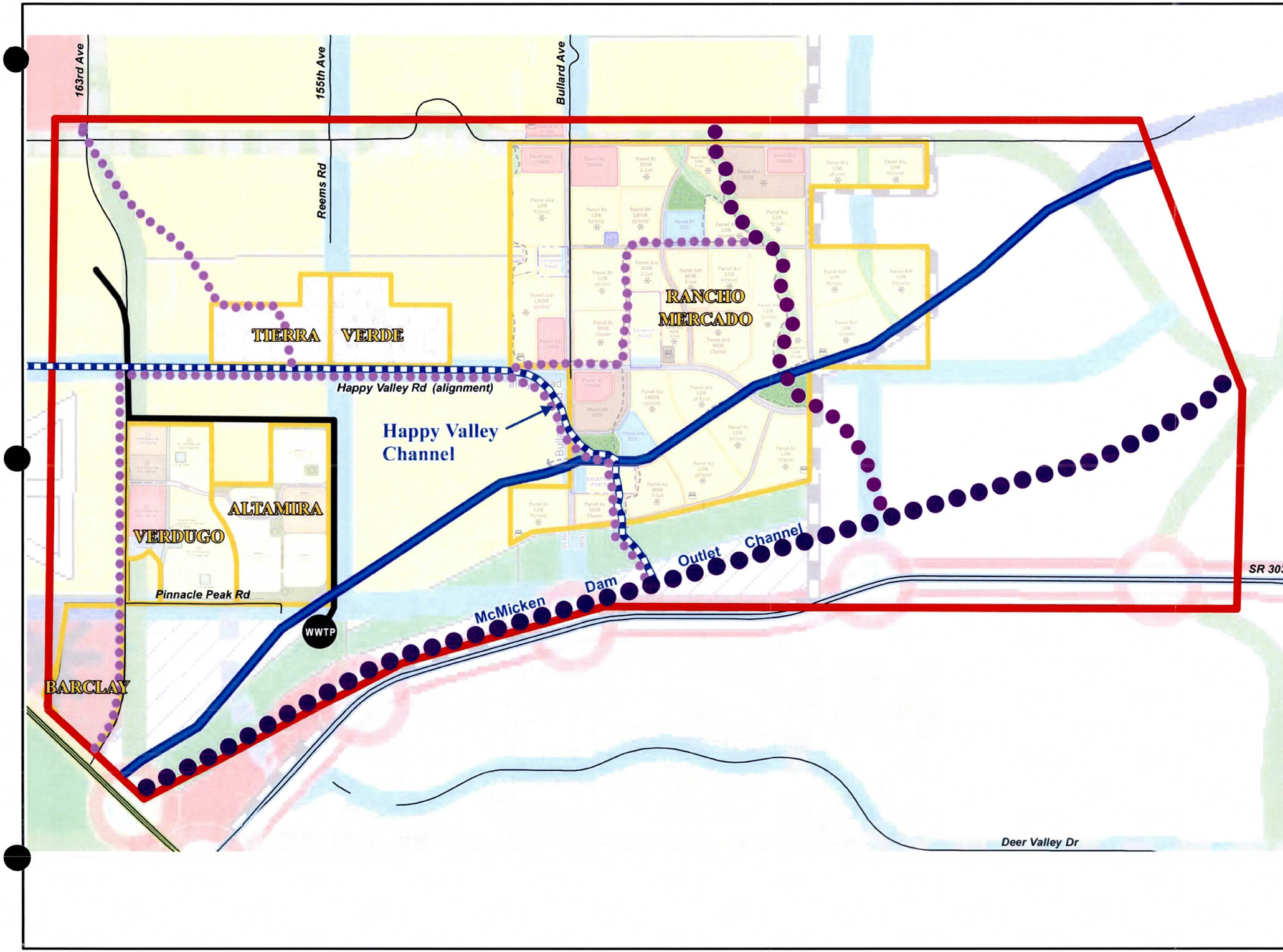
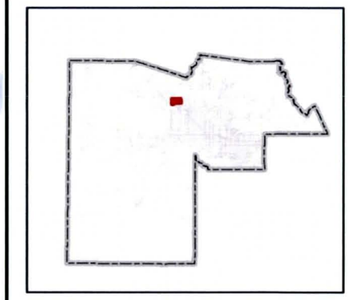
Figure 2.3 – Study Area Opportunities And Constraints



Flood Control District of Maricopa County



Happy Valley DCR

Legend

- Study Area Limits
- Property Ownership
- Parcels
- Regional Trail
- Community Trail
- Local Trail
- Sewer Line
- Wastewater Treatment Plant (WWTP)

0 250 500 1,000 Feet

1 inch equals 1,000 feet

Happy Valley DCR Opportunity & Constraints

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MCK	KJK

PROJECT NUMBER 45104030

DATE 10.14.09

FIGURE —

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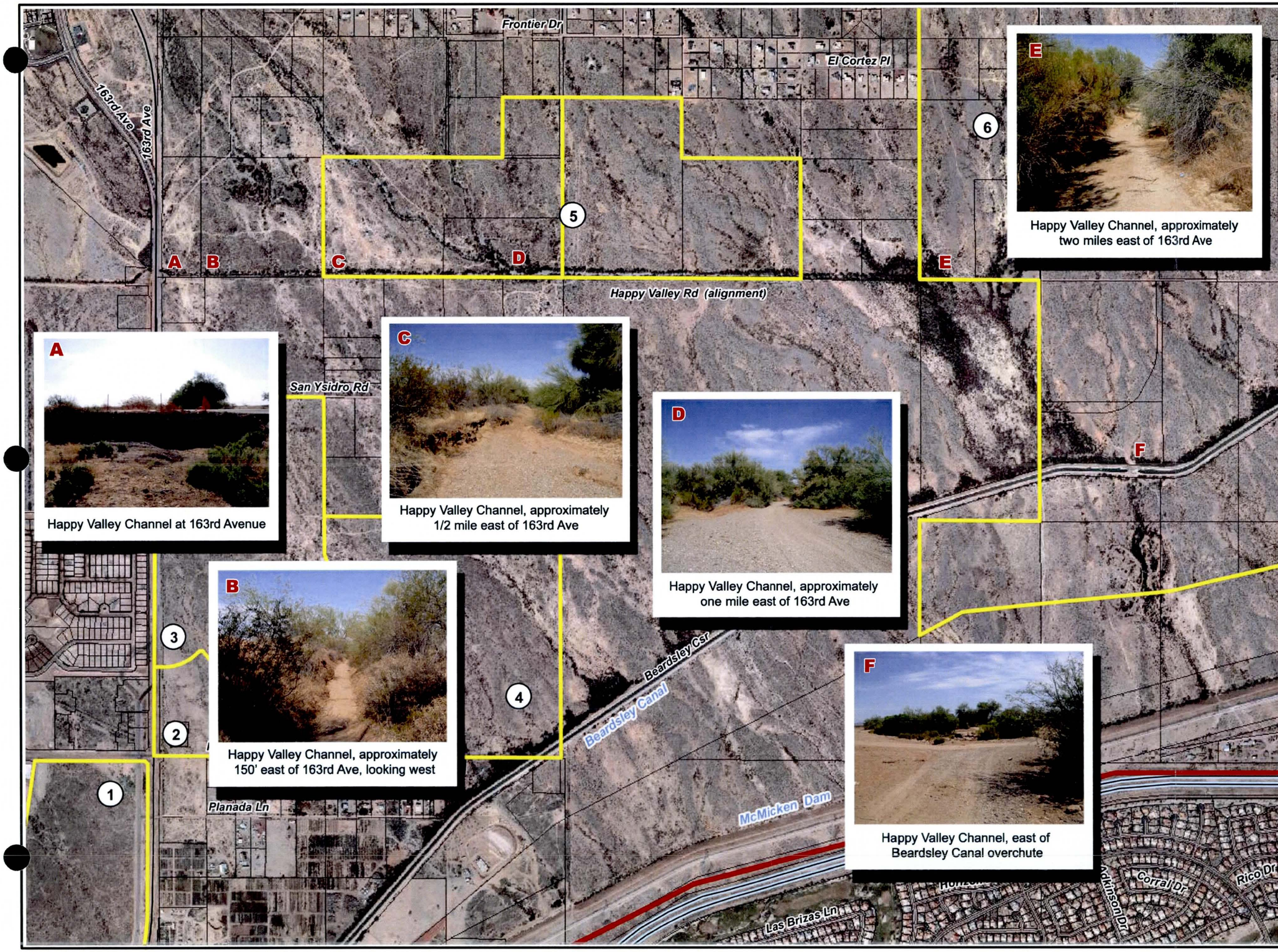
Figure 2.4 – Happy Valley Channel Character



Happy Valley Channel at 163rd Avenue

Happy Valley Channel, approximately 1/2 mile east of 163rd Ave

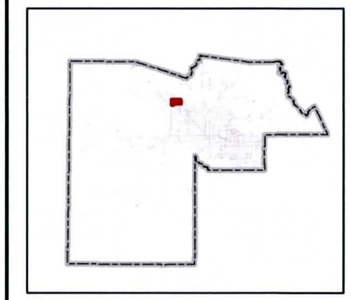
Happy Valley Channel, approximately one mile east of 163rd Ave

Happy Valley Channel, approximately two miles east of 163rd Ave

Happy Valley Channel, approximately 150' east of 163rd Ave, looking west

Happy Valley Channel, east of Beardsley Canal overchute

Flood Control District of Maricopa County



Happy Valley DCR

Legend

- Study Area Limits
- Property Ownership
- Parcels

1. Barclay
2. Evergreen / Devco
3. Verdugo
4. Altamira
5. Tierra Verde
6. Rancho Mercado

0 250 500 1,000 Feet

1 inch equals 1,000 feet

Happy Valley DCR
Channel Character

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MCK	KJK

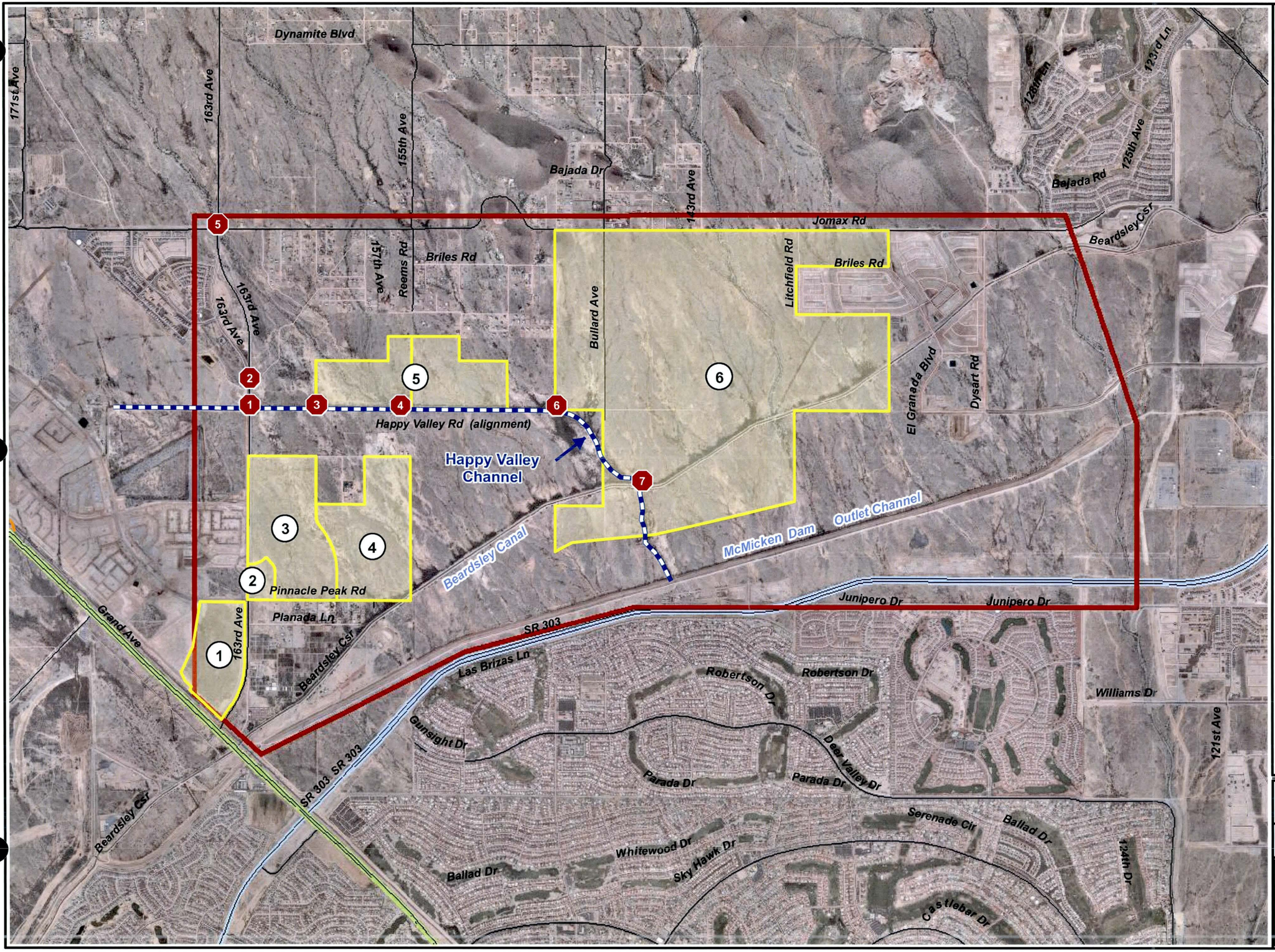
PROJECT NUMBER 45104030

DATE 10.14.09

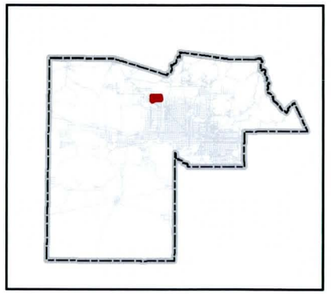
FIGURE —

File: H:\PDATA\45104030\GIS\Data Collection\HV_DCR Character Img.mxd

Figure 2.5 – Site Visit Tour



Flood Control District of Maricopa County



Happy Valley DCR

Legend

- Study Area Limits
- Property Ownership
- Tour Stop Location

1. Barclay
2. Evergreen / Devco
3. Verdugo
4. Altamira
5. Tierra Verde
6. Rancho Mercado

0 625 1,250 2,500 Feet

1 inch equals 2,500 feet

Happy Valley DCR
Site Visit Tour

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MCK	KJK

PROJECT NUMBER 45104030

DATE 10.14.09

FIGURE —

File: H:\PDATA\45104030\GIS\Data Collection Report\HV DCR_Site Visit.mxd

Figure 2.6 – Altamira Land Use Plan

CONCEPTUAL LAND USE PLAN

NOTE: FULL STREET IMPROVEMENTS WILL BE BUILT ALONG THE RIGHT-OF-WAY TRANSITIONING FROM PINNACLE PEAK ROAD TO REEMS ROAD

PARK LOCATION

N

0' 200' 400'

CVL COE & VAN LOO

15 June 2009

Exhibit C

N:\01\0178003\Graphics\PL\Exhibit\01-0178003 - C - CLUP.indd

ALTAMIRA

Figure 2.7 – Rancho Mercado Land Use Plan

Rancho Mercado

City of Surprise, Arizona

Planned Area Development
Figure 6
Land Use Master Plan

LEGEND

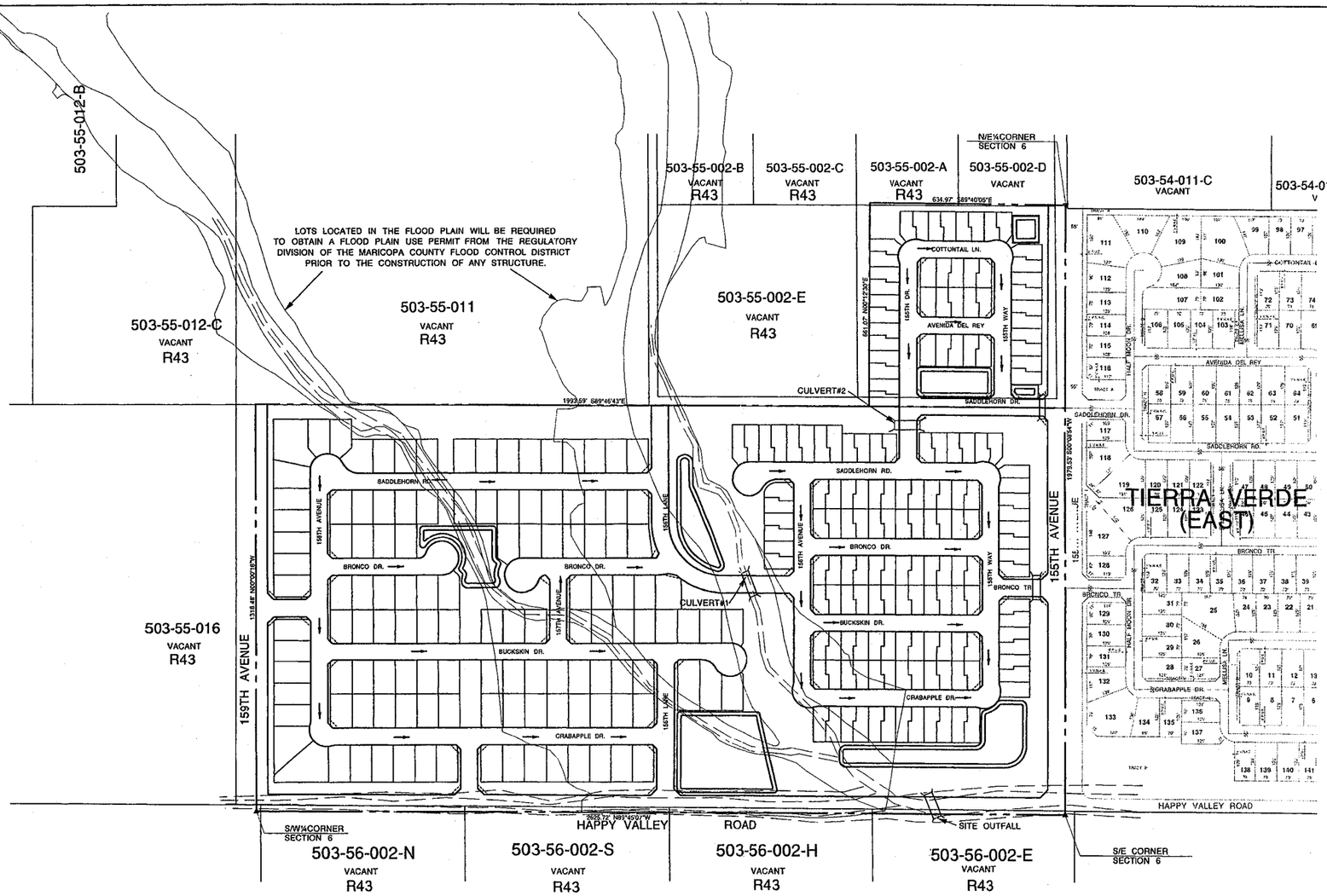
- Low Density Residential (LDR) 2.0-5.0 du/ac
- Low Medium Density Residential (LMDR) 4.0-6.0 du/ac
- Medium Density Residential (MDR) 5.0-10.0 du/ac
- High Density Residential (HDR) 15.0 + du/ac
- Community Commercial
- Commercial / Employment
- Educational/School
- Recreational Open Space
- Open Space/Wash Corridors
- Fire Station
- Proposed Future Loop 303 Interchange
- Neighborhood / Community Trail
- Property Boundary
- Proposed Mini Parks (Locations TBD at time of plat)
- Well Site
- Water Campus

Date: 06-26-06
Drawn By: MR
Revised: 02-23-07

LVA Urban Design Studio L.L.C.
Master Planned Communities, Land Planning, Site Planning & Design, Environmental Analysis & Landscape Design
7502 East Main Street
Scottsdale, Arizona 85251
Phone (480)994-0994
Fax (480)994-7332
www.lvadesign.com

Figure 2.8 – Tierra Verde Preliminary Plat

PRELIMINARY PLAT FOR TIERRA VERDE WEST



OWNER/DEVELOPER:

TIERRA VERDE WOODSIDE, LLC
8950 S. 52ND STREET
SUITE 115
TEMPE, AZ. 85284
(480) 755-0801
(480) 755-0802 (FAX)
CONTACT: PAUL KROFF/GENE C. MORRISON

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER AND THE NORTH HALF OF THE SOUTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 6, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, AZ..

SITE DATA

EXISTING ZONE	R-43
PROPOSED ZONING	PLANNED AREA DEVELOPMENT
TOTAL SITE AREA	88.49 AC.
NET RESIDENTIAL AREA	81.46 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	7.02 AC.
TOTAL LOT YIELD	295 LOTS
GROSS RESIDENTIAL DENSITY	3.33 DU/AC.
NET DENSITY	3.77 DU/AC
TOTAL OPEN SPACE PROVIDED	24.07 AC. OR 30.00%.

TAX PARCEL#'S: 503-55-002F, 503-55-015B, 503-55-015A

LEGEND:

EXISTING CONTOUR — 1000 —
EXISTING WATER — W —
EXISTING SEWER — S —
PROPOSED WATER — W —
PROPOSED SEWER — S —
PROPOSED VALVE
PROPOSED MANHOLE
PROPOSED CLEANOUT
FIRE HYDRANT
SURFACE DRAINAGE
SIGHT VISIBILITY LINE
TOT LOT
VIEWS — V —

NOTES:

1. ALL DEVELOPMENT PHASES DEPICTED ON THIS PRELIMINARY PLAT SHALL BE PROVIDED
A MINIMUM OF TWO (2) SEPARATE POINTS OF UNOBSTRUCTED ACCESS WITH A MINIMUM WIDTH OF TWENTY FEET, INSTALLED AND MAINTAINED PURSUANT TO THE REQUIREMENTS OF THE CITY OF SURPRISE.

2. ALL LOTS UNDER THE SUBURBAN RESIDENTIAL (SR) LAND USE HAVE A MINIMUM WIDTH OF 70'.
ALL LOTS UNDER THE MEDIUM DENSITY RESIDENTIAL (MDR) LAND USE HAVE A WIDTH OF 50'/40'.

3. FIRM-MAP NUMBER 04013C1135 F DATED: JULY 19, 2001.

4. ALL DRAINAGE DESIGN WILL BE DONE IN ACCORDANCE WITH THE CITY OF SURPRISE "PRELIMINARY AND FINAL DRAINAGE REPORT GUIDELINES", THE CITY OF SURPRISE MUNICIPAL CODE (CHAPTER 15 AND 16), THE FCDMC HYDROLOGY AND HYDRAULICS MANUAL(S) AND THE OFFSITE DRAINAGE WILL BE BASED ON THE WADMS UPDATE.

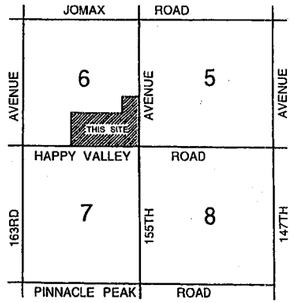
5. UNTIL SUCH TIME A LETTER OF MAP REVISION IS PUBLISHED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, ANY STRUCTURE ON (SHEET 3) LOTS 63-75, 81-90, 100-103, AND ON (SHEET 4) LOTS 6-13, 16-29, 42-63, 77-84, 96, 97, 102-110, 115-117, 119 HAVE AN INDIVIDUAL FLOODPLAIN USE PERMIT APPROVED BY THE REGULATORY DIVISION OF THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY BEFORE THE CITY WILL ISSUE A BUILDING PERMIT.

PARCEL DATA

PARCEL #	GROSS ACREAGE	NET ACREAGE	LOT SIZE	LOT TOTAL	GROSS DENSITY	NET DENSITY
1	42.500	35.780	70'X 110'	127	2.988	3.549
2	45.985	42.435	50'/40'X 95'	168	3.653	3.959
TOTAL	88.485	78.215		295	3.334	3.772

PUBLIC UTILITIES AND SERVICES

TELEPHONE.....QWEST
ELECTRIC.....ARIZONA PUBLIC SERVICE-APS
WATER.....CITY OF SURPRISE
GAS.....SW GAS
CVTT.....COX COMMUNICATIONS
REFUSE.....CITY OF SURPRISE
SEWER.....CITY OF SURPRISE
POLICE.....MARICOPA COUNTY SHERIFF OFFICE
FIRE.....CITY OF SURPRISE



VICINITY MAP
(NOT TO SCALE)

CVL
COE & VAN LOO CONSULTANTS, INC.

CVL#: 04013401
DATE: 06/26/2006

SHEET 1 OF 4

Roosevelt
26 JUN 2006
13:37:59
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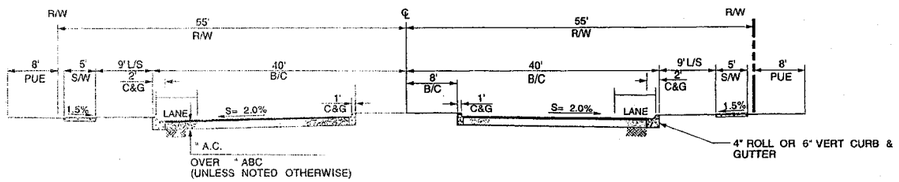
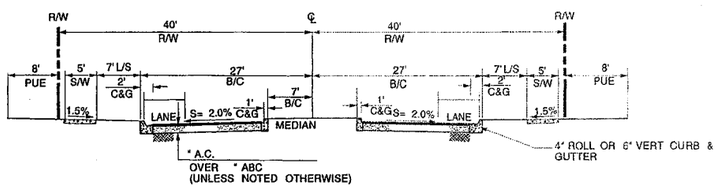
3583 P06



HAPPY VALLEY RD. VIEW LOOKING WEST
155TH AVE. VIEW LOOKING SOUTH

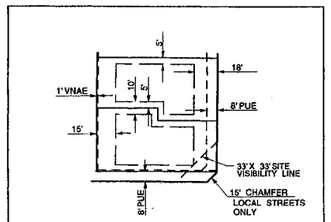
HALF STREET
NTS

TRACT TABLE		
TRACT	AREA (AC)	DESCRIPTION
A	1.380	OPEN SPACE/ LANDSCAPE/ RETENTION/ DRAINAGE
B	0.040	8' MIN. LANDSCAPE STRIP
C	0.040	8' MIN. LANDSCAPE STRIP
D	0.630	OPEN SPACE/ LANDSCAPE/RETENTION
E	1.580	OPEN SPACE/ LANDSCAPE/ RETENTION/ DRAINAGE
F	9.180	OPEN SPACE/ LANDSCAPE/ RETENTION/DRAINAGE/ TRAIL
G	0.030	8' MIN. LANDSCAPE STRIP
H	0.030	8' MIN. LANDSCAPE STRIP
I	0.030	8' MIN. LANDSCAPE STRIP
J	0.030	8' MIN. LANDSCAPE STRIP
K	0.030	8' MIN. LANDSCAPE STRIP
L	0.030	8' MIN. LANDSCAPE STRIP
M	4.000	OPEN SPACE/LANDSCAPE/ RETENTION/DRAINAGE/ TOT LOT/ TRAIL
N	0.040	8' MIN. LANDSCAPE STRIP
O	0.040	8' MIN. LANDSCAPE STRIP
P	1.700	OPEN SPACE/ LANDSCAPE/ RETENTION/ TOT LOT/ TRAIL
Q	0.050	8' MIN. LANDSCAPE STRIP
R	0.040	8' MIN. LANDSCAPE STRIP
S	0.350	OPEN SPACE/ LANDSCAPE/ RETENTION/ TRAIL
T	0.040	8' MIN. LANDSCAPE STRIP
U	0.860	OPEN SPACE/ LANDSCAPE/ RETENTION/ TRAIL
V	0.610	OPEN SPACE/ LANDSCAPE/ RETENTION/ TRAIL
W	3.250	OPEN SPACE/LANDSCAPE/ RETENTION/DRAINAGE/ TRAIL
X	0.060	8' MIN. LANDSCAPE STRIP
TOTAL	24.070	



159TH. AVE. VIEW LOOKING SOUTH

HALF STREET
NTS

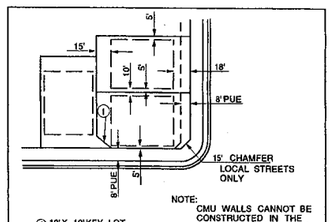


SETBACKS

FRONT	10' TO LIVING SPACE, SIDE ENTRY GARAGE OR COVERED PORCH OR 18' FROM ROW TO FACE OF GARAGE DOOR (FRONT FACING)
REAR	15'
SIDE	10' BUILDING SEPARATION
CORNER SIDE YARD	10' (INCLUDES ADJ. LANDSCAPE TRACT)

TYPICAL Z-LOT(50'/40' X 95') DETAIL

(NOT TO SCALE)

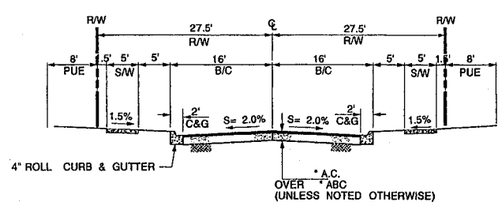


SETBACKS

FRONT	10' TO LIVING SPACE, SIDE ENTRY GARAGE OR COVERED PORCH OR 18' FROM ROW TO FACE OF GARAGE DOOR (FRONT FACING)
REAR	15'
SIDE	5' MIN/ 10' TOTAL
CORNER SIDE YARD	10' (INCLUDES ADJ. LANDSCAPE TRACT)

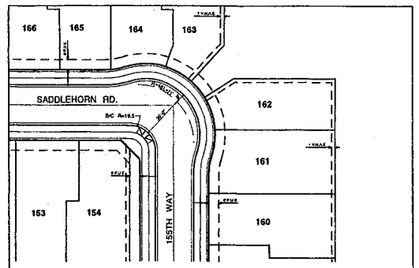
TYPICAL 70' X 110' LOT DETAIL

(NOT TO SCALE)



LOCAL STREETS

NTS



FIRE TURNING RADIUS DETAIL

PRELIMINARY PLAT FOR TIERRA VERDE WEST

OWNER/DEVELOPER:

TIERRA VERDE WOODSIDE, LLC
8950 S. 52ND STREET
SUITE 115
TEMPE, AZ. 85284
(480) 755-0801
(480) 755-0802 (FAX)
CONTACT: PAUL KROFF/GENE C. MORRISON

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER AND THE NORTH HALF OF THE SOUTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 6, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, AZ..

SITE DATA

EXISTING ZONE	R-43
PROPOSED ZONING	PLANNED AREA DEVELOPMENT
TOTAL SITE AREA	88.49 AC.
NET RESIDENTIAL AREA	81.46 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	7.02 AC.
TOTAL LOT YIELD	295 LOTS
GROSS RESIDENTIAL DENSITY	3.33 DU/AC.
NET DENSITY	3.77 DU/AC
TOTAL OPEN SPACE PROVIDED	24.07 AC. OR 30.00%.

TAX PARCEL#'S: 503-55-002F, 503-55-015B, 503-55-015A

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
TOT LOT	
VIEWS	V

Registered Professional Engineer (Civil)
CERTIFICATE NO. 10516
PAUL E. SIDERS
Date Signed 6/26/06
ARIZONA, U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

CVL#: 04013401
DATE: 06/26/2006

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26 JUN 2006
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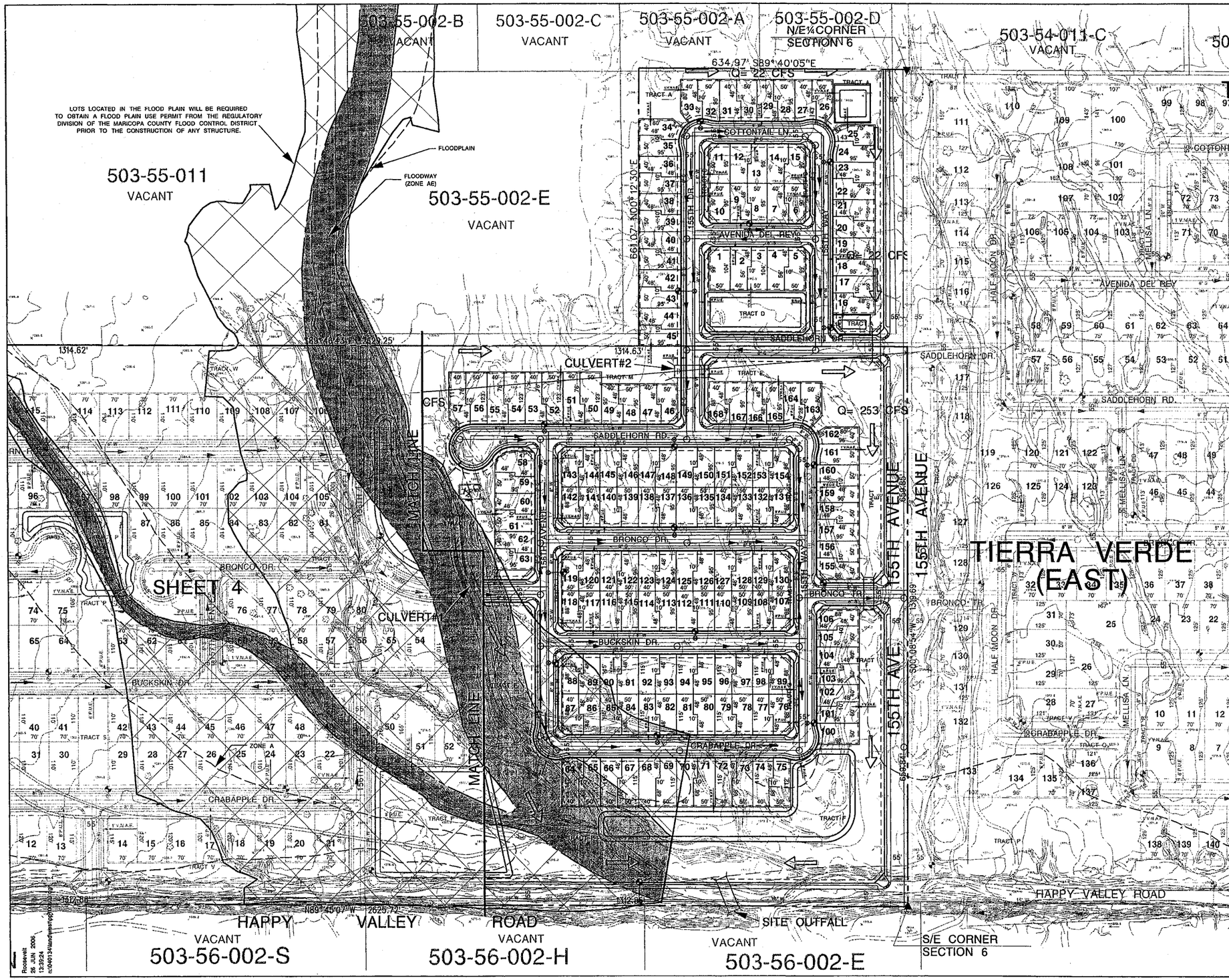
PRELIMINARY PLAT FOR TIERRA VERDE WEST



OWNER/DEVELOPER:

TIERRA VERDE WOODSIDE, LLC
8950 S. 52ND STREET
SUITE 115
TEMPE, AZ. 85284
(480) 755-0801
(480) 755-0802 (FAX)
CONTACT: PAUL KROFF/GENE C. MORRISON

PREPARED BY:

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PHOENIX, ARIZONA 85014
(602) 285-4752
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CONTACT: DAVE COBLE

PROJECT LOCATION

THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER AND THE NORTH HALF OF THE SOUTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 6, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, AZ..

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EXISTING ZONE	R-43
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TAX PARCEL#'S: 503-55-002F, 503-55-015B, 503-55-015A

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
TOT LOT	TOT LOT
VIEWS	V

Registered Professional Land Surveyor
CERTIFICATE NO. 10516
PAUL E. SIDERS
ARIZONA U.S.A.

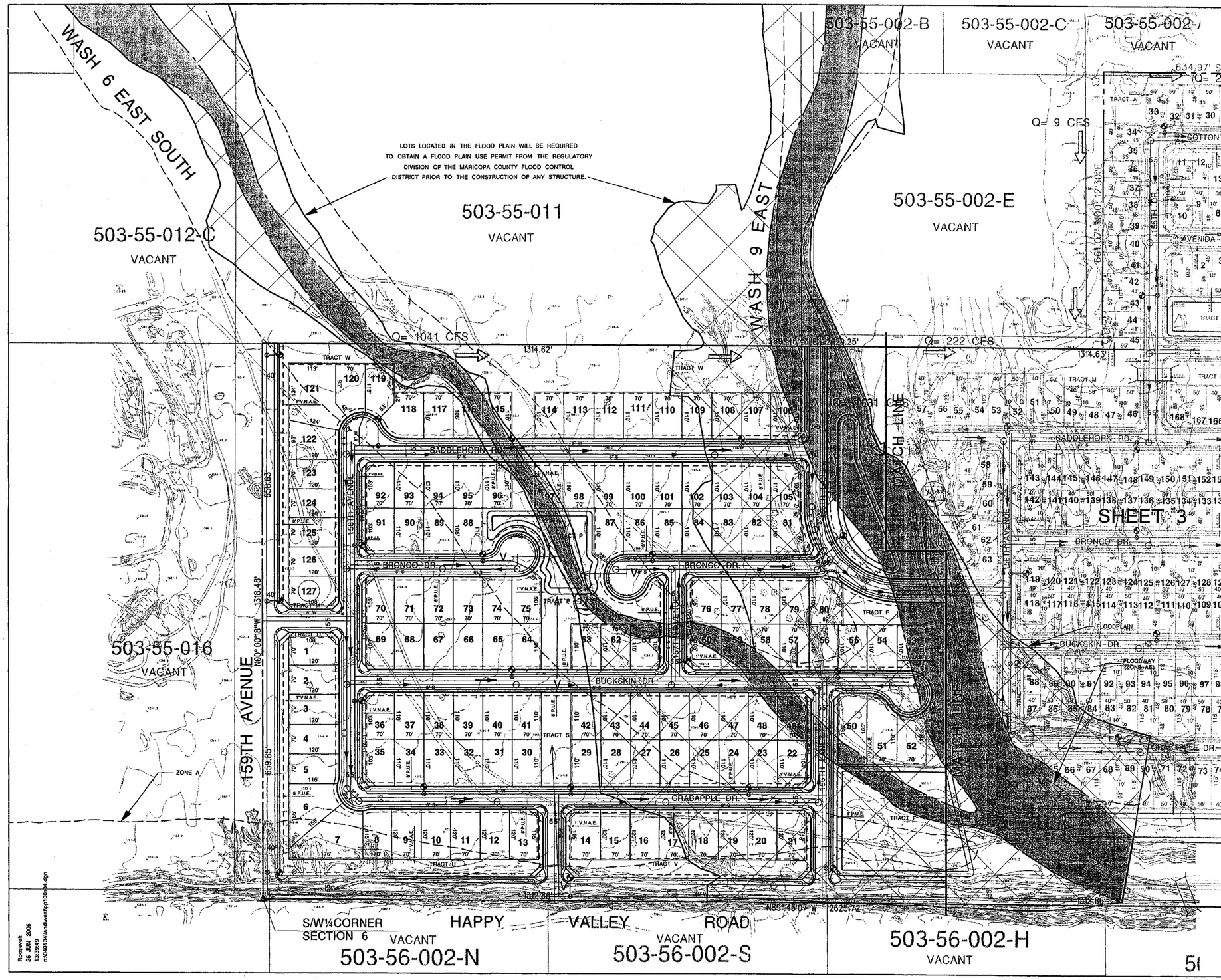
CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 04013401
DATE: 06/26/2006

SHEET 3 OF 4

PRELIMINARY PLAT FOR TIERRA VERDE WEST



OWNER/DEVELOPER:

TIERRA VERDE WOODSIDE, LLC
8950 S. 52ND STREET
SUITE 115
TEMPE, AZ. 85284
(480) 755-0801
(480) 755-0802 (FAX)
CONTACT: PAUL KROFF/GENE C. MORRISON

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

THE SOUTHWEST QUARTER OF THE SOUTHEAST QUARTER AND THE NORTH HALF OF THE SOUTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 6, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, AZ..

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TOTAL LOT YIELD	295 LOTS
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NET DENSITY	3.77 DU/AC
TOTAL OPEN SPACE PROVIDED	24.07 AC. OR 30.00%.

TAX PARCEL#'S: 503-55-002F, 503-55-015B, 503-55-015A

SHEET 3

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
TOT LOT	
VIEWS	V

Registered Professional Engineer (Civil) CERTIFICATE NO. 10516 PAUL E. SIDERS ARIZONA, U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 04013401
DATE: 06/26/2006

SHEET 4 OF 4

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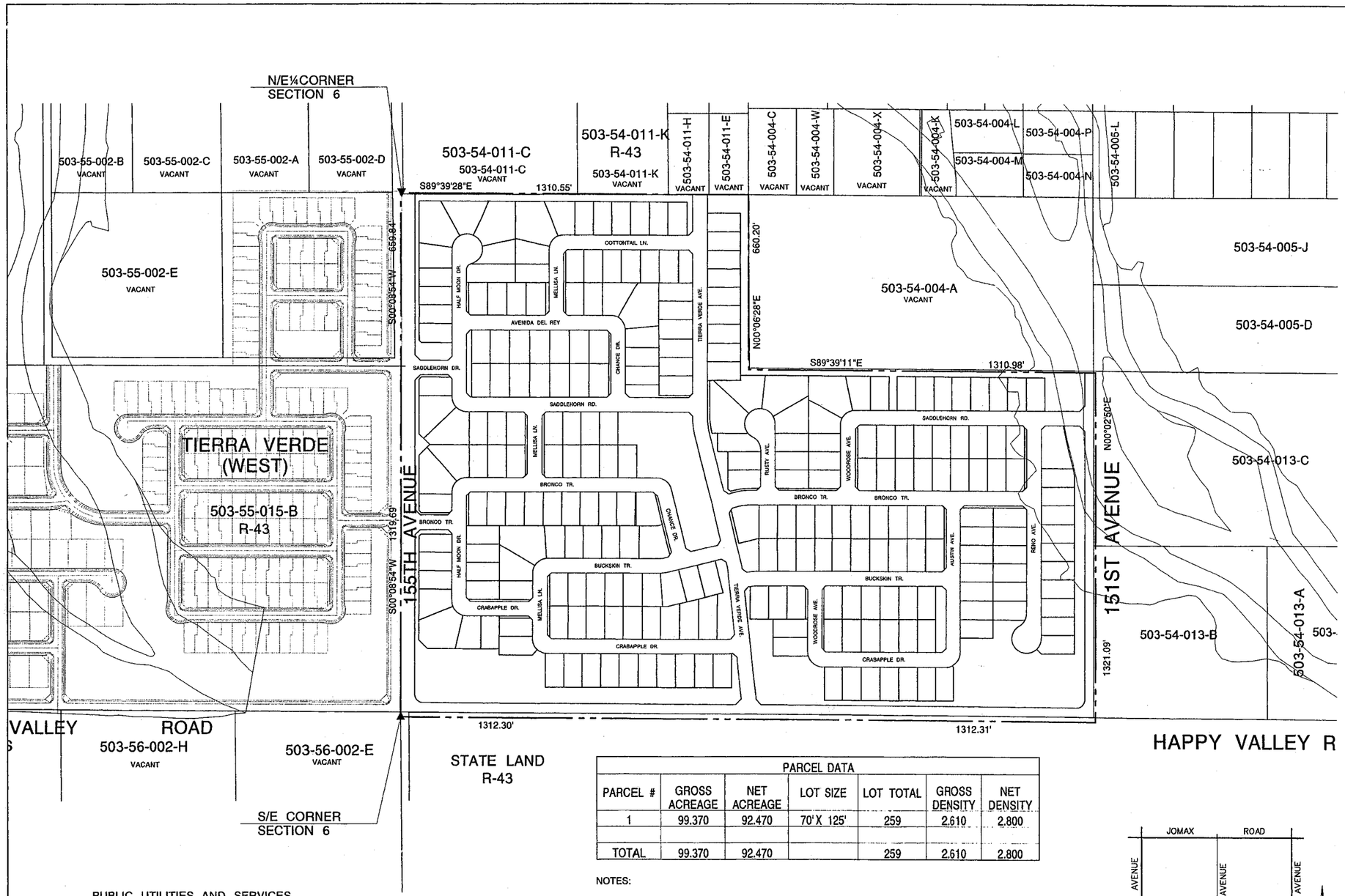
PRELIMINARY PLAT FOR TIERRA VERDE EAST



OWNER/DEVELOPER:

VOYAGER SURPRISE 100, LLC
6900 E. 2ND STREET
SUITE 1000
SCOTTSDALE, AZ. 85251
(480) 675-7238
(480) 874-0678 (FAX)
CONTACT: MARK VOIGT

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

THE SITE IS A PORTION OF THE SOUTHWEST QUARTER OF SECTION 5, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA

TAX PARCEL#'S: 503-54-011-B, 503-54-012

SITE DATA

EXISTING ZONING	R-43
TOTAL SITE AREA	99.38 AC.
NET RESIDENTIAL AREA	92.40 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	6.98 AC.
TOTAL LOT YIELD	259 LOTS
GROSS RESIDENTIAL DENSITY	2.61 DU/AC.
NET RESIDENTIAL DENSITY	2.80 DU/AC.
TOTAL OPEN SPACE PROVIDED	15.692 AC. OR 16.98% of NET RES'L AREA
PARKS/TRAILS	13.762 AC. OR 14.89%
RETENTION	14.346 AC. OR 15.52%

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-7

PARCEL DATA						
PARCEL #	GROSS ACREAGE	NET ACREAGE	LOT SIZE	LOT TOTAL	GROSS DENSITY	NET DENSITY
1	99.370	92.470	70'X 125'	259	2.610	2.800
TOTAL	99.370	92.470		259	2.610	2.800

NOTES:

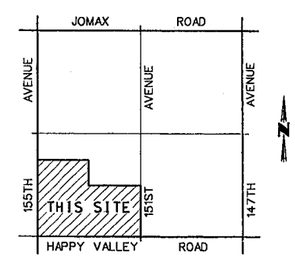
ALL DEVELOPMENT PHASES DEPICTED ON THIS PRELIMINARY PLAT SHALL BE PROVIDED A MINIMUM OF TWO (2) SEPARATE POINTS OF UNOBSTRUCTED ACCESS WITH A MINIMUM WIDTH OF TWENTY FEET, INSTALLED AND MAINTAINED PURSUANT TO THE REQUIREMENTS OF THE CITY OF SURPRISE.

ALL LOTS HAVE A MINIMUM WIDTH OF 70'.

UNTIL SUCH TIME A LETTER OF MAP REVISION IS PUBLISHED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, ANY STRUCTURE ON (SHEET 3) LOTS 1-3, 133-147, AND ON (SHEET 4) LOTS 148, 151-164, 167-174, 184, 185, 187-198, 250, 251 HAVE AN INDIVIDUAL FLOODPLAIN USE PERMIT APPROVED BY THE REGULATORY DIVISION OF THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY BEFORE THE CITY WILL ISSUE A BUILDING PERMIT.

PUBLIC UTILITIES AND SERVICES

TELEPHONE.....QWEST
ELECTRIC.....ARIZONA PUBLIC SERVICE-APS
WATER.....CITY OF SURPRISE
GAS.....SW GAS
CVTT.....COX COMMUNICATIONS
REFUSE.....CITY OF SURPRISE
SEWER.....CITY OF SURPRISE
POLICE.....MARICOPA COUNTY SHERIFF OFFICE AT 12425 W. BELL ROAD
FIRE.....CITY OF SURPRISE-163RD & GRAND AVENUE



VICINITY MAP
(NOT TO SCALE)

Registered Professional Engineer (Civil) CERTIFICATE NO. 10516 PAUL E. SIDERS Date Signed 6/26/06 ARIZONA U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'
CVL#: 040134
DATE: 06/26/06

SHEET 1 OF 4

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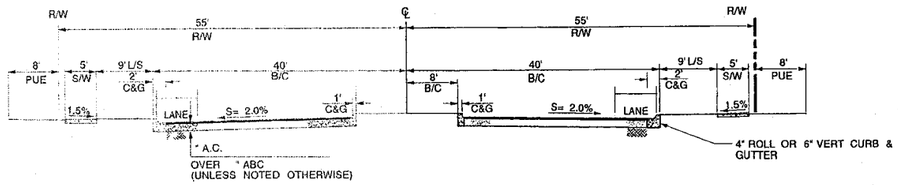
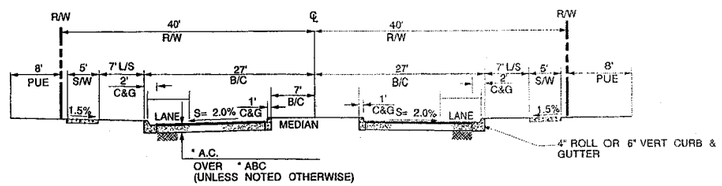


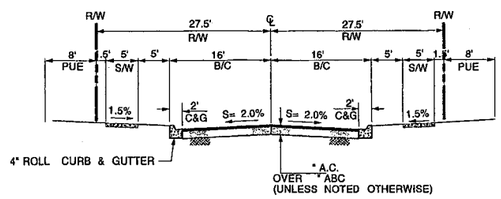
155TH AVE. VIEW NORTH
HAPPY VALLEY RD. VIEW WEST

HALF STREET
NTS



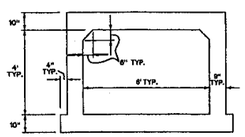
151ST. AVE. VIEW NORTH

HALF STREET
NTS

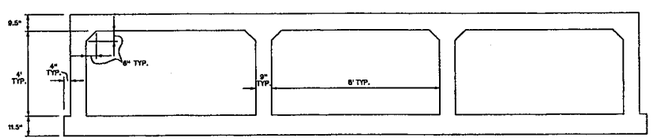


INTERIOR LOCAL STREETS

NTS

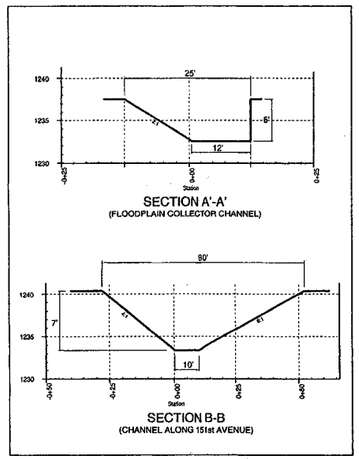


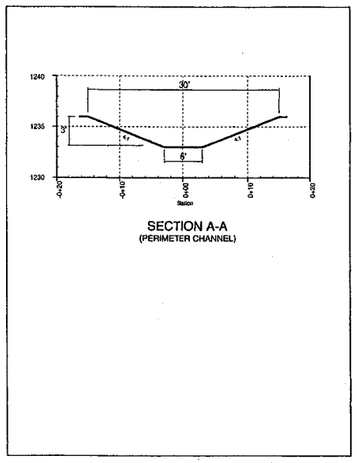
1-4'X6' BOX CULVERT
(CULVERT CROSSING AT HAPPEY VALLELY ROAD)



3-4'X8' BOX CULVERT
(CULVERT CROSSING AT 151st AVENUE)

PARCEL 1		
TRACT	AREA (AC)	DESCRIPTION
A	2.686	OPEN SPACE/ LANDSCAPE/ RETENTION WASH/TRAILS
B	0.020	8' MIN. LANDSCAPE STRIP
C	0.033	13' MIN. LANDSCAPE STRIP
D	0.040	8' MIN. LANDSCAPE STRIP
E	0.146	OPEN SPACE / LANDSCAPE
F	0.154	OPEN SPACE/ LANDSCAPE/ RETENTION
G	0.040	8' MIN. LANDSCAPE STRIP
H	0.107	8' MIN. LANDSCAPE STRIP
I	0.251	8' MIN. LANDSCAPE STRIP
J	0.040	8' MIN. LANDSCAPE STRIP
K	2.334	OPEN SPACE/ LANDSCAPE/ RETENTION/PARK/TRAILS
L	0.211	OPEN SPACE/ LANDSCAPE/ RETENTION
M	0.040	8' MIN. LANDSCAPE STRIP
N	0.040	8' MIN. LANDSCAPE STRIP
O	0.040	8' MIN. LANDSCAPE STRIP
P	3.532	OPEN SPACE/ LANDSCAPE/ RETENTION/TRAILS
Q	0.020	8' MIN. LANDSCAPE STRIP
R	0.040	8' MIN. LANDSCAPE STRIP
S	0.219	OPEN SPACE/ LANDSCAPE/ RETENTION
T	0.040	8' MIN. LANDSCAPE STRIP
U	0.040	8' MIN. LANDSCAPE STRIP
V	0.040	8' MIN. LANDSCAPE STRIP
W	0.020	8' MIN. LANDSCAPE STRIP
X	0.040	8' MIN. LANDSCAPE STRIP/TRAILS
Y	0.325	OPEN SPACE/ LANDSCAPE/ RETENTION
Z	0.020	8' MIN. LANDSCAPE STRIP
AA	0.035	7' MIN. LANDSCAPE STRIP
BB	0.214	OPEN SPACE/ LANDSCAPE
CC	4.885	OPEN SPACE/ LANDSCAPE/ RETENTION/PARK/TRAILS
DD	0.040	8' MIN. LANDSCAPE STRIP
TOTAL	15.692	





PRELIMINARY PLAT FOR TIERRA VERDE EAST

OWNER/DEVELOPER:

VOYAGER SURPRISE 100, LLC
6900 E. 2ND STREET
SUITE 1000
SCOTTSDALE, AZ. 85251
(480) 675-7238
(480) 874-0678 (FAX)
CONTACT: MARK VOIGT

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

THE SITE IS A PORTION OF THE SOUTHWEST QUARTER OF SECTION 5, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA

TAX PARCEL#'S: 503-54-011-B, 503-54-012

SITE DATA

EXISTING ZONING	R-43
TOTAL SITE AREA	99.38 AC.
NET RESIDENTIAL AREA	92.40 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	6.98 AC.
TOTAL LOT YIELD	259 LOTS
GROSS RESIDENTIAL DENSITY	2.61 DU/AC.
NET RESIDENTIAL DENSITY	2.80 DU/AC.
TOTAL OPEN SPACE PROVIDED	15.692 AC. OR 16.98% of NET RES'L AREA
PARKS/TRAILS	13.762 AC. OR 14.89%
RETENTION	14.346 AC. OR 15.52%

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-7

Registered Professional Engineer (Civil) CERTIFICATE NO. 10516 PAUL E. SIDERS Date Signed 6/26/06 ARIZONA U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 040134
DATE: 06/26/06

SHEET 2 OF 4

Roosevelt
26 JUN 2006
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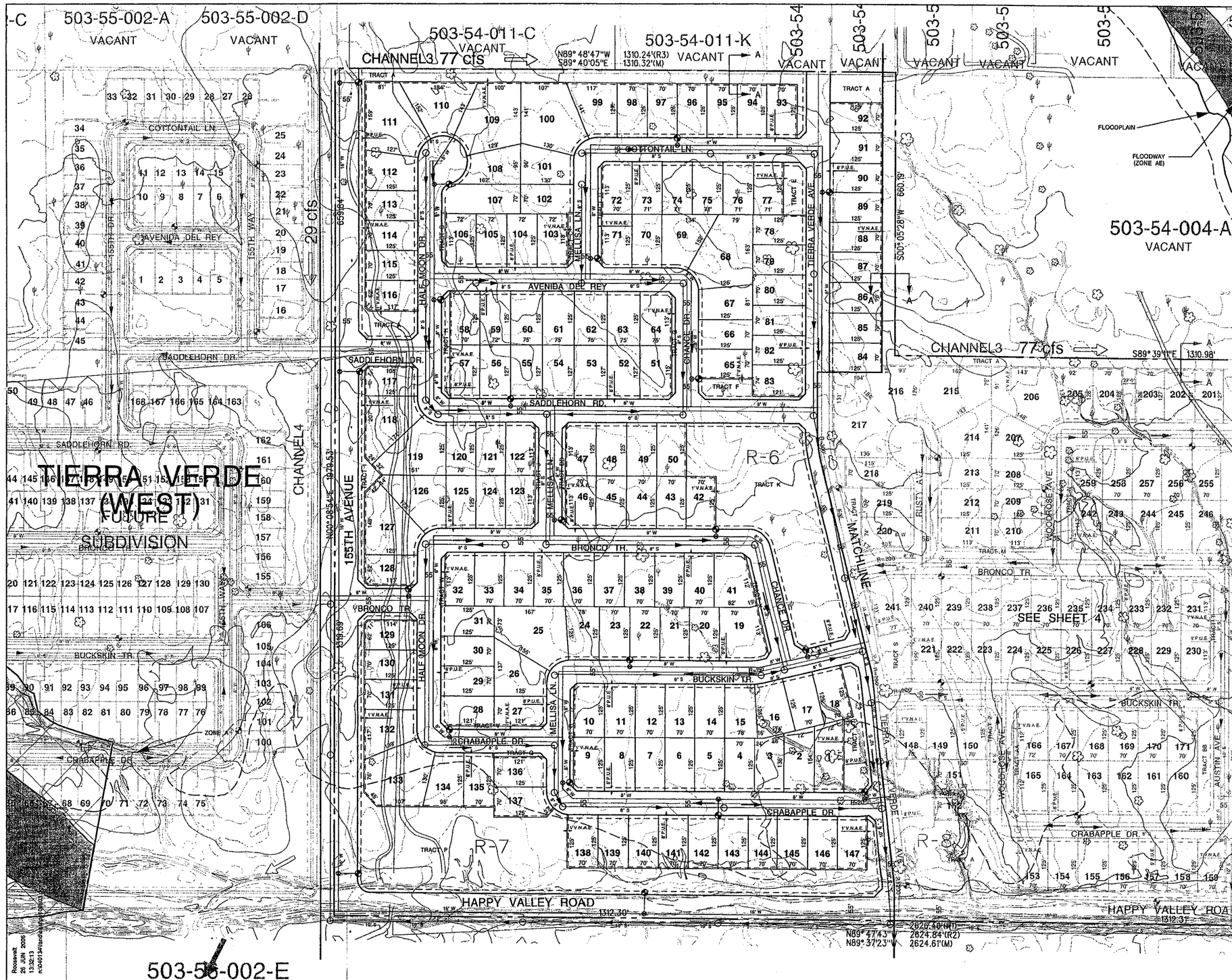

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PHOENIX, ARIZONA 85014
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CONTACT: DAVE COBLE

PROJECT LOCATION

THE SITE IS A PORTION OF THE SOUTHWEST QUARTER OF SECTION 5, TOWNSHIP 4 NORTH, RANGE 1 WEST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA

TAX PARCEL#'S: 503-54-011-B, 503-54-012

SITE DATA

EXISTING ZONING	R-43
TOTAL SITE AREA	99.38 AC.
NET RESIDENTIAL AREA	92.40 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	6.98 AC.
TOTAL LOT YIELD	259 LOTS
GROSS RESIDENTIAL DENSITY	2.61 DU/AC.
NET RESIDENTIAL DENSITY	2.80 DU/AC.
TOTAL OPEN SPACE PROVIDED	15.692 AC. OR 16.98% of NET RES'L AREA
PARKS/TRAILS	13.762 AC. OR 14.89%
RETENTION	14.346 AC. OR 15.52%

LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-7

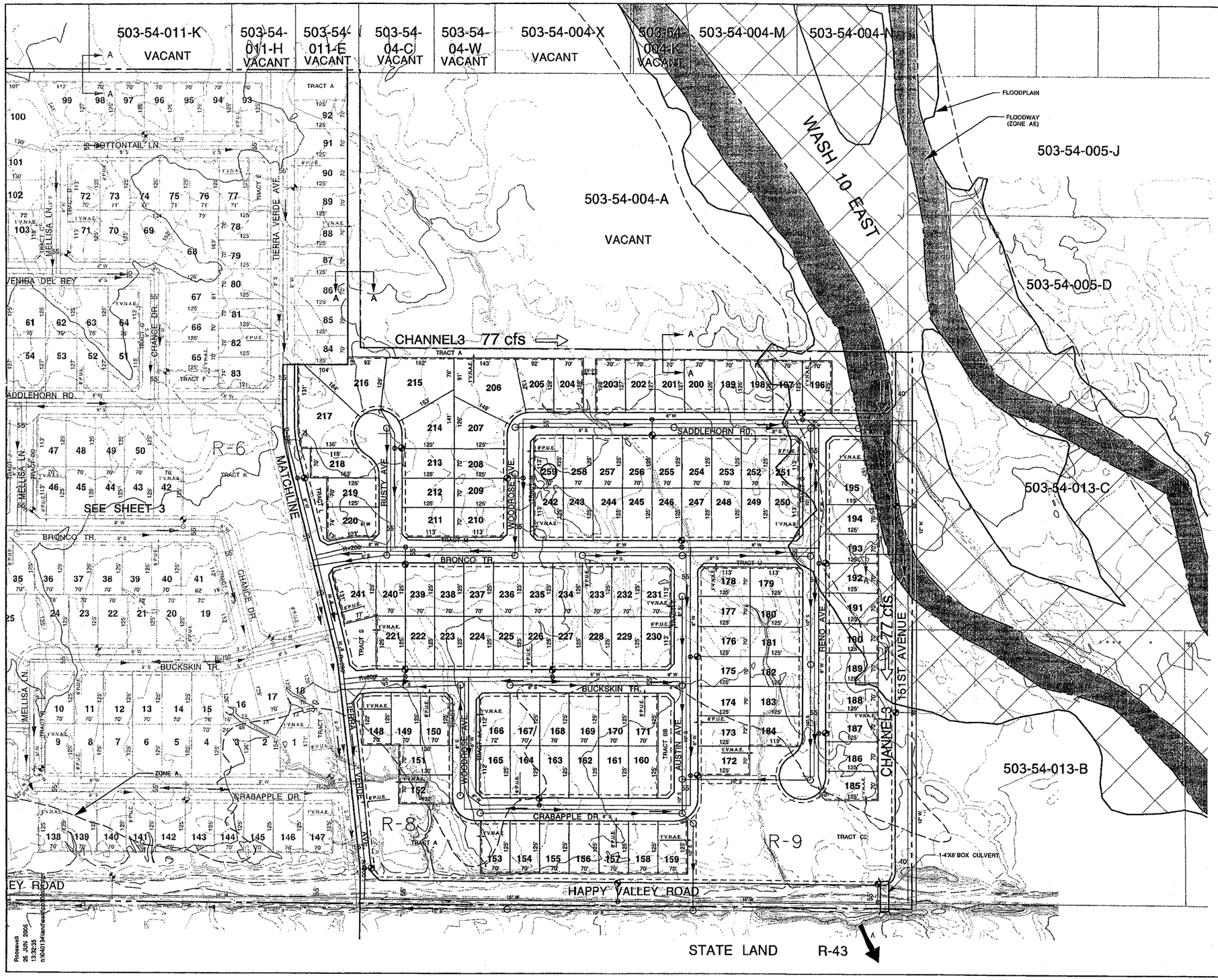
Registered Professional Engineer (Civil) CERTIFICATE NO. 10516 PAUL E. SIDERS ARIZONA U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 040134
DATE: 06/26/06

SHEET 3 OF 4



PRELIMINARY PLAT FOR TIERRA VERDE EAST

OWNER/DEVELOPER:

VOYAGER SURPRISE 100, LLC
6900 E. 2ND STREET
SUITE 1000
SCOTTSDALE, AZ. 85251
(480) 675-7236
(480) 874-0678 (FAX)
CONTACT: MARK VOIGT

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

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LEGEND:

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-7

Registered Professional Engineer (Civil) CERTIFICATE NO. 10516 PAUL E. SIDERS Date Signed 6/26/06 ARIZONA U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 040134
DATE: 06/26/06

SHEET 4 OF 4

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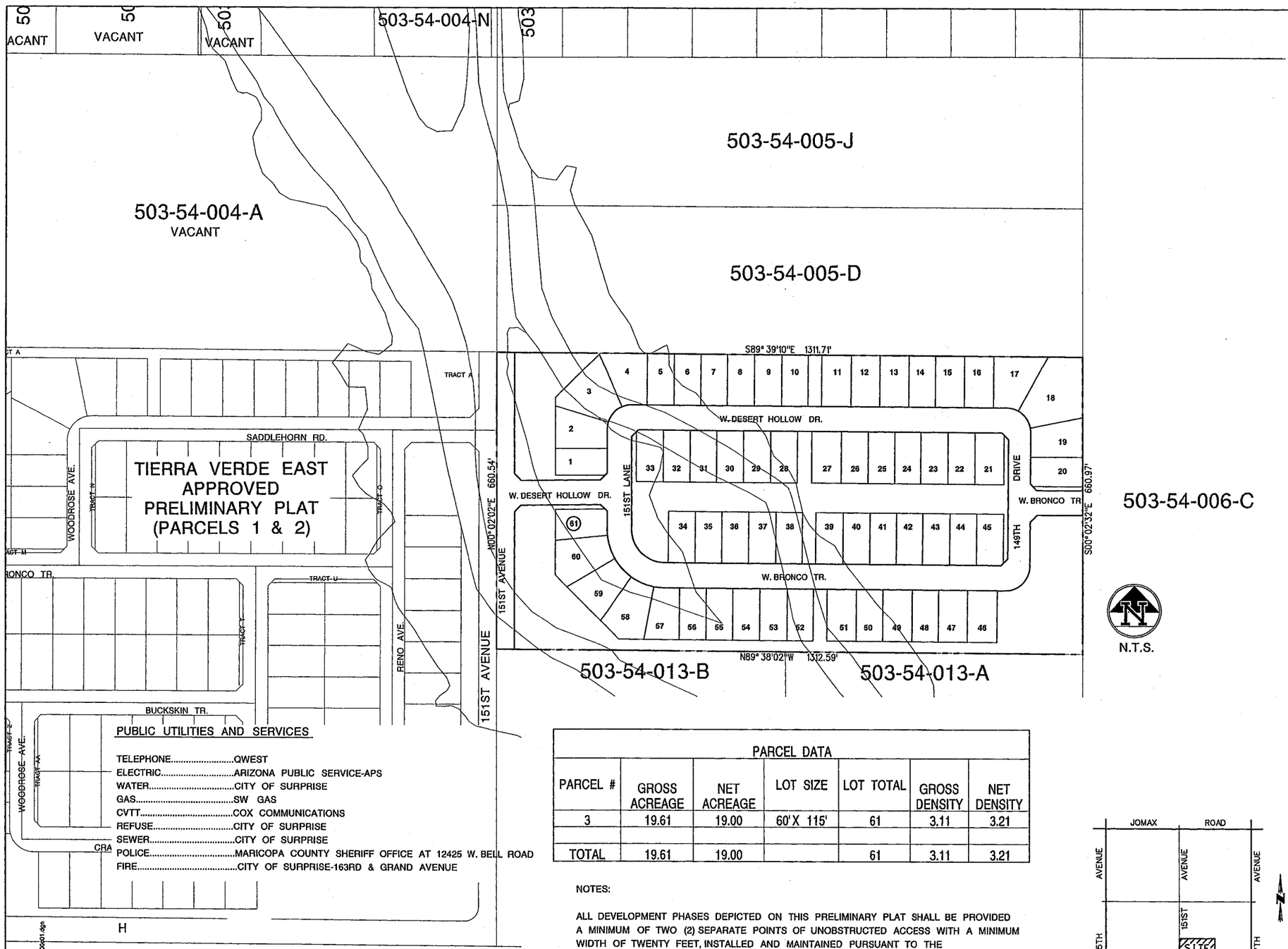
PRELIMINARY PLAT FOR TIERRA VERDE EAST PARCEL 3



OWNER/DEVELOPER:

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SUITE 1000
SCOTTSDALE, AZ. 85251
(480) 675-7238
(480) 874-0678 (FAX)
CONTACT: MARK VOIGT

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PHOENIX, ARIZONA 85014
(602) 285-4752
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PROJECT LOCATION

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TAX PARCEL NUMBER: 503-54-013-C

SITE DATA

EXISTING ZONING	R-43
TOTAL SITE AREA	19.61 AC.
NET RESIDENTIAL AREA	19.00 AC.
DEDICATED PUBLIC RIGHT OF WAY (R/W)	.61 AC.
TOTAL LOT YIELD	61 LOTS
GROSS RESIDENTIAL DENSITY	3.11 DU/AC.
NET RESIDENTIAL DENSITY	3.21 DU/AC.
TOTAL OPEN SPACE PROVIDED	5.20 AC. OR 27.37% of NET RES'L AREA

LEGEND

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-1A
FLOODPLAIN	
FLOODWAY (ZONE AE)	
FEMA (ZONE A)	

PUBLIC UTILITIES AND SERVICES

TELEPHONE.....QWEST
ELECTRIC.....ARIZONA PUBLIC SERVICE-APS
WATER.....CITY OF SURPRISE
GAS.....SW GAS
CVTT.....COX COMMUNICATIONS
REFUSE.....CITY OF SURPRISE
SEWER.....CITY OF SURPRISE
POLICE.....MARICOPA COUNTY SHERIFF OFFICE AT 12425 W. BELL ROAD
FIRE.....CITY OF SURPRISE-163RD & GRAND AVENUE

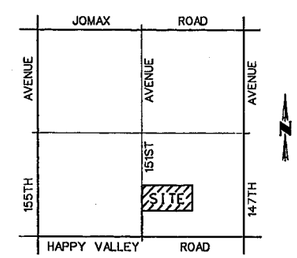
PARCEL DATA

PARCEL #	GROSS ACREAGE	NET ACREAGE	LOT SIZE	LOT TOTAL	GROSS DENSITY	NET DENSITY
3	19.61	19.00	60'X 115'	61	3.11	3.21
TOTAL	19.61	19.00		61	3.11	3.21

NOTES:

ALL DEVELOPMENT PHASES DEPICTED ON THIS PRELIMINARY PLAT SHALL BE PROVIDED A MINIMUM OF TWO (2) SEPARATE POINTS OF UNOBSTRUCTED ACCESS WITH A MINIMUM WIDTH OF TWENTY FEET, INSTALLED AND MAINTAINED PURSUANT TO THE REQUIREMENTS OF THE CITY OF SURPRISE.

ALL LOTS HAVE A MINIMUM WIDTH OF 60'.



VICINITY MAP
(NOT TO SCALE)

COE & VAN LOO CONSULTANTS, INC.

CVL#: 1.01.0113201
DATE: 12/17/2007

SHEET 1 OF 3

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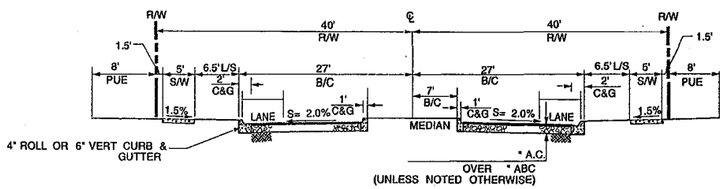
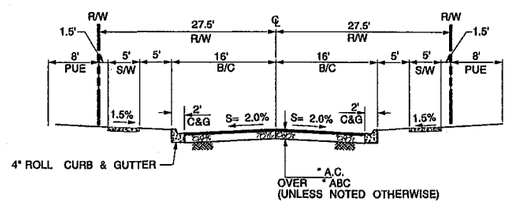


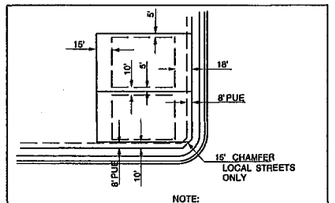
151ST. AVE. VIEW SOUTH

HALF STREET
NTS



INTERIOR LOCAL STREETS

NTS

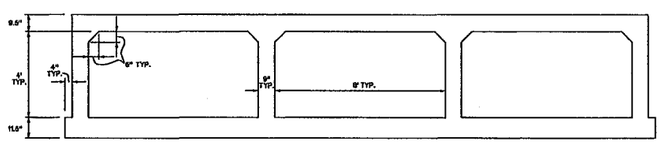


NOTE:
CMU WALLS CANNOT BE CONSTRUCTED IN THE PUBLIC UTILITY EASEMENT.

SETBACKS	
FRONT	10' TO LIVING SPACE, SIDE ENTRY GARAGE OR COVERED PORCH OR 18' FROM ROW TO FACE OF GARAGE DOOR (FRONT FACING)
REAR	15'
SIDE	5' MIN/ 10' TOTAL
CORNER SIDE YARD	10' (INCLUDES ADJ. LANDSCAPE TRACT)

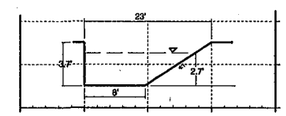
TYPICAL 60' X 115' LOT DETAIL

(NOT TO SCALE)

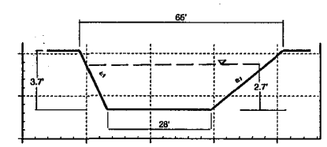


3-8'X4' BOX CULVERT
(CULVERT CROSSING AT 151st AVENUE AND SADDLEHORN ROAD)

PARCEL 1		
TRACT	AREA (AC)	DESCRIPTION
A	0.74	OPEN SPACE/ LANDSCAPE/ RETENTION
B	0.08	OPEN SPACE/ LANDSCAPE
C	1.70	OPEN SPACE/ LANDSCAPE/ RETENTION
D	2.66	OPEN SPACE/ LANDSCAPE/ RETENTION
E	0.02	10' MIN LANDSCAPE
TOTAL	5.20	



SECTION B - B
(COLLECTOR CHANNEL 2)



SECTION A - A
(CHANNEL 1 ALONG 151st AVENUE)

PRELIMINARY PLAT FOR TIERRA VERDE EAST PARCEL 3

OWNER/DEVELOPER:

VOYAGER SURPRISE 100, LLC
6900 E. 2ND STREET
SUITE 1000
SCOTTSDALE, AZ. 85251
(480) 675-7238
(480) 874-0678 (FAX)
CONTACT: MARK VOIGT

PREPARED BY:

COE & VAN LOO CONSULTANTS, INC.
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
(602) 285-4752
(602) 285-4753 (FAX)
CONTACT: DAVE COBLE

PROJECT LOCATION

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TAX PARCEL NUMBER: 503-54-013-C

SITE DATA

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TOTAL OPEN SPACE PROVIDED	5.20 AC. OR 27.37% of NET RES'L AREA

LEGEND

EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-1A
FLOODPLAIN	
FLOODWAY (ZONE AE)	
FEMA (ZONE A)	

Registered Professional Engineer (Civil) CERTIFICATE NO. 39836 JEFFERY RAY McINTOSH Date Signed 12/17/07 ARIZONA U.S.A.

CVL
COE & VAN LOO CONSULTANTS, INC.

CVL#: 1.01.0113201
DATE: 12/17/2007

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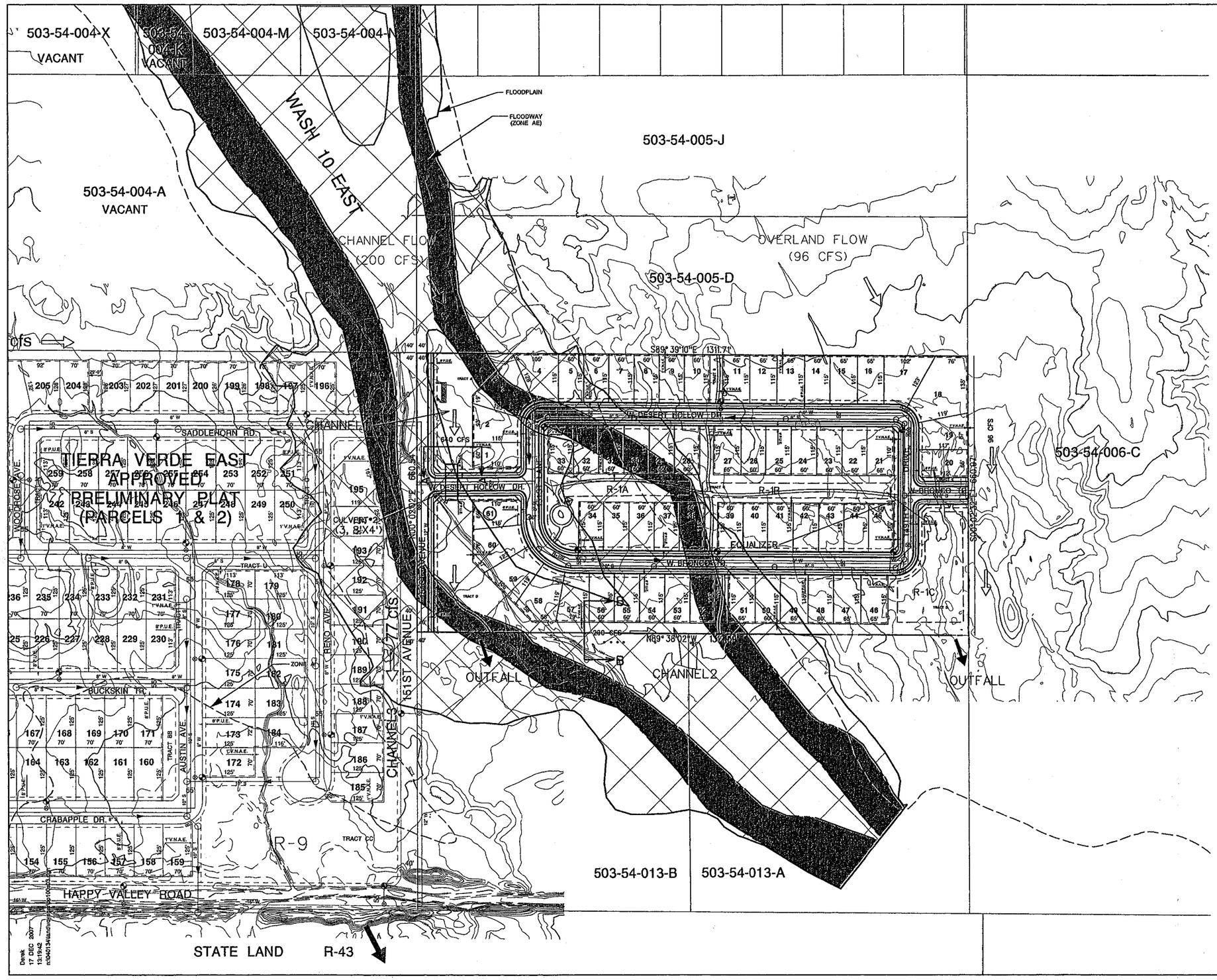

PRELIMINARY PLAT FOR TIERRA VERDE EAST PARCEL 3

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EXISTING CONTOUR	1000
EXISTING WATER	W
EXISTING SEWER	S
PROPOSED WATER	W
PROPOSED SEWER	S
PROPOSED VALVE	
PROPOSED MANHOLE	
PROPOSED CLEANOUT	
FIRE HYDRANT	
SURFACE DRAINAGE	
SIGHT VISIBILITY LINE	
RETENTION BASIN DESIGNATION	R-1A
FLOODPLAIN	
FLOODWAY (ZONE AE)	
FEMA (ZONE A)	

Registered Professional Engineer (Civil)
CERTIFICATE NO. 39836
JEFFERY RAY McINTOSH
Date Signed 12-17-07
ARIZONA, U.S.A.

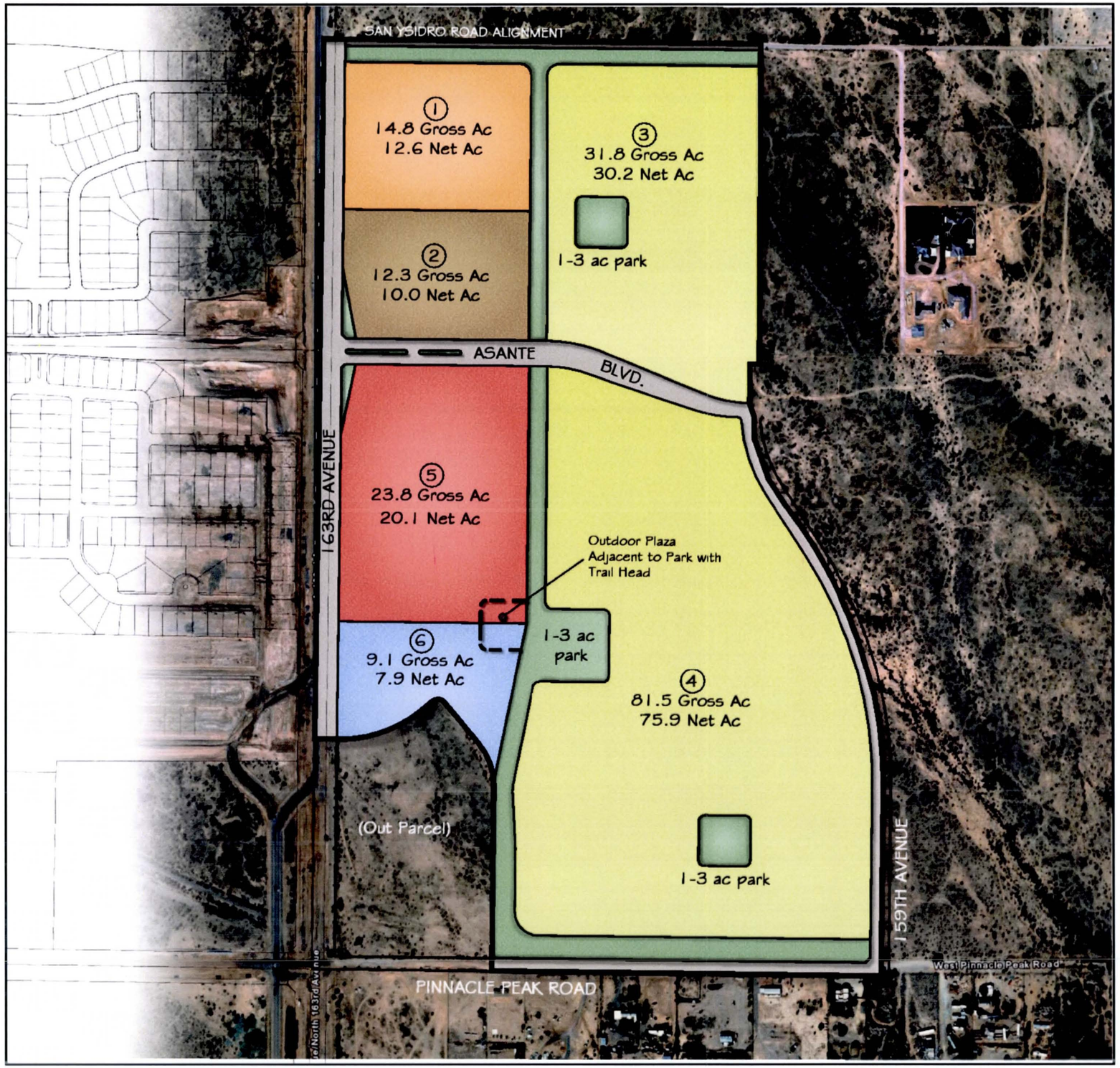
CVL
COE & VAN LOO CONSULTANTS, INC.

0' 50' 100' 200'
SCALE: 1" = 100'

CVL#: 1.01.0113201
DATE: 12/17/2007

SHEET 3 OF 3

Figure 2.9 – Verdugo Land Use Plan



VERDUGO

CONCEPTUAL LAND USE PLAN

Surprise, Arizona

SITE DATA

ZONING		LAND USE %	DU/AC	NET AC	GROSS AC	*DU (max.)
1	MDR	8.5	8	12.6	14.8	118
2	MHDR	7.1	15	10.0	12.3	184
3	SR	18.4	3	30.2	31.8	95
4	SR	47.0	3	75.9	81.5	244
5	Neighborhood Commercial	13.7	----	20.1	23.8	----
6	Office	5.3	----	7.9	9.1	----
	Total	100		156.7	173.3	641

*Lot count based on gross acreage

Net acreage = gross - ROW (163rd, Pinnacle Peak, San Ysidro, Asante Blvd. & Collector Road)

Exhibit #6
Conceptual Land Use Plan

North

0 200' 400' 600'

01.05.09

Figure 2.10 – City of Surprise Parks Master Plan Map

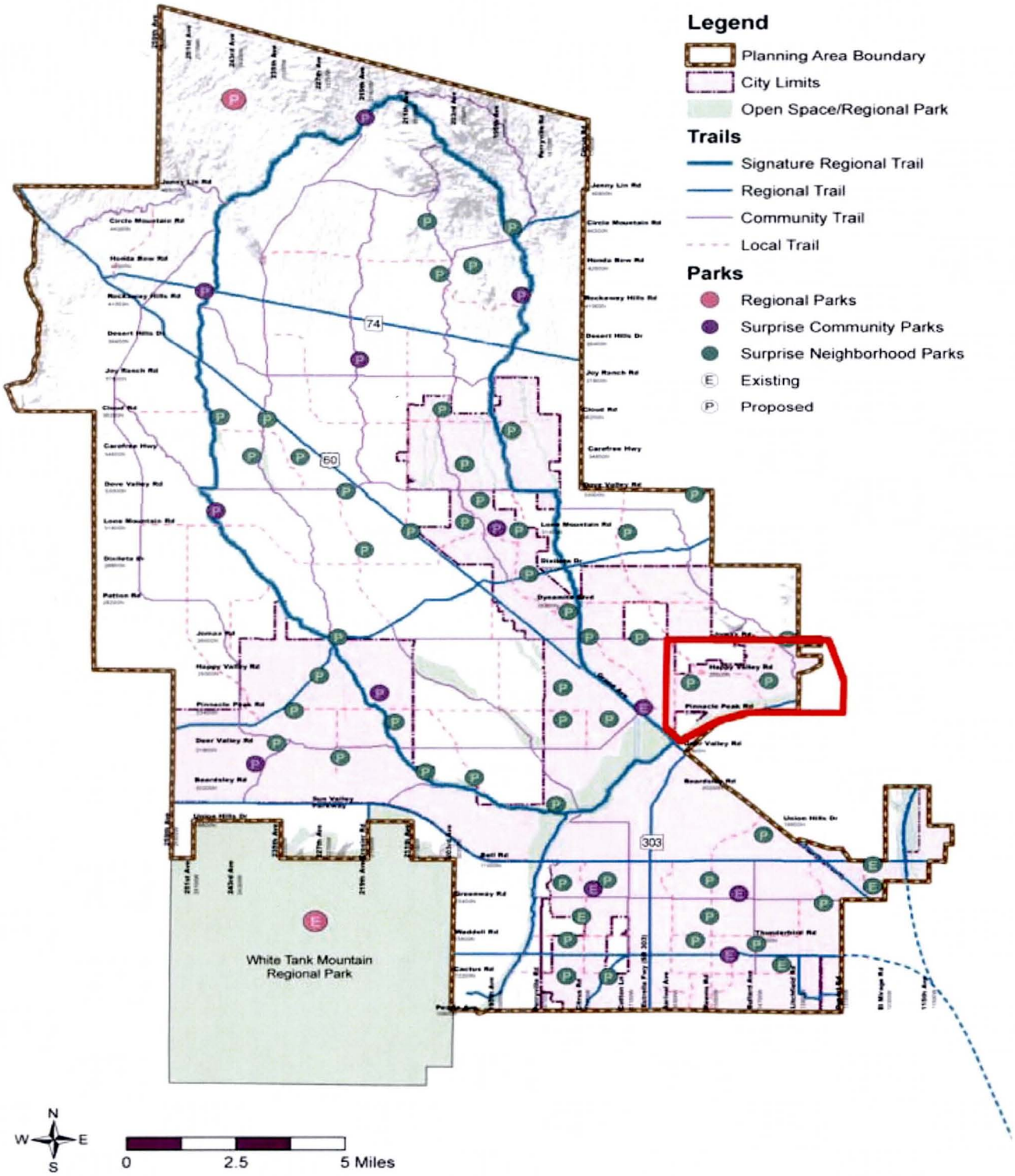


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Figure 2.11 – City of Surprise Trails Master Plan Map

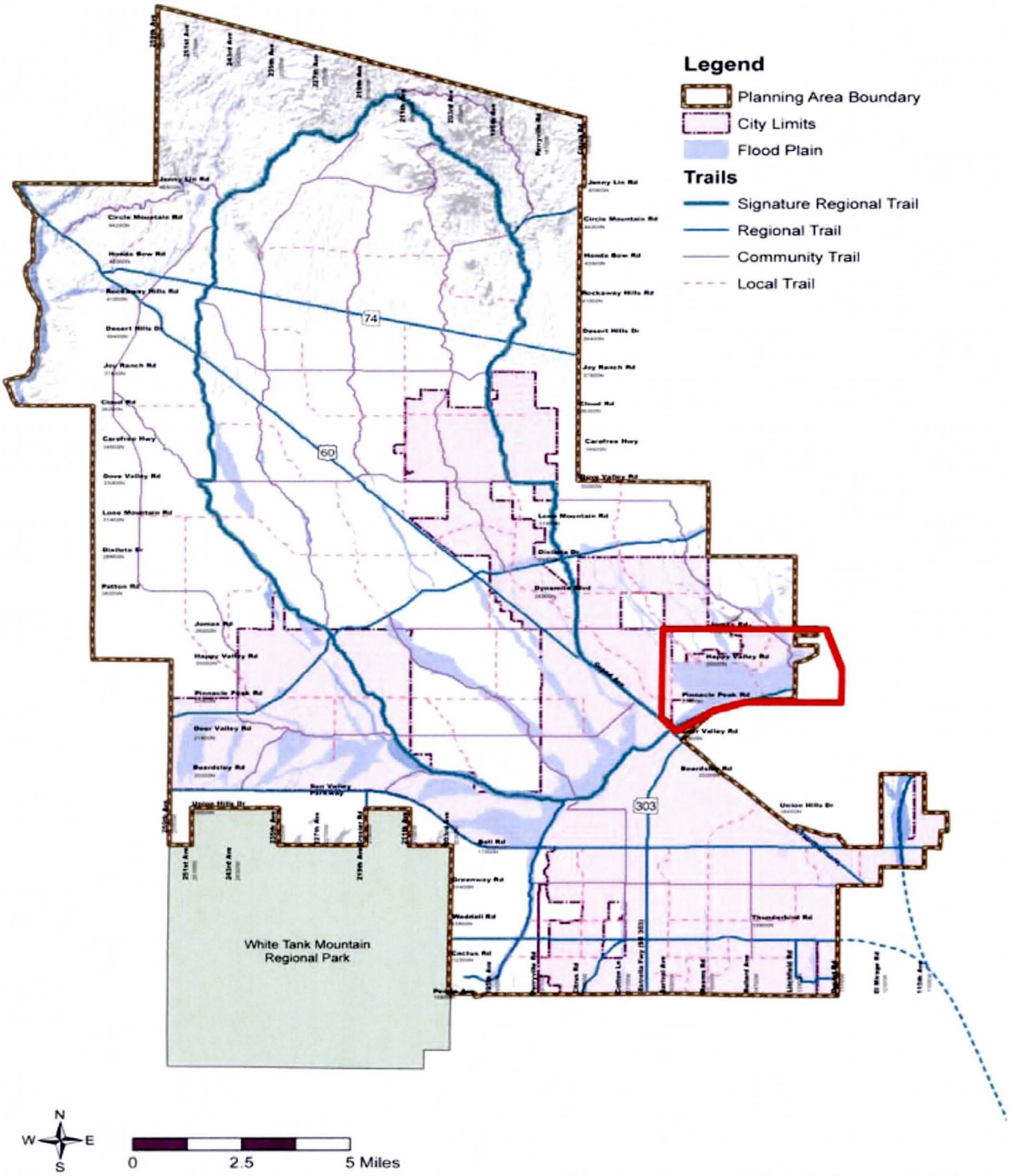

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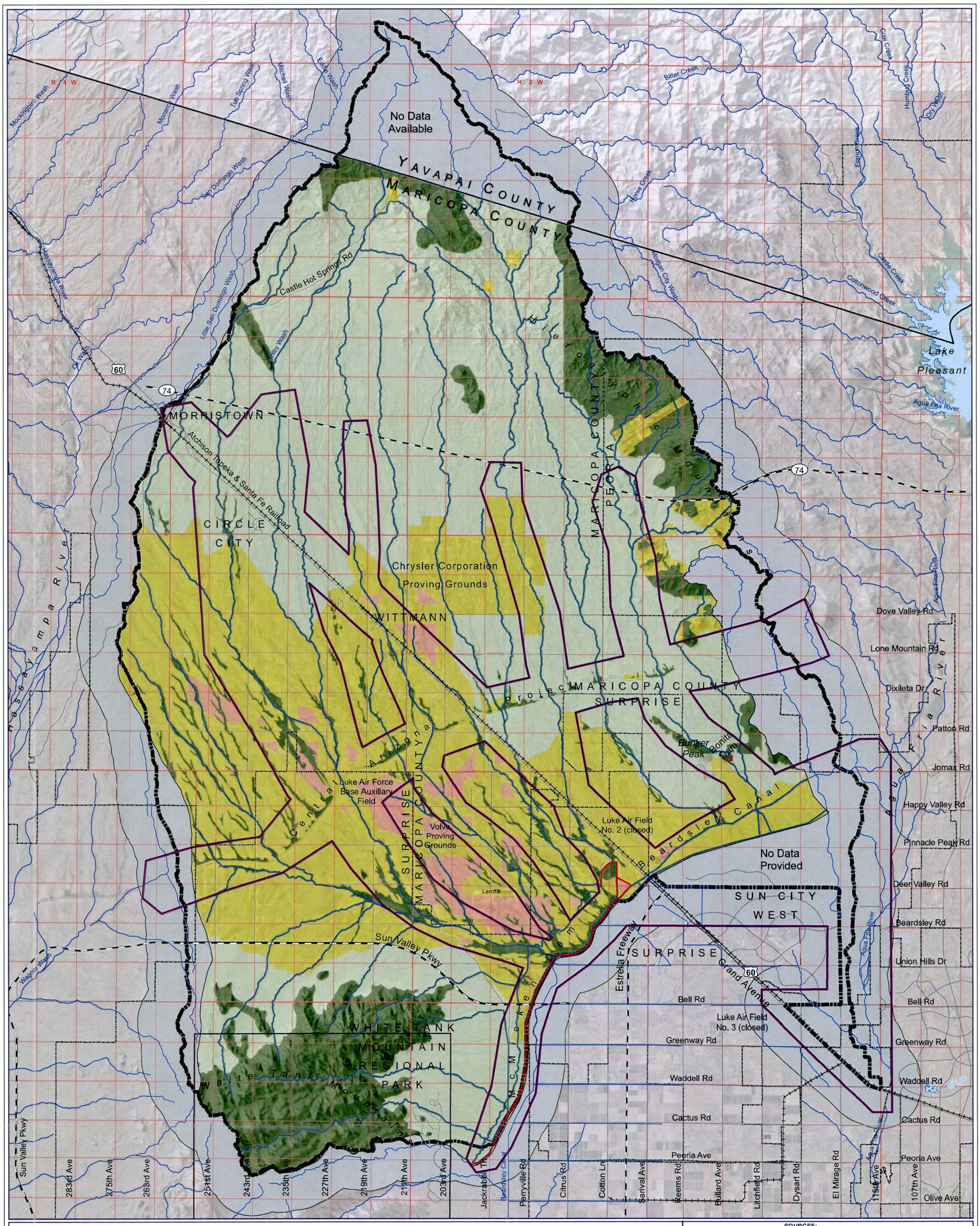
Figure 2.12 – Planned Scenic Resource Compatibility in Wittmann ADMP Area



LEGEND

FUTURE SCENIC RESOURCE COMPATIBILITY RATINGS

- Compatibility Class 1
- Compatibility Class 2
- Compatibility Class 3
- Compatibility Class 4
- Unmapped

	Compatibility Classes					
Compatibility Class 1	Non-Structural					
Compatibility Class 2	Non-Structural	Soft				
Compatibility Class 3	Non-Structural	Soft	Semi-Soft			
Compatibility Class 4	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment		
Compatibility Class 5	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	
Compatibility Class 6	Non-Structural	Soft	Semi-Soft	Hard w/ Aesthetic Treatment	Semi-Hard	Hard
Incompatible						

Compatibility Levels
CC: Complimentary and Compatible
NC: Not Complimentary or Compatible

0 0.5 1 1.5 2 Miles

N

REFERENCE FEATURES

- Site Study Boundary
- Focus Area
- Township & Range
- Public Land Survey Sections
- Dams
- Lakes
- Streams
- Highway
- Major Arterial Road
- Railroads
- County Boundary
- Municipal Boundary
- Previous Site Study Boundary

SOURCES:

This map was prepared as part of the overall assessment of the visual landscape character for the Wittmann ADMP for the Flood Control District of Maricopa County, under contract 2004C034 with EPG, Inc., Phoenix, Arizona. This map was prepared using Geographic Information Systems (GIS) software. GIS data supplied by the Flood Control District of Maricopa County, and field investigations conducted by EPG, Inc. For more information about this map, please contact the Flood Control District of Maricopa County/Landscape Architecture Branch at (602)506-1501, or write to us at 2801 W. Durango Street, Phoenix, AZ, 85009

Flood Control District of Maricopa County

Entellus EDAW AECOM

PREPARED BY: EDAW, INC.
Date: Jan. 10, 2007

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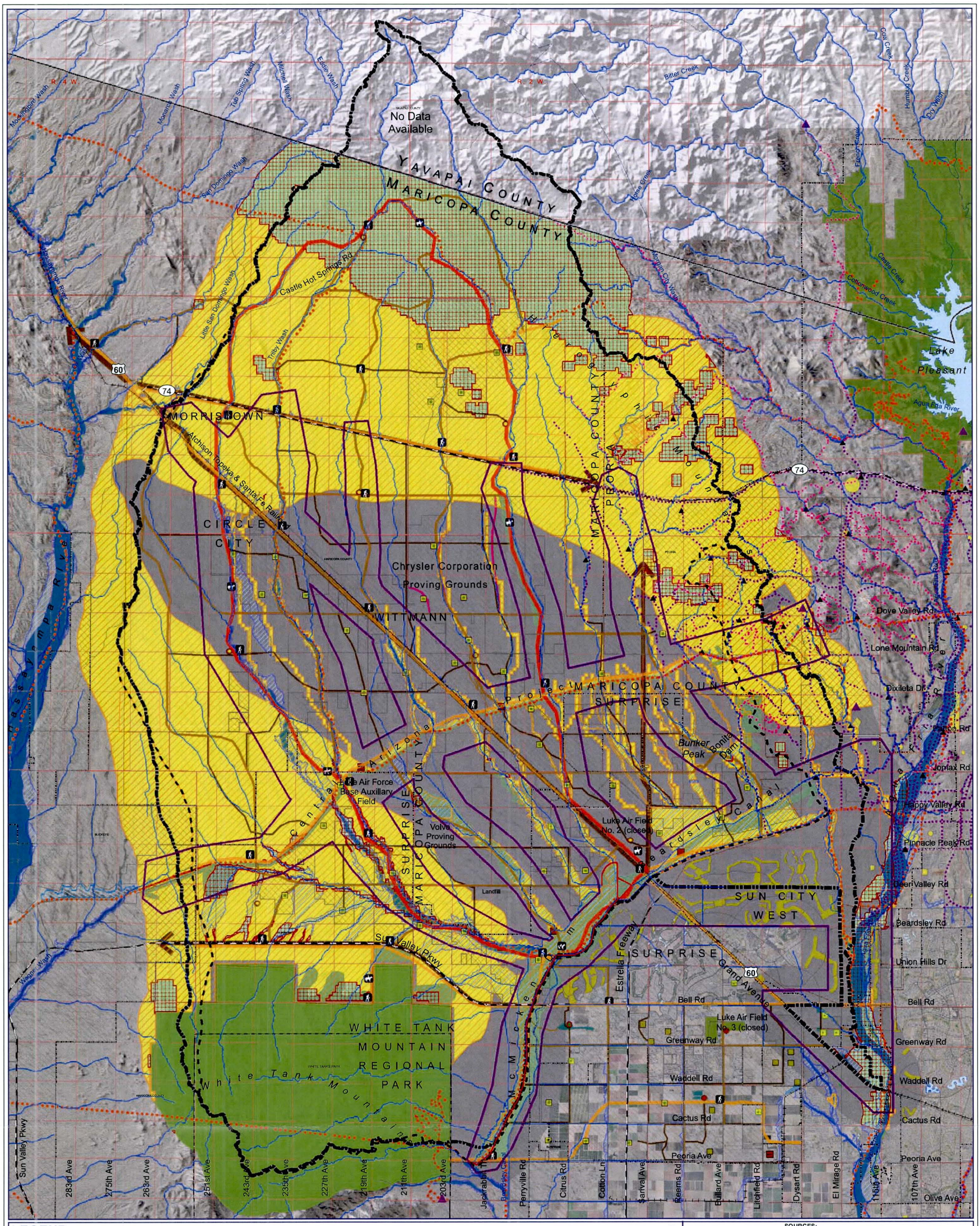
WITTMANN AREA DRAINAGE MASTER PLAN
Flood Control District of Maricopa County

Figure 3-10
Planned Future Scenic Resource Compatibility

Figure 2.13 – Recreation Inventory and Compatibility in Wittmann ADMP Area



LEGEND

Recreation Compatibility
- Class 1
- Class 2
- Class 3
- Class 4
- No Data

Corporate Boundaries
- Buckeye
- Peoria
- Yavapai County
- All Developments

Floodplains/Floodway
- Floodway
- Areas of 100-year flood
- Areas of 100-year shallow flood
- Washes
- Main Washes
- Water Treatment Plant
- Maricopa County Regional Trail

Surprise Parks & Trails
- Community-Existing
- Community-InProgress
- Community-Proposed
- Neighborhood-Existing
- Neighborhood-Proposed
- Neighborhood-Rehab
- Surprise TrailHeads
- Surprise HorseTrail
- Neighborhood Trail
- Local Trail
- Community Trail
- Regional Trail
- Signature Trail
- Scenic Roads

Parks & Recreation
- Open Space - Retention Areas
- Open Space - Conservation Areas
- Open Space - Public
- Open Space - Agricultural
- West Valley Recreation Corridor
- Regional Park
- Urban Park
- Golf Course/Ball Park
- Proposed Parks (Peoria)
- Private (Proving) Trail
- Peoria Trails
- Peoria Back-country Trails
- Proposed Valley Trail Locations
- Peoria Trailheads

REFERENCE FEATURES
- Site Study Boundary
- Focus Area
- Township & Range
- Public Land Survey Sections
- Dams
- Lakes
- Streams
- Highway
- Major Arterial Road
- Railroads
- County Boundary
- Municipal Boundary
- Previous Site Study Boundary

SOURCES:

This map was prepared as part of the overall assessment of the visual landscape character for the Wittmann ADMP for the Flood Control District of Maricopa County, under contract 2004C034 with EPG, Inc., Phoenix, Arizona. This map was prepared using Geographic Information Systems (GIS) software, GIS data supplied by the Flood Control District of Maricopa County, and field investigations conducted by EPG, Inc. For more information about this map, please contact the Flood Control District of Maricopa County/Landscape Architecture Branch at (602)506-1501, or write to us at 2801 W. Durango Street, Phoenix, AZ, 85009

Flood Control District of Maricopa County

Entelus EDAW AECOM

PREPARED BY: EDAW, INC.
Date: Jan. 10, 2007

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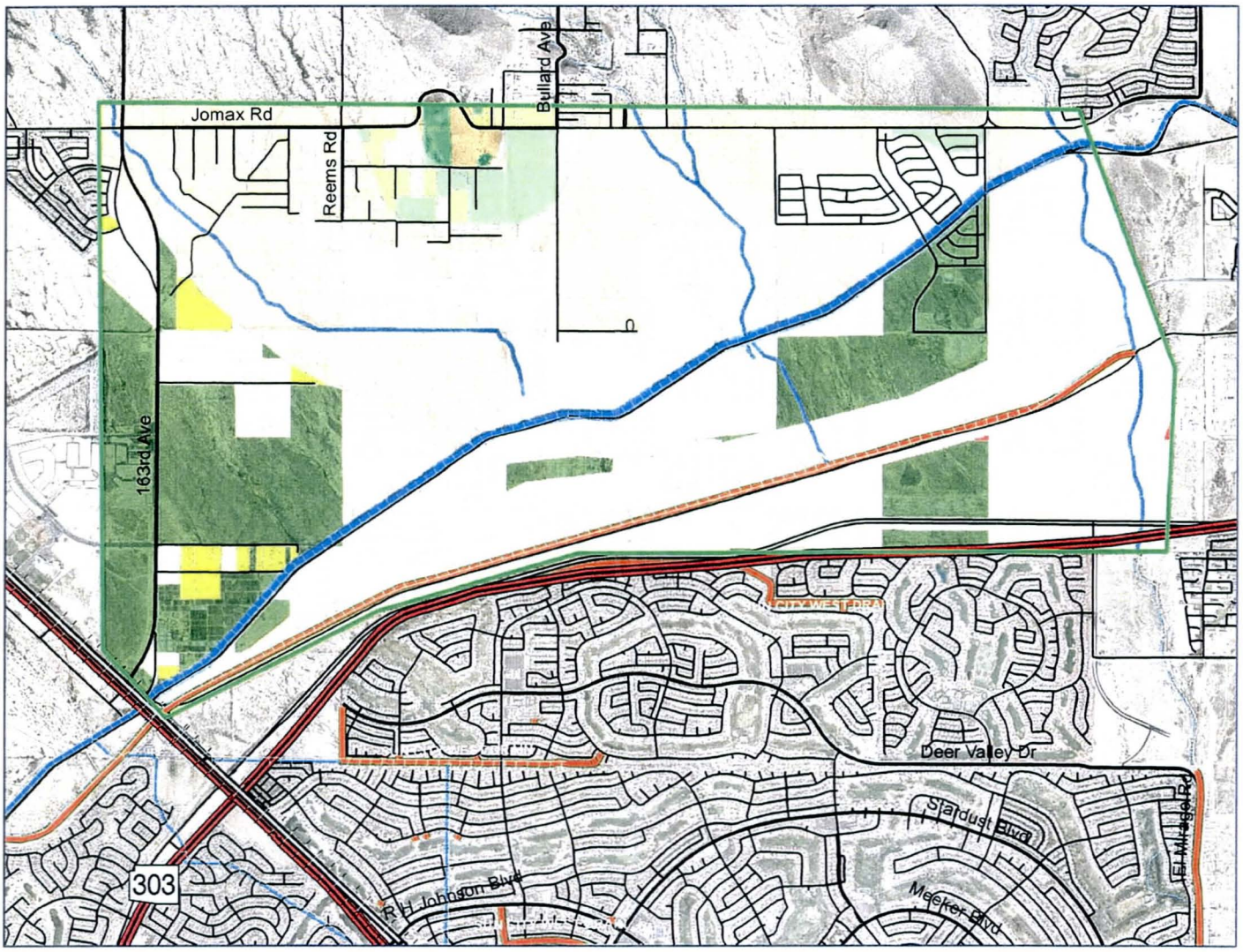
WITTMANN AREA DRAINAGE MASTER PLAN
Flood Control District of Maricopa County

Figure 4-4

Recreation Inventory in the Study Area and Recreation Compatibility

Figure 2.14 – Existing Study Area Landscape Character Units

Existing Landscape Character Units



Future Landscape Character Units	Acres	Percentage
Natural Foothills	38	< 1%
Natural Lower Bajada	1348	20%
Natural Upper Bajada	122	2%
Natural Arroyo	33	< 1%
Natural Valley Plains	2473	36%
Natural Valley Wash	148	2%
Rural Foothills	24	< 1%
Rural Lower Bajada	891	13%
Rural Upper Bajada	146	2%
Rural Arroyo	19	< 1%
Rural Valley Plains	1256	18%
Rural Valley Wash	48	< 1%
Suburban Foothills	5	< 1%
Suburban Lower Bajada	190	3%
Suburban Upper Bajada	57	< 1%
Suburban Arroyo	2	< 1%
Suburban Valley Plains	97	1%
Suburban Valley Wash	2	< 1%
Industrial Valley Plains	3	< 1%

Reference Features

- Study Area
- Highways
- Major Arterial
- Collector Street
- Rail-Road
- Canals
- Streams
- FCD Structures

Sources

-Flood Control District of Maricopa County Landscape Inventory & Analysis (LIA), 2008
-Existing Landscape Character Cultural Settings Map, 2008
-Landscape Character Physical Settings Map, 2008

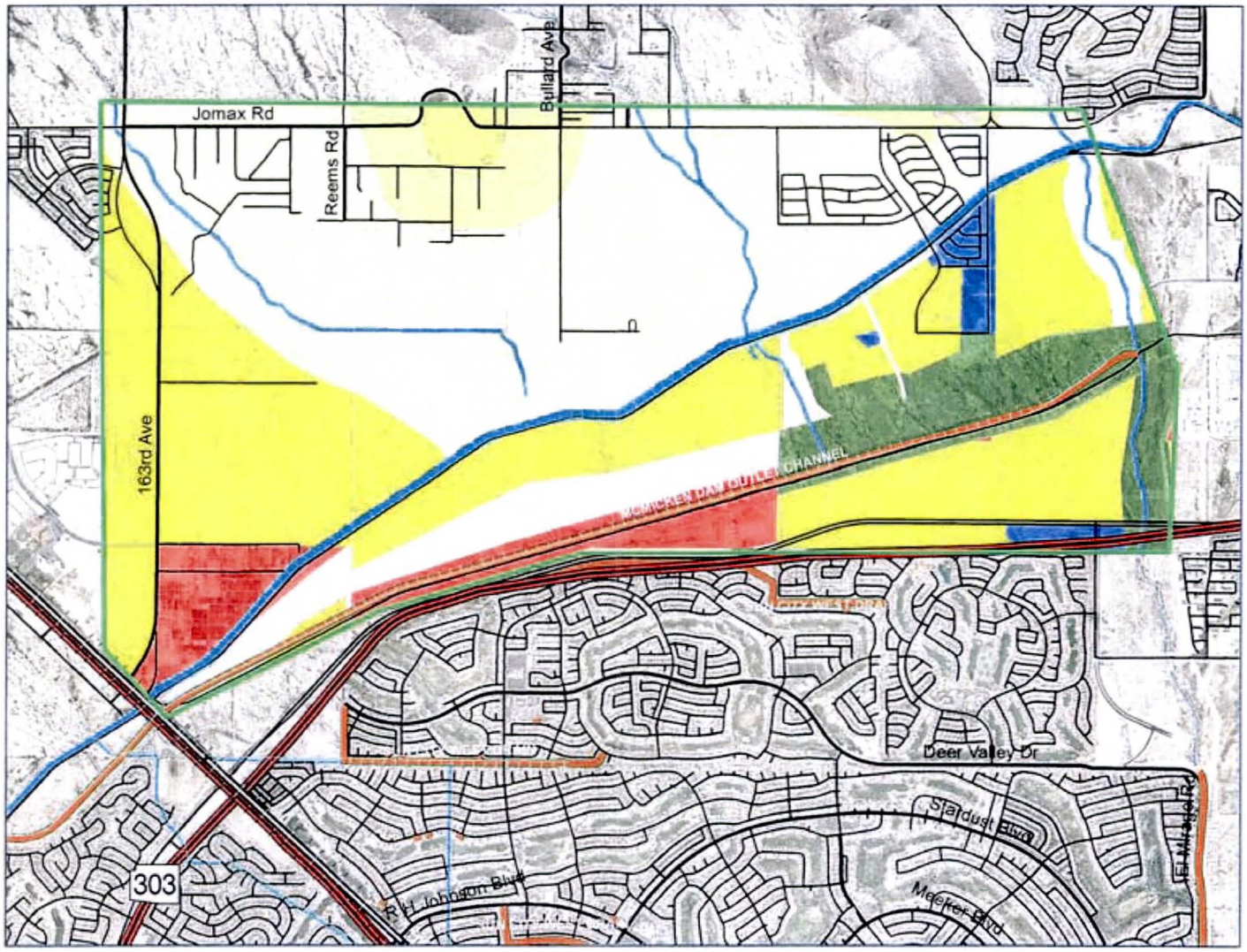
Prepared by
Flood Control District of Maricopa County
October 2009

0 2,350 4,700 9,400 Feet

1 inch = 0.75 miles

Figure 2.15 – Future Study Area Landscape Character Units

Future Landscape Character Units



Future Landscape Character Units	Acres	Percentage
Natural Foothills	1	< 1%
Natural Lower Bajada	29	< 1%
Natural Upper Bajada	7	< 1%
Natural Arroyo	1	< 1%
Natural Valley Plains	475	7 %
Natural Valley Wash	49	< 1%
Rural Valley Plains	538	8%
Rural Valley Wash	16	< 1%
Suburban Foothills	66	1%
Suburban Lower Bajada	2379	34%
Suburban Upper Bajada	301	4%
Suburban Arroyo	53	< 1%
Suburban Valley Plains	2268	33%
Suburban Valley Wash	104	2%
Urban Lower Bajada	19	< 1%
Urban Upper Bajada	16	< 1%
Urban Valley Plains	118	2%
Urban Valley Wash	1	< 1%
Industrial Valley Plains	431	6%
Industrial Valley Wash	28	< 1%

Reference Features

- Study Area
- Highways
- Major Arterial
- Collector Street
- Rail-Road
- Canals
- Streams
- FCD Structures

Sources

-Flood Control District of Maricopa County Landscape Inventory & Analysis (LIA), 2008
-Future Landscape Character Cultural Settings Map, 2008
-Landscape Character Physical Settings Map, 2008

Prepared by
Flood Control District of Maricopa County
October 2009

0 2,350 4,700 9,400 Feet

1 inch = 0.75 miles

Figure 2.16 – Floodplain Protection Structure Types

FLOOD PROTECTION STRUCTURE TYPES

Introduction

Preservation of the natural landscapes of Maricopa County and protection of local community character are primary objectives of the Flood Control District's Board approved Policy for the Landscaping and Aesthetic Treatment of Flood Control Structures. The development of context sensitive flood mitigation solutions that protect and enhance open spaces, recreation, biological, and cultural resource environments of Maricopa County are also important goals that are an integral part of carrying out the District's overall mission.

The identification and selection of flood protection structure types that have the potential to be context sensitive with the environments in which they are placed is an important early step in District planning studies. This handbook is intended to serve as a guide to assist in the identification and selection of flood control structure types that have the potential to be context sensitive with the valued characteristics of the scenery, recreation and open space environments of Maricopa County. Future updates of this handbook will include guidelines for the identification and selection of flood protection structure types that are context sensitive with the biological and cultural resource environments of Maricopa County.

Six Flood Control Structure Types that are frequently considered, evaluated and recommended in District Area Drainage and Watercourse Master Planning studies, Project Pre-designs and Final Designs are listed in Table 1 below.

Table 1 Flood Protection Structure Types and thier Potential to Acheieve Context Sensitivity with the landscape settings of Maricopa County

Flood Protection Structure Types	Potential Magnitude of Landscape Alteration	Potential to Achieve Context Sensitivity
Non-Structural	Lowest	Highest
Underground Pipe	↕	↕
Channel Levee		
Conveyance Channel		
Storage Basin		
Flood Retarding Structure or Dam	Highest	Lowest

These structure types vary in their physical and visual characteristics and, hence, their ability to complement the variety of landscape settings, open spaces and recreation environments found within Maricopa County. The above structure types are arrayed as a spectrum according to their overall potential to modify and achieve context sensitivity with the landscape settings commonly found within Maricopa County. Within this spectrum, the Non-structural and Underground Pipe structure types have the highest potential for achieving context sensitivity with a majority of the landscape settings in Maricopa County. The Levee and Conveyance Channel structure Types generally have an intermediate potential, whereas the Storage Basin and Flood Retarding structure types tend to have the lowest potential for achieving context sensitivity with a majority of the landscape settings in Maricopa County.

The physical dimension or "scale" of the structure types relative to the size of the features in the surrounding landscape setting also influences the perceived ability of flood control structures to achieve context sensitivity with the visual environments in which they are placed. The size and depth of large scale flood control structures can appear to be visually overwhelming and out of context with landscape settings comprised of small scale features. For this reason, the Levee, Conveyance Channel, Storage Basin and Flood Retarding structure types are further stratified into three structure type scale sub-classes. The three scale sub-classes include:

Small Scale Structures
Medium Scale Structures
Large Scale Structures

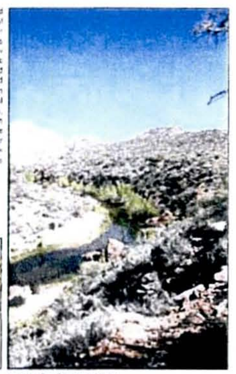
The physical dimensions of the structure types associated with each Scale Sub-Class are summarized in Table 2.

Table 2 Flood Protection Structure Types Scale Sub-Classes

Structure Type	Scale Sub-Class	Physical Dimension
Non-Structural	NA	NA
Underground Pipe	NA	NA
Channel Levee	Small	Up to 6 ft. height and up to 25 ft. width
	Medium	6-10 ft. height and 25-100 ft. width
	Large	10+ ft. height and 100 ft. + width
Conveyance Channel	Small	Up to 5 ft. depth and up to 25 ft. width
	Medium	5-8 ft. depth and 25-100 ft. width
	Large	8 ft. + depth and 100 ft. + width
Storage Basin	Small	Up to 8 ft depth and 5 acres in size
	Medium	Up to 8 ft depth (60%) up to 15 ft depth (40%) and 5-20 acres in size
	Large	15 + ft depth and 20+ acres in size
Dam	Small	Up to 10 ft high and up to 1 mile in total length
	Medium	10-15 ft high and 1-2 miles in total length
	Large	15+ feet height and 2+ miles in total length

Non-Structural Method

The Non-Structural Structure Type is representative of flood plain preservation and is characterized by an absence of structural elements or features for flood protection or other purposes. Exceptions may include low standard road facilities for flood plain monitoring and administrative purposes and low impact facilities to support passive recreation activities, public information/education, and natural resource restoration and management. Typically, this structure type is implemented through a variety of local ordinances, County floodplain regulations, State statutes and Federal regulations. Natural topographic features such as rivers, washes, arroyos, channels, valleys and ridges perform the functions of storm water conveyance, storage and retardation. Since the visual character of the landscape is usually preserved under this structure type, it will usually complement and become context sensitive with the visual character of most landscape settings.



Unnamed Arroyo, White Tank Mountain

Upper New River, Tonto National Forest

Agua Fria River at Carefree Highway

Gila River at State Route 87

Gila River at El Mirage Road

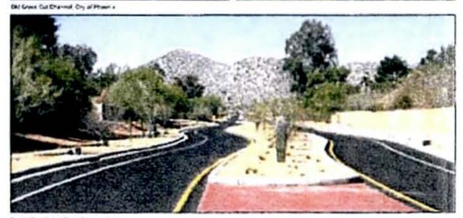
Natural Basin, West side of White Tank Mountain

Underground Pipe

The underground pipe structure type includes construction of all types of buried conduit conveyance structures. The overall form of this structure type is linear. Visible landscape disturbances resulting from this structure type are usually limited to the introduction of linear lines and patterns into the landscape setting. With sufficient right of way, the visibility of these disturbances often can be minimized through vegetation restoration and application of landscape architectural design principles. Consequently, this structure type is typically low in visual prominence and is able to achieve context sensitivity with a wide range of landscape settings, recreation and open space environments in Maricopa County. This structure type also provides opportunities for linear parks, trails, open space connectivity and spatial separation of local communities.

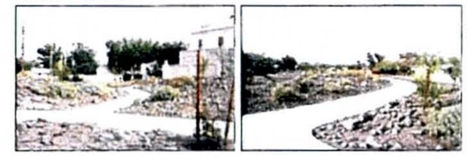
Bethany Home Outfall Channel Reach 6, City of Glendale

Old Cross Cut Channel, City of Phoenix



Double Tree Ranch Road, Paradise Valley

10th Street Storm Drain, City of Phoenix



Central Arizona Project Underground Pipe

Channel Levee

The channel levee structure type includes earthen and hard structural embankments, dikes and vertical flood walls for controlling flood waters adjacent to a watercourse. The channel levee structure type is seen as a linear protuberance with a geometric or organic convex form in the landscape. Since this structure type is usually limited to a height of six feet or less, its visual prominence in the landscape is most often moderately low. This structure type, therefore, is context sensitive with a moderate range of landscape settings, recreation and open space environments in Maricopa County.

Channel Levees may be constructed either as stand alone structures or in combination with a constructed conveyance channel. When constructed as stand alone structures, channel levees can provide opportunities for preservation of natural river and wash floodplains situated below the levee. When they are constructed as an integral part of a conveyance channel, the levee structure is likely to appear as a vertical extension of the channel side slopes above the natural grade of the landscape.

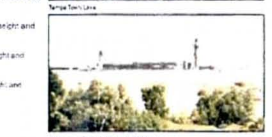
The Channel Levee structure type is further stratified into three scale sub-classes to better define their potential context sensitivity with the landscape settings, recreation and open space environments in Maricopa County. The three scale sub-classes include:

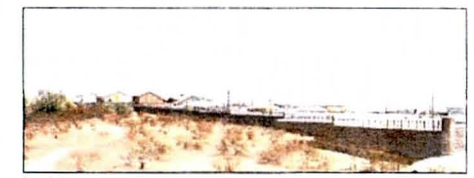
Small Scale Channel Levees. Up to 6 ft. height and up to 25 ft. width

Medium Scale Channel Levees 6-10 ft. height and 25-100 ft. width

Large Scale Channel Levees 10+ ft. height and 100 ft. + width

Tempe Town Lake





Terrace Development

New River Channel

Gila River

Conveyance Channel

The conveyance channel structure type includes all types of constructed earthen and hard lined open channel structures that serve the purpose of conveying storm waters. The major structural components of this structure type include the channel bottom, side slopes and overbank area, the latter of which typically includes a maintenance road and landscape setback (buffer) area. The overall form of the conveyance channel structure type typically appears in the landscape as a concave linear flat bottomed trough with either a geometric or organic shape. The interior side slopes of this structure type can vary from vertical to gently sloping. This structure type typically includes a variety of ancillary structural features which can include inlets, outlets, weirs, grade control structures, energy dissipaters and low flow channels. The length and width of these structures can vary significantly. The overall visual prominence of the conveyance channel structure type ranges from moderately low to moderate based upon their size and interior position in the landscape. The conveyance channel structure type is context sensitive with a moderate range of landscape settings, recreation and open space environments in Maricopa County.

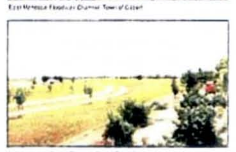
The conveyance channel structure type is further stratified into scale sub-classes to better define their context sensitivity with the visual, recreation and open space environments of Maricopa County. The scale sub-classes for this structure type include the following:

Small Scale Conveyance Channels:
Up to 5 ft. depth and up to 25 ft. width

Medium Scale Conveyance Channels:
5-8 ft. depth and up to 25-100 ft. width

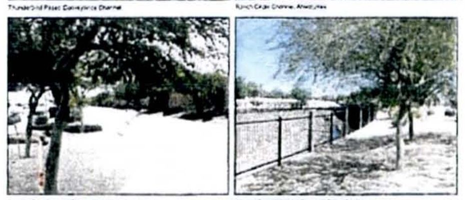
Large Scale Conveyance Channels:
8 ft.+ depth and up to 100 ft.+ width

East Maricopa Floodway Channel, Town of Gilbert



Bethany Home Outfall Channel, City of Glendale

Thunderbird Paseo Conveyance Channel



Arizona Canal Diversion Channel, City of Phoenix

Storage Basin

The storage basin structure type includes all types of earthen and hardened open flood water storage basins that are commonly found throughout metropolitan areas of Maricopa County.

The major structural components of this structure type include a large bottom area, side slopes and an overbank area that typically contains a maintenance road facility and landscape setback area. Storage basin structures typically appear as a large concave depression or hollow with either a geometric or organic form in the landscape. Ancillary features often include a low flow channel, inlets, weirs, energy dissipaters, outlets and riser structures. The overall size of these structure types can vary significantly. The visual prominence of these structures typically ranges from moderately high to high due to their apparent size and extent. The storage basin structure type is context sensitive with a limited range of landscape settings, recreation and open space environments in Maricopa County.

The storage basin structure type is further stratified into scale sub-classes to better define their context sensitivity with the visual, recreation and open space environments of Maricopa County. The scale sub-classes for this structure type include the following:

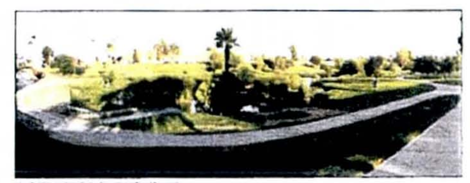
Small Scale Storage Basins:
Up to 8 ft depth 5 acres in size

Medium Scale Storage Basins:
Up to 8 ft depth (60%) up to 15 ft depth (40%)
5-20 acres in size

Large Scale Storage Basins:
15 + ft depth 20+ acres in size

Kiwanis Park, City of Tempe

East Maricopa Floodway Golf Course



Vista Del Camino Park - Indian Bend Wash, City of Scottsdale

Sun Ray Park, Ahwatukee

Town of Guadalupe North Basin

Dam

The dam structure type includes all types of earthen and hardened flood retarding structures that are designed to retard and temporarily store storm waters. The major structural components of this structure type include the dam embankment, pool reservoir, principle outlet, emergency spillway.

The dam structure type usually appears in the landscape as an extended linear protuberance with either a geometric or organic convex form. It is similar in overall form to the channel levee structure type but its physical dimension is usually much larger. Ancillary structures include principal and emergency spillways, outlets, and riser structures. Dam structures that are owned and operated by the District are typically situated in the landscape along the cusp between the lower bajada and the valley plain and are usually viewed against the backdrop of isolated mountain ranges that are found throughout the Sonoran Desert in Maricopa County. The visual prominence of these structures is typically high due to the scale and magnitude of their protuberant form. The dam structure type is context sensitive with a limited range of landscape settings, recreation and open space environments in Maricopa County.

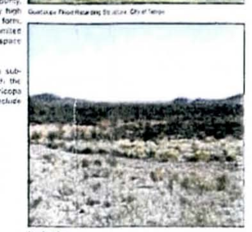
The Dam structure type is further stratified into scale sub-classes to better define their context sensitivity with the visual, recreation and open space environments of Maricopa County. The scale sub-classes for this structure type include the following:

Small Scale Dams:
Up to 10 ft high 1 mile or less in total length

Medium Scale Dams:
10-15 ft high 1-2 miles in total length

Large Scale Dams:
15+ feet height and 2+ miles in total length

Guadalupe Flood Retarding Structure, City of Tempe



New River Dam

White Tanks Flood Retarding Structure #3

Cave Creek Dam

McMicken Dam

New River Dam

2801 West Durango Street, Phoenix, Arizona 85009, 602-506-1501

Figure 2.17 – Floodplain Protection Structural Methods

FLOOD PROTECTION STRUCTURAL METHODS

Introduction

Preservation of the natural landscapes of Maricopa County and protection of local community character are primary objectives of the Flood Control District's Board approved Policy for Landscaping and Aesthetic Treatment of Flood Control Facilities. These objectives are accomplished by planning and designing flood protection facilities to complement the positive visual characteristics of the landscape settings in which they are located.

The District routinely evaluates and implements a variety of non-structural and structural methods for providing flood protection in Area Drainage and Watercourse Master Planning, Project Pre-Design and Final Design. Listed below are six of the most commonly applied methods by the Flood Control District of Maricopa County.

- Non-Structural Method
- Soft Structural Method
- Semi-Soft Structural Method
- Hard Structural Method with Aesthetic Treatment
- Semi-Hard Structural Method
- Hard Structural Method

These flood protection structural methods vary in their physical and visual characteristics and their relative ability to complement or enhance the visual character of the landscape settings found in Maricopa County. The above flood protection structural methods are arrayed as a spectrum according to their visual character and potential for achieving context sensitivity with the landscapes of Maricopa County (refer to Tables 1 and 2).

The identification and selection of flood protection structural methods that have the potential to complement the visual character of the landscape settings in which they will be constructed, therefore, is a key first step towards developing flood protection solutions that will be context sensitive with the visual environment and meet the goals of the District's aesthetic treatment policy.

Following are brief descriptions and photo examples for each of the flood protection structural methods identified above. They are presented here to provide a better understanding of their visual characteristics, potential to achieve context sensitivity with the visual environments of Maricopa County, and their use in flood protection method landscape compatibility assessments.

Table 1

Flood Protection Methods	Super Structure					Structural Components			
	None	Earthen		Hard		None	Concealed or Buried	Aesthetic Treatment Applied	Standard Engineering Design
		With Aesthetic Treatment	Without Aesthetic Treatment	With Aesthetic Treatment	Without Aesthetic Treatment				
Non Structural	X					X			
Soft Structural		X					X		
Semi-Soft Structural		X						X	
Hard Structural Method w/ Aesthetic Treatment				X				X	
Semi-Hard Structural			X						X
Hard Structural					X				X

Table 2

Flood Protection Methods	Level of Landscape Modification	Effect on Landscape Character	Potential for Context Sensitivity
Non Structural	Not Present (None)	Preserved	Highest
Soft Structural	Not Evident	Retained	
Semi-Soft Structural	Slightly Evident	Partially Retained	
Hard with Aesthetic Treatment	Evident*	Modified	
Semi Hard Structural	Strongly Evident (Visually Dominant)	Strongly Modified	
Hard Structural	Very Strongly Evident (Drastic Alteration)	Drastically Modified	Lowest

Non-Structural Method

- Characterized by an absence of flood control structures
- May include low-standard roads for administration
- Natural landforms & drainage features convey or store storm waters
- Existing landscape character is preserved
- Complements the character of most landscape settings

Waterman Wash

Gila River

Gila River

Gila River

Estrella Ranch Natural Urban Basin - Natural

Agua Fria River

Ridge Line along Estrella Parkway

Soft-Structural Method

- Superstructure is constructed of earthen (soft) materials
- Overall form emulates surrounding natural landforms
- Hard structural components are concealed or are not noticeable
- Utilizes materials with colors & textures found in surrounding landscape
- Aesthetic features include vegetation planting & landscape buffers
- Existing landscape character is retained
- Complements the character of most landscape settings

Falcon Dunes Golf Course Detention Basin

Wildfire Golf Course Conveyance Channel

Gax Basin

Arizona Biltmore Basin

Old Cross Cut Channel

Stone Creek Golf Course, Indian Bend Wash Channel

Freestone Park Basin

Guadalupe Flood Retarding Structure

White Tanks Flood Retarding Structure #3 (S-mation)

Semi-Soft Structural Method

- Superstructure is constructed of earthen (soft) materials
- Structural components such as inlets & outlets may be hard (concrete)
- Forms, colors and features of structural components complement the setting
- Aesthetic features include vegetation planting & landscape buffers
- Existing landscape character is slightly modified
- Complements the character of most landscape settings

Upper Fan Park Silver Creek & Paradise Valley Detention Basin

Wildfire Golf Course Conveyance Channel

Laveen Area Conveyance Channel

Vista Del Camino Park - Indian Bend Wash

Thunderbird Paseo Conveyance Channel

El Dorado Park - Indian Bend Wash

10th Street Basin

Brittany Home Outfall Channel

El Dorado Park - Indian Bend Wash

43rd Ave & Southern Detention Basin

Guadalupe Flood Retarding Structure

Hard Structural Method with Aesthetic Treatment

- Superstructure is constructed of hard (concrete) materials
- Overall form is freeform or gracefully meandering
- Structural components (inlets, outlets, etc) may be hard or soft
- Aesthetic features include:
  - User of attractive colors and textures
  - Architectural detailing & rustication techniques
  - Urban art
  - Vegetation planting & Landscape buffers
- Character of structure is visually dominant as a feature attraction
- Complementary to select settings

Double Tree Ranch Channel

Crismon Development Channel

Arizona Canal Diversion Channel

Cherry Creek Conveyance Channel - Denver, Colorado

Arizona Canal Diversion Channel

Santa Fe Dam

Cherry Creek Conveyance Channel - Denver, Colorado

Cave Creek Dam

Semi-Hard Structural Method

- Superstructure is constructed of earthen (soft) materials
- Overall form is geometric & contrasts with natural landforms
- Structural components are hard & geometric
- Aesthetic features are absent
- Structure is visually dominant within the setting
- Compatible with limited landscape settings

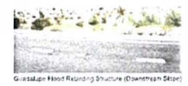
Sunny Cove River Structure Dam

McMicken Outlet Channel

East Maricopa Floodway Channel

Talum Wash Basin

Sumer Basin


Guadalupe Flood Retarding Structure (Downstream Slope)

McMicken Dam

Sossaman Basin

White Tanks Flood Retarding Structure #3

Hard Structural Method

- Superstructure is constructed of hard (concrete) materials
- Overall form is geometric & contrasts with natural landforms
- Structural components are hard & geometric
- Aesthetic features are absent
- Structure strongly dominates the character of the setting
- Compatible with limited landscape settings

Speedway Flood Retarding Structure Conveyance Channel

White Tanks 4 Inlet Conveyance Channel

US 60 Arizona Department of Transportation Basin

Dobbel Drain Conveyance Channel

City of Mesa Conveyance Channel

Skunk Creek 4 Drop Structure

City of Williams Dam

Table 2.1 – List of Project Contacts

HV DCR Stakeholder List

Name	Company	Project Affiliation	e-mail	Phone	Address 1	Address 2	City	State	Zip
Mark Voigt	Voyager	Tierra Verde East	mvoigt@voyagerproperties.com	480 946 9635	6900 East Second Street		Scottsdale	AZ	85251
Charlie Caldwell	William Lyon Homes	Rancho Mercado	charlie.caldwell@lyonhomes.com	480 893 1000	8840 East Chaparral Road, Ste. 200		Scottsdale	AZ	85250
Paul Kroff	Woodside Homes	Tierra Verde West	PKroff@woodside-homes.com	480 755 0801	1811 South Alma School Road, Ste. 190		Mesa	AZ	85210
Stuart Barney	Evergreen Devco	163rd & Pinnacle Peak	stuart.barney@evergreendev.com	602 808 8600	2390 East Camelback Road, Ste. 410		Phoenix	AZ	85016
Anthony Sumner	Sandbox Development Consultants	Verdugo	anthony@sandboxdevelopment.com	602 275 5445	312 West Edgemont Avenue		Phoenix	AZ	85003
Phil Miller	Westpac Development Corporation	Alta Mira	developaz@gmail.com	480 889 1999	7595 East McDonald Drive, Ste. 105		Scottsdale	AZ	85250
Paul Siders	Coe & Van Loo Consultants, Inc.	Tierra Verde East & West	psiders@cvlci.com	602 264 6831	4550 North 12th Street		Phoenix	AZ	85014
Ricaro Aguirre	Coe & Van Loo Consultants, Inc.	Tierra Verde East & West, Alta Mira	raguirre@cvlci.com	602 264 6831	4550 North 12th Street		Phoenix	AZ	85014
Brian Rahal	DEI Professional Services	Verdugo	brahal@deipro.com	602 954 0038	6225 North 24th Street, Ste. 200		Phoenix	AZ	85016
George Cannataro	Coe & Van Loo Consultants, Inc.	Alta Mira	gcannataro@cvlci.com	602 285 4726	4550 North 12th Street		Phoenix	AZ	85014
Kevin Kugler	RBF Consulting	HV Study	kkugler@rbf.com	602 467 2249	16605 North 28th Avenue, Ste. 100		Phoenix	AZ	85053
Nathan Ford	RBF Consulting	HV Study	nford@rbf.com	602 467 2254	16605 North 28th Avenue, Ste. 100		Phoenix	AZ	85053
Jeff Davidson	City of Surprise	HV Study	jeff.davidson@surpriseaz.com	623 222 6131	16000 North Civic Center Plaza		Surprise	AZ	85374
Hobart Wingard	City of Surprise	HV Study	Hobart.wingard@surprizeaz.com	623 222 3000	16000 North Civic Center Plaza		Surprise	AZ	85374
Adam Copeland	City of Surprise	HV Study	Adam.Copeland@surpriseaz.com	623 222 3000	16000 North Civic Center Plaza		Surprise	AZ	85374
Debbi Shortal	FCDX	HV Study	dls@mail.maricopa.gov	602 506 1034	2801 W Durango		Phoenix	AZ	85009
Greg Jones	FCDX	HV Study	gli@mail.maricopa.gov	602 506 5537	2802 W Durango		Phoenix	AZ	85009
John Holmes	FCDX	HV Study	jwh@mail.maricopa.gov	602 506 3320	2803 W Durango		Phoenix	AZ	85009
Jon Loxley	FCDX	HV Study	jonloxley@mail.maricopa.gov	602 506 2956	2804 W Durango		Phoenix	AZ	85009
Amir Motamedi	FCDX	HV Study	amm@mail.maricopa.gov	602 506 2956	2805 W Durango		Phoenix	AZ	85009
Kevin Kammerzell	Atwell-Hicks	Rancho Mercado	kkammerzell@atwell-hicks.com	480 218 8831	4700 E. Southern Ave.		Mesa	AZ	85206

Table 2.2 – Property Ownership List

Happy Valley Channel – Ownership List

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-020-A

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-019

KAMARATA GEORGE J/ARLENE G TR
31208 N 61ST ST
CAVE CREEK, AZ 85331 USA
Parcel: 503-69-003-B

FIRST INTERSTATE BANK OF ARIZONA TR
P O BOX 13519
ARLINGTON, TX 76094 USA
Parcel: 503-55-016

SAFOU SANDERS
7294 N 68TH LN
GLENDALE, AZ 853031128 USA
Parcel: 503-54-003-E

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-006-C

RANCHO MERCADO INVESTMENT LTD
4417 NORTH SADDLEBAG TRAIL
SCOTTSDALE, AZ 852510000 USA
Parcel: 503-69-010-F

ESTRELLA FREEWAY LAKE PLEASANT LTD PTSHP
3010 E CAMELBACK RD
STE 100
PHOENIX, AZ 850164415 USA
Parcel: 503-54-006-J

KAMARATA FAMILY TRUST
31208 N 61ST ST
CAVE CREEK, AZ 853310000 USA
Parcel: 503-69-003-A

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-010-G

BOOKBINDER RONALD S/FLASH AND THE BOYS LLC ET
3200 N CENTRAL AVE STE 2000
PHOENIX, AZ 85012 USA
Parcel: 503-54-012

VOYAGER SURPRISE 20 LLC
6900 E SECOND ST
SCOTTSDALE, AZ 85251 USA
Parcel: 503-54-013-C

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-011-D

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-004

BOOKBINDER RONALD S/FLASH AND THE BOYS LLC ET
3200 N CENTRAL AVE STE 2000
PHOENIX, AZ 85012 USA
Parcel: 503-54-011-B

ACE PSP LLC
PO BOX 9356
PHOENIX, AZ 85068 USA
Parcel: 503-55-004

RAYIS YOUSIF/MAJDOLINE
9433 E VOLTAIRE
SCOTTSDALE, AZ 85260 USA
Parcel: 503-54-003-F

RANCHO MERCADO INVESTMENT
4417 NORTH SADDLEBAG TRAIL
SCOTTSDALE, AZ 852510000 USA
Parcel: 503-69-010-H

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-001

MAZIA STEVEN/DONNA
9914 1 57TH DR
GLENDALE, AZ 85302 USA
Parcel: 503-54-013-B

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-010-E

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-011-E

ROADRUCK SARAH TR
12906 W GEORGIA AVE
LITCHFIELD PARK, AZ 85340 USA
Parcel: 503-54-013-A

KUCZYK NICHOLAS/HELEN ANN TR
HC 03 BOX 305 M
PAYSON, AZ 85541 USA
Parcel: 503-56-002-H

MANDOU TOMA/MARIM
8143 W ELECTRA LN
PEORIA, AZ 853831697 USA
Parcel: 503-69-010-D

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-016

PLEASANT VALLEY INVESTMENTS LLC
8950 S 52ND ST STE 115
TEMPE, AZ 85284 USA
Parcel: 503-55-015-A

DAOUD DAVID J/REBECCA K
2883 E TULSA ST
CHANDLER, AZ 85225 USA
Parcel: 503-56-002-N

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-006-B

YARNELL J E/BRENDA/DAVID/GIBERSON J/LORTON A
R.R. 1 BOX 187
COWDEN, IL 62422 USA
Parcel: 503-56-001-A

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801W DURANGO ST
PHOENIX, AZ 85009 USA
Parcel: 503-69-018

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-69-002

PEPINO ROCCO & RENEE
228 E EL CAMINO DR
PHOENIX, AZ 85020 USA
Parcel: 503-56-002-S

DAY JOHN R & DAWN RAE
8002 W PINCHOT
PHOENIX, AZ 850330000 USA
Parcel: 503-56-002-E

PLEASANT VALLEY INVESTMENTS LLC
8950 S 52ND ST STE 115
TEMPE, AZ 85284 USA
Parcel: 503-55-015-B

SAFOU SANDERS G
6419 W SILVERSAGE LN
PHOENIX, AZ 85085 USA
Parcel: 503-54-003-D

WILLIAM LYON HOMES INC
8840 E CHAPARRAL RD STE 200
SCOTTSDALE, AZ 85250 USA
Parcel: 503-54-006-H

163RD & HAPPY VALLEY ROAD LLC
6721 W REDFIELD RD
PEORIA, AZ 85381 USA
Parcel: 503-56-001-B

Table 2.3 – List of Collected Reports and Electronic Files

Data ID	Document	Data Description	Media Type	Prepared By
	Altamira - Planned Area Development Amendment	PAD Narrative, Exhibits and ALTA	PDF File	CVL
	Happy Valley Channel Drainage Study Funding Agreement	signed agreement	PDF File	City of Surprise
	City of Surprise General Plan 2020 Exhibits	all exhibits within GP 2020	PDF File	City of Surprise
	Surprise Parks and Trails Master Plan	narrative, design guidelines and exhibits	PDF File	City of Surprise/EDAW
	SPA 2 Sewer Main Plans (30%)	preliminary plan and profile plans	PDF File	CMX
	SPA 2 Interceptor Sewer - Prelim Design Report	narrative	PDF File	CMX
	Surprise WWTP - Warranty Deed	deed with exhibits	PDF File	City of Surprise/Asante LLC
	Surprise WWTP - Site & Grading Plan	final plan	PDF File	Carollo
	Tierra Verde - CLOMR	narrative, exhibts and appendix	PDF File	CVL
	Tierra Verde East - Final Drainage Report	narrative, exhibts and appendix	PDF File	CVL
	Tierra Verde East Infrastructure - Final Drainage Report	narrative, exhibts and appendix	PDF File	CVL
	Tierra Verde West - Final Drainage Report	narrative, exhibts and appendix	PDF File	CVL
	Wittmann ADMS - Existing Conditions Update	HEC-1, HEC-RAS, Exhibits, Appendix	Various	DEI
	Tierra Verde Parcel 3 - ALTA		PDF File	Neil/McGill Consultants
	Tierra Verde West - ALTA	TV West 80 & TV West 10	PDF File	CVL
	Tierra Verde West - Lotting		CADD File	CVL
	Tierra Verde East - Lotting		CADD File	CVL
	Tierra Verde Parcel 3 - Lotting		CADD File	CVL
	Tierra Verde West - Prelim Landscape Plan	Plan sheet	PDF File	CVL
	Tierra Verde East - Prelim Landscape Plan	Plan sheet	PDF File	CVL
	Tierra Verde Parcel 3 - Prelim Landscape Plan	Plan sheet	PDF File	CVL
	Tierra Verde West - Pre-Plat	Plan sheet	PDF File	CVL
	Tierra Verde East - Pre-Plat	Plan sheet	PDF File	CVL
	Tierra Verde Parcel 3 - Pre-Plat	Plan sheet	PDF File	CVL
	Tierra Verde Parcel 3 - Prelim Grading Plan	Plan sheet	PDF File	CVL
	Tierra Verde Parcel 3 - Planned Area Development	PAD Narrative, Exhibits and Approval w/ Stips	PDF File	CVL
	Tierra Verde - Offsiter Water, Wastewater, Paving Plans		Various CADD File	CVL
	Wittmann ADMP - Volume AA		Various	Entellus
	Rancho Mercado - Master Drainage Report		Various	CMX
	Rancho Mercado - Pre-Plat		Various CADD Files & PDF	CMX
	Rancho Mercado - Siphon Improvement Plans (100%)	Plan set	PDF File	Davey-Cairo Eng
	Rancho Mercado - ALTA	State Land ALTA & RM ALTA	PDF File	CMX
	Rancho Mercado - Land Use Master Plan	From RM PAD	PDF File	LVA
	Rancho Mercado - Open Space and Trails Master Plan	From RM PAD	PDF File	LVA
	Rancho Mercado - Phasing Plan	From RM PAD	PDF File	LVA
	Rancho Mercado - Phase I Lotting Exhibit		PDF File	CMX
	Ranch Mercado - Density Table		PDF File	CMX
	Rancho Mercado - Annexation Boundary		PDF File	LVA
	Verdugo - Land Use Plan		PDF File	DEI
	Verdugo - Vicinity Map		PDF File	DEI
	Happy Valley DCR	GIS data, dtm, dxf, MrSid, shp		FCDMC
	Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects		PDF & Hard Copy	FCDMC
	Flood Protection Structure Types Handbook		Hard Copy	FCDMC
	Flood Protection methods		Hard Copy	FCDMC
	Wittmann ADMP - Final Scenery and Recreation resources Assessment Summary Report		PDF File	EDAW/AECOM
	Happy Valley Drainage DCR - Landscape Inventory & Analysis (LIA)		Hard Copy	FCDMC
	Updated Wittmann ADMP Hydrology Report - July 2005	Verify with Nathan (from 8/27/09 mtg)		FCDMC/Entellus

Table 2.4 – Surprise Trail Plan

Table 8 Trails Development Standards Table

	Regional Trail	Community Trail	Local Trail
Right of Way	50 feet minimum width, designed as naturalized open space as determined by the City.	30 feet minimum width, designed as naturalized open space as determined by the City.	15' Min.
Main Trail Width	12' (3' Shoulder)	8' (2' Shoulder)	6' (2' Shoulder)
Main Trail Surface	Concrete. No openings great than 1/2 inch per ADA.	Concrete. No openings great than 1/2 inch per ADA.	Concrete. No openings great than 1/2 inch per ADA.
Parallel Trail Width	5' with 3' shoulder non-paved	4' as appropriate	NA
Parallel Trail Surface	Stabilized decomposed granite.	Stabilized decomposed granite.	NA
Sight Distance	130' minimum. If unattainable, provide adequate signage.	50' minimum. If unattainable, provide adequate signage.	50' minimum. If unattainable, provide adequate signage.
Signage	As needed for safety, regulations and as desired for interpretation and wayfinding. (MUTCD)	As needed for safety, regulations and as desired for interpretation and wayfinding. (MUTCD)	As needed for safety, regulations and as desired for interpretation and wayfinding. (MUTCD)
Grades	5% maximum preferred. In special circumstances, up to 8.33% allowed, not to exceed 200' in length.	5% maximum preferred. In special circumstances, up to 8.33% allowed, not to exceed 200' in length.	5% maximum preferred. In special circumstances, up to 8.33% allowed, not to exceed 200' in length.
Cross slope	2% typical. (ADA)	2% typical. (ADA)	2% typical. (ADA)
Vertical Clearance	15' preferred. Adequate signage where clearance is shorter.	12' preferred. Adequate signage where clearance is shorter.	12' preferred. Adequate signage where clearance is shorter.
Radius at intersection of trails	100' minimum. Adequate signage where it is shorter. 40' minimum at tight corners and switchbacks.	80' Min.	25' Min.
Separation from Roadway	20' Min. (Unless authorized by City of Surprise)	8' Min. (Unless authorized by City of Surprise)	6' Min.
Trail Striping of Main Trail	Center lane striping where use levels warrant per AASHTO.	Center lane striping where use levels warrant per AASHTO.	At Intersections Only
Amenities	Restrooms and drinking fountains at strategic trailheads and parks. Benches, approximately 2 per mile. See Amenities Chart.	See Amenities List	See Amenities List

CHAPTER 3 – HYDROLOGY REPORT

3.1 EXISTING CONDITIONS METHOD DESCRIPTION

The Flood Control District of Maricopa County and the City of Surprise have identified the need to evaluate the existing and differing hydrologic studies in the vicinity of the Happy Valley Wash generally located near the intersection of 163rd Avenue and Happy Valley Road (alignment).

The purpose of this hydrologic report and analysis is to provide the existing conditions hydrology in the vicinity of the Happy Valley Wash in accordance with the project scope. The existing conditions hydrology analysis will evaluate several potential flow split locations not previously considered in the Wittmann ADMSU or in any FCDMC document. This would include the breach in the Happy Valley berm in Asante west of 163rd Avenue and the 163rd Avenue culvert near the Happy Valley Road (alignment). In addition, the existing conditions will incorporate the Asante Channel and the development of Asante Phase I and II. The existing conditions hydrology findings will become the baseline for the evaluation of the alternatives as part of the Design Concept Report. Another purpose of this report is to document the methodology, assumptions, and present the results of the hydrologic analysis. Peak flows for 100-year 24-hour storm were computed using the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 Version 4.1, dated June 1998. Two scenarios were modeled for the existing conditions. One scenario, "with berm," included modeling with the Happy Valley berm in place and functional. The second scenario, "without berm," removed the Happy Valley Wash berm and only considered the existing wash below the natural grade elevations located south of the berm.

The Happy Valley Channel Existing Conditions HEC-1 models were compiled using information from the Wittmann Area Drainage Master Study Update (ADMSU) prepared by Entellus in June 2005. With guidance from FCDMC staff, some modifications were made to the existing ADMSU HEC-1 model to reflect development since the completion of the ADMSU and correct some potential deficiencies identified by DEI Professional Services, LLC. These modifications included: updating subbasin boundaries, updating subbasin parameters, adding flow splits, and diversions for the construction of Desert Oasis and Jomax Road improvements. Additional modifications were made so both scenarios associated with the berm could be modeled. Watershed Modeling System (WMS) Version 7.1 was used to update the Green-Ampt and Clark Unit Hydrograph parameters for subbasins that were modified. The subbasin parameters for the Asante Phase I and Phase II were obtained from DEI Professional Services, LLC. DDMSW was used to update the Clark Unit Hydrograph parameters for the Asante Phase I and Phase II sbubasins.

The Happy Valley DCR Watershed extends north of the Central Arizona Project (CAP) canal. There are five CAP Canal overchutes that convey water south toward the Happy Valley Channel. Additional CAP Canal overchutes convey water south to the Asante Channel and McMicken Dam Outlet Channel. Flows from the CAP overchutes were obtained from the Wittmann (ADMSU) and areas north of the CAP are not shown since no modifications were made during this hydrologic update. The Happy Valley DCR Watershed has a drainage area of about 19.8 square miles south of the CAP Canal and is primarily located in the City of Surprise, Maricopa County, Arizona (Refer to Figure 3.1). It is located within portions of Township 4 North, Range 1 West (Sections 4, 5, 6, 7, 8, 9, 17, and 18), Township 4 North, Range 2 West (Sections 1, 2, 3, 10, 11, 12, 13, 14, 15, 23, and 24), Township 5 North Range 1 West (Sections 19, 30, 31, 32, and 33) and Township 5 North Range 2 West (Sections 23, 24, 25, 26, 27, 34, 35, and 36).

3.2 Existing Conditions Parameter Estimation

Hydrologic parameters were estimated using the FCDMC's methodology as outlined in the *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology* (Sabol et al., 1995). The following sections discuss the parameter estimation in detail.

3.2.1 Drainage Area Boundaries

Figure 3.2 and 3.3 show the subbasin delineation for the Happy Valley DCR Watershed below the CAP Canal with aerial photos and topo lines as their respective backgrounds. The drainage area is approximately 19.8 square miles south of the CAP Canal.

The Wittmann ADMSU subbasins and Asante Phase I and II subbasins were maintained wherever possible. However, seventeen subbasins were modified for this analysis (Refer to Figures 3.2 and 3.3). The subbasin delineation was performed with the aid of aerial photos and the Wittmann 2-foot topography provided by the FCDMC. The boundaries reflect the recent development in the watershed and are influenced by the location of roads and the Happy Valley berm. This study maintains the same subbasin naming convention used in the original study except for the seventeen modified subbasins. These seventeen modified subbasins were split from four subbasins PI624A, PI639A, WI524A, and PI621. These seventeen basins use the same prefix as the basin it was previously located within and the next available letter not used in the previous study except for an undeveloped portion of Asante Phase III and IV. For example, PI624B, PI624C, PI624D, PI624E, PI624F, PI624G, PI624H were part of PI624A in the original model.

3.2.2 Watershed Work Maps

Figure 3.4 shows the subbasin boundaries overlain on top of the soil map units, according to the Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona and

Maricopa County, Arizona, Central Part Soil Surveys. Figure 3.5 shows the land use designation obtained from the Wittmann ADMSU with one modification. This modification included changing the land use designation of the developed area of Desert Oasis from Vacant to Small Lot Residential – Single Family (4-6 dwelling units per acre).

3.2.3 Precipitation

The rainfall depth, rainfall distribution, and areal reduction were maintained from the Wittmann ADMSU. Precipitation depths for the 100-year 24-hour storm event were obtained from the NOAA Atlas 2. The SCS Type II 24-hour precipitation distribution was used. Areal reduction was performed using the JD record option of the HEC-1 and based on the NOAA HYDRO-40 curve provided in the Drainage Design Manual.

3.2.4 Physical Parameters

This section describes the methods used for estimation of the physical hydrologic parameters such as rainfall losses, the unit hydrograph, time of concentration, storage coefficient, and routing.

3.2.4.1 Rainfall Losses

The Green-Ampt infiltration equations were used within HEC-1 to estimate rainfall losses according to the procedures outlined in Sabol et al. (1995). WMS was used to calculate the logarithmic area averages of the hydraulic conductivities of each map unit within each sub-basin. WMS also selects the wetting front capillary suction (PSIF) and soil moisture deficit (DTHETA) using the average XKSAT value. After PSIF and DTHETA are calculated the XKSAT value was adjusted for vegetative cover.

A GIS based soils map of data from the SCS (now NRCS) Soil Survey of Aguila-Carefree area and Soil Survey of Maricopa County, Arizona-Central Part was obtained from the FCDMC for input into WMS. The soil characteristics map unit values that were used in WMS to compute the rainfall losses were obtained from the Wittmann ADMSU and are found in Appendix A.1.

The surface retention losses, percent impervious, and vegetation cover for each land use type are estimated based on Sabol et al. (1995) and the Wittmann ADMSU Land Use with updated information to more accurately reflect the Desert Oasis area. The values used for surface retention loss values, percent impervious, and vegetation cover were obtained from the Wittmann ADMSU and are shown in Appendix A.2.

The soil and land use data are used by WMS to compute the Green-Ampt rainfall loss parameters for each subbasin. The Green-Ampt rainfall loss parameters for the seventeen modified subbasins are found in Table 3.1.

Table 3.1 Green-Ampt Parameters

BASIN	IA (in)	DTHETA	PSIF	XKSAT (in/hr)	RTIMP (%)
PI624B	0.43	0.25	4.30	0.53	2.2
PI624C	0.35	0.25	4.69	0.32	5.0
PI624D	0.36	0.26	4.45	0.40	4.5
PI624E	0.25	0.25	4.55	0.42	35.0
PI624F	0.35	0.25	4.55	0.35	5.0
PI624G	0.35	0.25	4.55	0.35	5.0
PI624H	0.35	0.25	4.55	0.35	5.0
PI621A	0.35	0.25	4.55	0.35	5.0
PI621B	0.35	0.25	4.55	0.35	5.0
PI621C	0.35	0.25	4.65	0.33	5.4
PI624A	0.34	0.34	4.55	0.35	3.0
PI639A	0.35	0.35	4.50	0.35	0
WI524A	0.35	0.35	4.40	0.37	0
3A	0.35	0.35	4.60	0.33	0
4A	0.35	0.35	4.55	0.34	0
4B	0.35	0.36	5.00	0.27	0
PI624	0.35	0.35	4.80	0.29	0

3.2.4.2 UNIT HYDROGRAPH METHOD

The Clark Unit Hydrograph method documented in Sabol et al. (1995) was used to compute the unit hydrographs. The time of concentration (T_c) and storage coefficient (R) were computed by WMS or DDMSW. They can be found on the UC records in the HEC-1 models.

3.2.4.3 TIME OF CONCENTRATION

Time of concentration was calculated using the following equation:

$$T_c = 11.4L^{0.50}K_b^{0.52}S^{-0.31}i^{-0.38}$$

where T_c is the basin's time of concentration in hours and

L = length of longest flow path in miles,

K_b = watershed resistance coefficient,

S = watercourse slope in feet/mile,

i = the average rainfall excess intensity, during the time T_c in inches/hour.

3.2.4.4 STORAGE COEFFICIENT

Storage coefficient was calculated using the following equation:

$$R = 0.37T_c^{1.11}A^{-0.57}L^{0.80}$$

where R is the basin's storage coefficient in hours and

T_c = time of concentration, in hours,

A = drainage area, in square miles,

L = length of flow path, in miles.

Table 3.2 – Sub-Basin Time of Concentration and Storage Coefficient Parameters

Basin	Area (sq mi)	L (mi)	K_b Type	Slope (ft/mi)	100-YR 24-HR T_c (hr)	100-YR 24-HR R (hr)
PI624B	0.098	0.86	B	46.7	0.558	0.644
PI624C	0.372	1.29	B	37.3	0.675	0.515
PI624D	0.323	1.55	B	42.6	0.783	0.763
PI624E	0.257	0.64	A	42.2	0.250	0.121
PI624F	0.060	0.66	B	36.2	0.492	0.603
PI624G	0.074	0.54	B	37.3	0.417	0.375
PI624H	0.075	0.81	B	42.0	0.521	0.663
PI621A	0.167	1.03	B	39.0	0.608	0.603
PI621B	0.035	0.45	B	44.6	0.362	0.427
PI621C	0.701	1.18	B	33.9	0.621	0.305
PI624A	1.306	2.51	B	42.2	0.861	0.562
PI639A	0.095	0.66	B	39.6	0.554	0.527
WI524A	0.599	1.55	B	40.0	0.758	0.517
3A	0.046	0.30	B	40.3	0.387	0.285
4A	0.185	0.82	B	34.1	0.621	0.486
4B	0.375	0.92	B	32.5	0.626	0.360
PI624	0.452	1.59	B	22.6	0.915	0.764

3.2.4.5 CHANNEL ROUTING PATH PARAMETERS

The normal depth storage-outflow channel routing is used to route runoff hydrographs through subbasins. The channel routing parameters include NSTEPS (the number of sub-reaches to be divided for the routing reach by HEC-1), initial outflow, left bank Manning's n, right bank Manning's n, main channel Manning's n, reach length, energy slope for the routing reach, and eight-point cross section X-Y data. The initial outflow is set at the initial inflow which is usually 0.0 cfs, implying that there is no flow in the channel when routing starts. The Manning's n values were maintained from the Wittmann ADMSU or Asante Phase I and II except in the Happy Valley Wash where the n values were changed to match the n values in the DEI HEC-RAS analysis. The eight-point cross section data were obtained using the provided 2-foot topographic information where not available from the Wittmann ADMSU or Asante. The reach length and channel bed slope were computed for the new routing reaches. The channel bed slope is used for energy slope because one of the assumptions for using Manning's equation is uniform flow (energy slope equals channel bed slope). The routing length, slope, and Manning's n values are shown in Table 3.3.

Table 3.3 – Channel Routing Summary

Reach	Reach Length (ft)	Slope (ft/ft)	LOB n value	Channel n value	ROB n value
RX624B	2000	0.006	0.043	0.035	0.043
RX624D	3854	0.006	0.043	0.035	0.043
RD624D	3140	0.008	0.043	0.035	0.043
RD624E	2793	0.007	0.043	0.035	0.043
RD624G	442	0.0068	0.056	0.025	0.056
RD624H	1534	0.0026	0.056	0.025	0.056
RD612	4537	0.0066	0.043	0.035	0.043
RD621A	1587	0.0038	0.056	0.025	0.056
RD621B	342	0.0038	0.056	0.025	0.056
R609-1	1523	0.0038	0.056	0.025	0.056
R609-2	1300	0.0038	0.056	0.025	0.056
R609-3	2449	0.0038	0.056	0.025	0.056
RDHVC1	3750	0.0069	0.043	0.035	0.043
RDHVC2	3091	0.0065	0.043	0.035	0.043
RD624B	6800	0.007	0.043	0.035	0.043
R621A1	1044	0.0038	0.043	0.035	0.043
R621A2	543	0.0038	0.043	0.035	0.043
RPI609	4513	0.0062	0.043	0.035	0.043
R6092N	2449	0.0038	0.043	0.035	0.043
RDHVC3	6823	0.0073	0.043	0.035	0.043
RDHVC4	6229	0.0064	0.043	0.035	0.043
RDHVC5	5105	0.0074	0.043	0.035	0.043
RPI628	7825	0.0077	0.043	0.035	0.043
R624A	680	0.0050	0.035	0.035	0.035

3.2.4.6 RETENTION

The retention was incorporated into the model for portions of Desert Oasis that have developed and have 100-year 2-hour retention consistent with City of Surprise requirements. A retention efficiency factor of 80% was applied to retention volume provided.

3.2.4.7 RESERVOIR ROUTING PARAMETERS

Areas with potential for ponding and stage-storage-discharge relationships were maintained from the Wittmann ADMSU. These included areas north of the CAP Canal and the Beardsley Canal.

3.2.4.8 Split Flows

There are several flow splits located within the Happy Valley DCR Watershed. The existing flow splits between the CAP Canal and the Happy Valley Channel were maintained from the Wittmann ADMSU. There are two flow splits associated with culverts on Jomax Road associated with Desert Oasis. These were identified previously by DEI. There is a 36" culvert located just east of the 171st Avenue Channel and west of the Desert Oasis tank site. DEI estimates this culvert conveys 47 cfs and any additional flow is diverted east along the north side of Jomax Road. There is also an existing 3 barrel, 8 ft x 4 ft box culvert that has capacity but the downstream channel creates a bottleneck. The HEC-RAS model estimates this capacity at 380 cfs and any remaining flow is directed east along Jomax Road. This diversion was included in the model but does not divert flow for the 100-year 24-hour storm due to the small tributary area.

Two new flow split locations were identified through the DCR process. These include the breach in the Happy Valley berm located in Asante (west of 163rd Avenue) and the 163rd Avenue and Happy Valley Road culvert. Additional survey data was obtained to perform a HEC-RAS lateral weir analysis at these two locations. The Asante Happy Valley berm breach has a 100-year 24-hour peak flow of 346 cfs with 235 cfs going through the breach and 111 cfs continuing east toward the 163rd Avenue / Happy Valley Road culvert. The 163rd Avenue / Happy Valley Road culvert was modeled in HEC-RAS and 60 cfs of the 405 cfs spills out of the channel and heads south down the west side of 163rd Avenue. Refer to Appendix A.4 for the survey data and the HEC-RAS analysis.

There are multiple flow splits located along the Happy Valley Wash berm. DEI prepared two HEC-RAS models of the Happy Valley Wash, one with the berm in place and functional and one without the berm. Refer to Appendix A.4 for the DEI results for comparison purposes. The DEI HEC-RAS model formed the basis for the flow splits used in the HEC-1 model for this DCR. The flows were updated based on the 100-year 24-hour flow computed as part of this study and the HEC-RAS models rerun to determine the flow splits based on the lateral weirs. The 100-year 6-hour was not run for this project but could generate higher flows at CP624H. As a result, a flow split may occur near the intersection of 163rd Avenue and Happy Valley Road for the with berm scenario and the flow split directed south may be higher at this location for the without berm scenario. Hard coding of the drainage area at concentration points downstream of diversions was used to account for the percentage of the area associated with the diversion since JD records and areal reduction were used. This method was used to maintain consistency between this study and the ADMSU.

3.3 Problems Encountered During the Study

3.3.1 Special Problems and Solutions

The Asante berm breach under existing conditions results in higher flows at C624 than DEI has shown for Asante. The plans for Asante Phase III and IV propose the elimination of this breach and direct the flows east to the Happy Valley Wash. The future conditions model incorporates DEI's data for Phase III and IV but the existing conditions model does not because Phase III and IV have not been constructed.

The split flow analysis was performed using the HEC-RAS models from DEI and updating them with the 100-year 24-hour flows. However, the "without berm" condition HEC-RAS model could not converge with the new flows. The lateral weirs were split to isolate the split flow locations. These modifications allowed the model to converge but the results did not maintain continuity of flow. To estimate the split flows, the model was run to determine the flow split near 163rd Avenue. Next, the model was truncated to eliminate the upstream flow split and the inflow was entered with the updated concentration point flows from the HEC-1 model with the first flow split. Each split flow area was analyzed separately moving down the channel with the results from the previous lateral weir calculations as the inflow and using the updated results from the HEC-1 model at concentration points. This approach seems to give reasonable results and maintains continuity.

Two routing reaches, RD624G and RD621B, had a minor increase in flow (1-3 cfs) for the "without berm" model. This is caused by the short routing distance and the five minute model interval. The model interval was not changed to maintain consistency between the Wittmann ADMSU since the increases are miniscule and do not alter the results.

3.3.2 Modeling Warning and Error Messages

The HEC-1 model did not contain any error messages. There are three types of warning messages. The first is as follows: "Warning Excess at Ponding Less Than Zero For Period. Excess Set To Zero".

This warning appears when a negative value for ponding occurs, which happens when the soil infiltration is greater than runoff. The model automatically corrects this by setting the negative value to zero.

The second warning is as follows: "Warning Modified Puls Routing May Be Numerically Unstable For Outflows Between (Value) To (Value)".

The third warning is as follows: "Warning Routed Outflow (Value) Is Greater Than Maximum Outflow (Value) In Storage-Outflow Table". This warning is from the routing of R4B and R1.5B obtained from Asante. The additional flow from Asante Berm breach and 163rd Avenue culvert cause these channels to exceed their capacity.

3.4 EXISTING CONDITIONS FINAL RESULTS

Table 3.4 shows a comparison between the Wittmann ADMSU concentration points and two existing conditions scenarios associated with this study. The detailed results can be found in the HEC-1 output files.

Table 3.4 – Sub-Basin Hydrologic Analysis Results

Drainage ID	Wittmann ADMSU 100-YR 24-HR Q (cfs)	Happy Valley Channel With Berm 100-YR 24-HR Q (cfs)	Happy Valley Channel Without Berm 100-YR 24-HR Q (cfs)
CPI618	629	629	629
CPI615	701	701	701
CPI612	1406	1406	1406
CP624D	N/A	217	217
CP624E	N/A	259	259
CP624G	N/A	405	405
CP624H	N/A	405	405
CP621A	N/A	1409	1317
CP621B	N/A	1399	607
CPI609	1197	2466	1740
CPI606	701	2098	1026
C606A	363	363	363
CPI604	321	321	321
CPI603	2450	3452	2857
C600A	1288	930	1277
CPI621 (PI621C)	1200	830	929
C624A (CP624C)	2060	346	346
CWI525	1614	1614	1614
CPI628	750	750	750
C624A	N/A	1500	1500
C639A	N/A	1550	1550
C524A	N/A	1768	1768

Drainage ID	Wittmann ADMSU 100-YR 24-HR Q (cfs)	Happy Valley Channel With Berm 100-YR 24-HR Q (cfs)	Happy Valley Channel Without Berm 100-YR 24-HR Q (cfs)
C2.8	N/A	1776	1776
C2.6	N/A	1759	1759
CWI524	712	1766	1766
CPI639	173	353	353
CWI506	2340	3353	3353
CWI500	23146	23515	23515
CPI635	2908	3017	3017
C1.14B	N/A	204	204
C1.15B	N/A	217	217
C1.17B	N/A	236	236
C636	384	233	233
C624	N/A	549	549
CPI624	1837	989	989
CPI633	3906	3016	3339
CPI600	4434	4146	4143

3.5 PREFERRED ALTERNATIVE HYDROLOGY

The Happy Valley DCR Preferred Alternative – *Flow Split with Basin*, consists of a series of improved conveyance channels running along the north side of the planned Happy Valley Road and the east side of 155th Avenue. One detention basin is proposed to be located at the southerly terminus of 155th Avenue just north of the Beardsley Canal.

The improved conveyance channel along the north side of Happy Valley Road expands in size and capacity as it collects contributing flows from Wash 5, 6, and 9 as it flows easterly from 163rd Avenue to 155th Avenue. Three conveyance channel sizes/sections make up this one mile length of channel. Section 3 of the Happy Valley Channel is the largest and carries approximately 2,450 cfs.

A designed flow split at 155th Avenue would direct approximately 1,730 cfs or 70% of the flows south (an approximate representation of historic flow patterns without the berm in place) into a new conveyance channel proposed along the east side of 155th Avenue. The remaining 30% flows (approximately 720 cfs) will continue in a smaller improved conveyance channel extending

from the flow split at 155th Avenue to the terminus of the improved conveyance channel section at its confluence with Wash 10. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal.

The 155th Avenue flows would outlet into an approximate 53-acre detention basin that would attenuate flows and bleed off larger events along the northerly edge of the Beardsley Canal towards the existing overchute. Contributing flows from both the Happy Valley Channel and the detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year storm.

The Preferred Alternative hydrology model is the existing conditions with the Preferred Alternative in place. In other words, the existing conditions model was updated to include the Preferred Alternative with no additional development. The five channel sections were incorporated into the HEC-1 model and used for routing the peak flows through the Preferred Alternative. Also, the proposed detention basin volumes were added to the Preferred Alternative HEC-1 model. Refer to the Appendix A.3 for the HEC-1 model. Figure 3.7 shows peaks flows for the existing conditions with the Preferred Alternative in place.

3.6 Future Conditions Hydrology

The Future Conditions hydrology model includes future conditions with the Preferred Alternative in place. The Wittmann ADMSU future conditions model and the Preferred Alternative Hydrology model were used to create the Future Conditions Hydrology HEC-1 model. In addition, Asante Phase III and IV were included to reflect Asante's plan for development. The Green-Ampt parameters for the seventeen basins that were modified as part of this DCR were updated based on the future land use map from the Wittmann ADMSU using DDMSW. The remaining basin data was obtained from the Wittmann ADMSU future conditions model or the Asante Phases I, II, III, and IV HEC-1 models. Retention was added for subbasins located within the Tierra Verde, Verdugo, Alta Mira, and Rancho Mercado developments. A retention efficiency factor of 80% was applied to retention volume provided.

Refer to the Appendix A.3 for the HEC-1 model. Figure 3.8 shows peaks flows for the future conditions with the Preferred Alternative in place. The results show the future conditions have higher peak flows for several components of the Preferred Alternative. The future conditions model did not account for retention provided by future development which should decrease the peak flows. During the design stage this should be evaluated since the Preferred Alternative was sized for the existing condition hydrology.

References

DEI Professional Services, LLC (February 2007), "Master Drainage Report for Asante Including Phases III and IV" prepared for Lennar Communities Development, Inc.

DEI Professional Services, LLC (June 2008), "Happy Valley Channel and It's Tributaries:Wash 5 East, Wash 6 East South and Wash 9 East Wittmann ADMS Update Existing Conditions Update" prepared for Beazer Homes Holdings Corp.

Entellus (July 2005) "Wittmann Area Drainage Master Study Update Hydrology Addendum prepared for the Flood Control District of Maricopa County.

Hydrologic Engineering Center (1991), "HEC-1 Flood Hydrograph Package, User's Manual," US Army Corps of Engineers.

Sabol, G. V., Rumann, J. M., Khalili, D., Waters, S. D., and T. Lehman (January, 1995). "Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology," prepared for Flood Control District of Maricopa County.

United States Department of Agriculture, Soil Conservation Service (April 1986), Soil Survey of Aguila-Carefree Area.

United States Department of Agriculture, Soil Conservation Service (April 1986), Soil Survey of Maricopa County, Arizona-Central Part.

Figure 3.1 – Location Map

Happy Valley DCR
Location Map
Figure 3.1

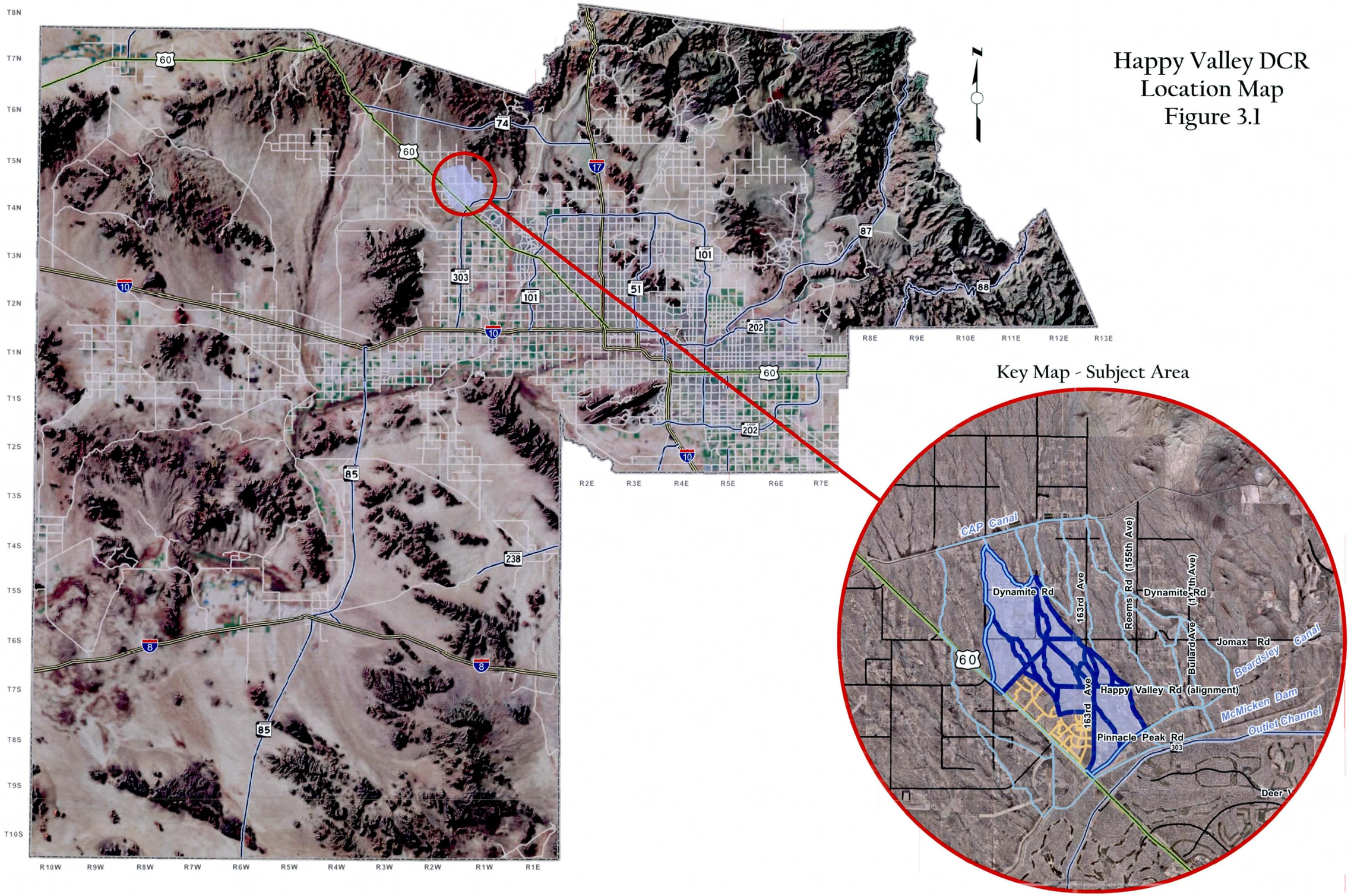


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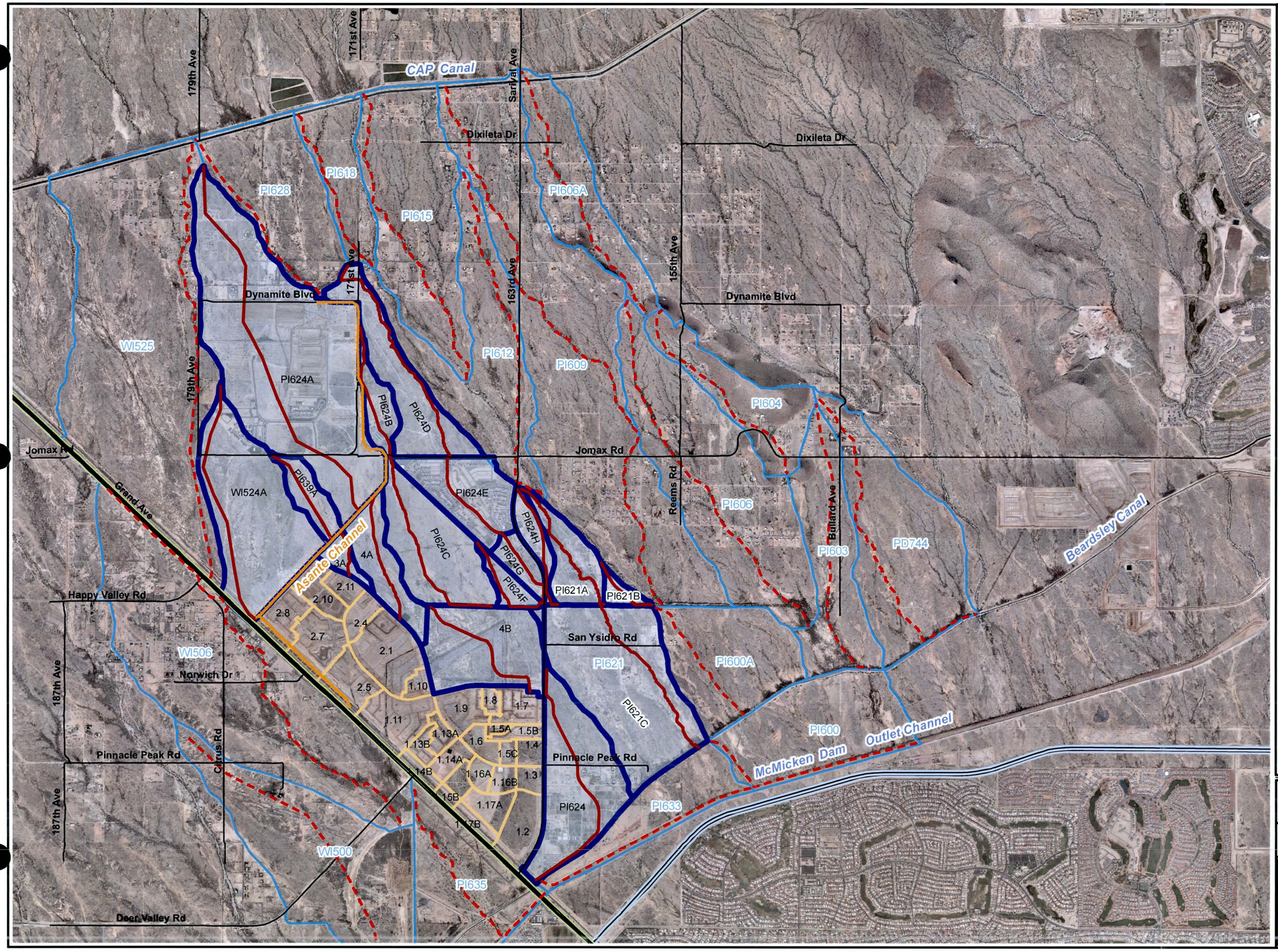
Figure 3.2 – Sub-Basin Boundaries w/Aerial



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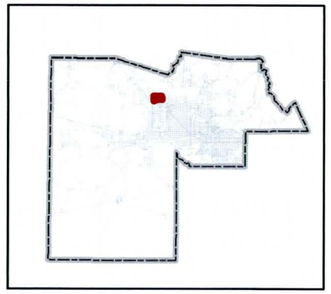

Happy Valley DCR

Legend

- Revised TOC
- Wittmann ADMSU TOC
- Revised Sub-Basin Boundary
- Wittmann ADMSU Sub-Basin Boundary
- Asante Basins

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries W/Aerial

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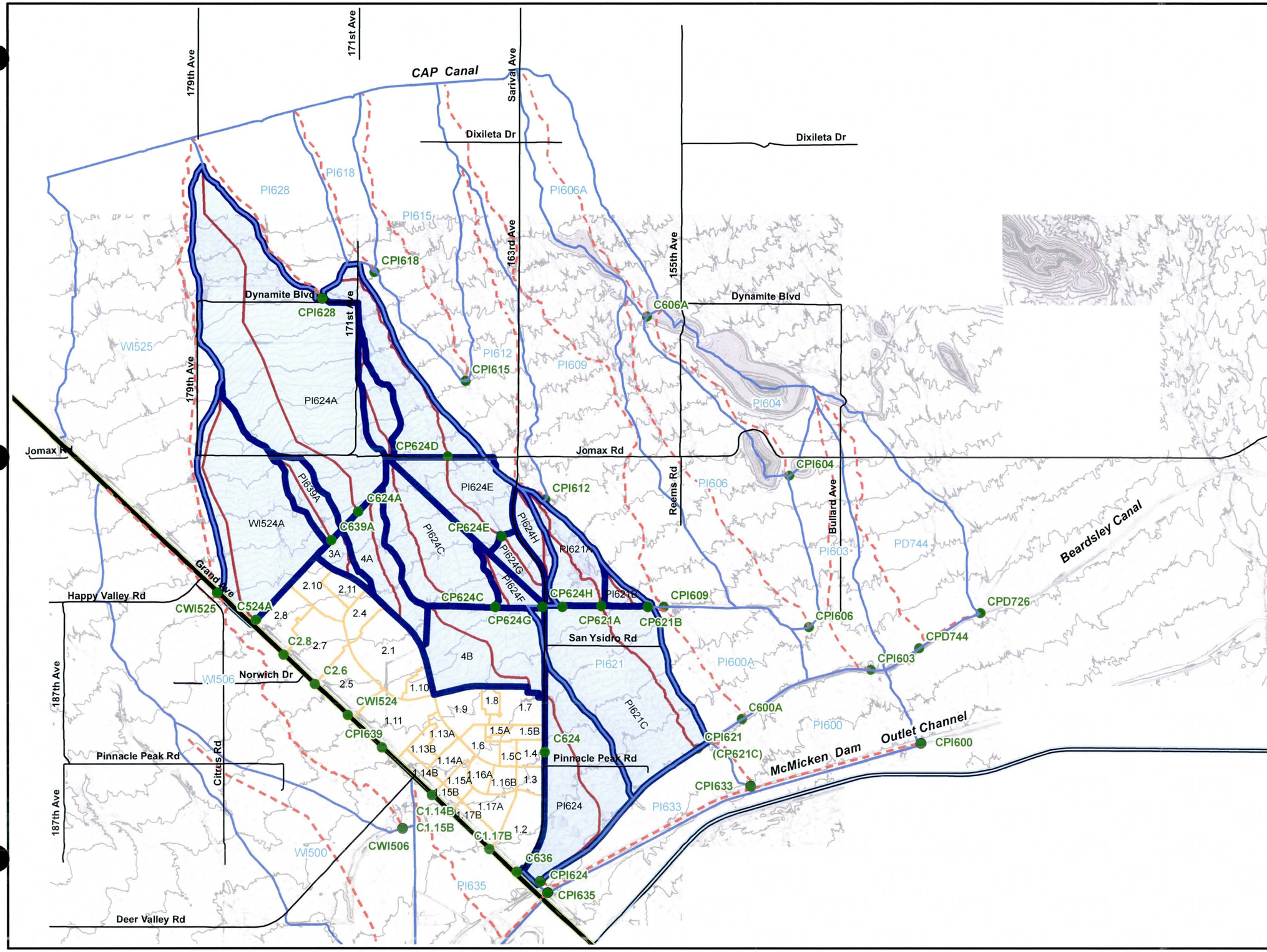
FIGURE 3.2

File: H:\PDATA\45104030\GIS\DCR_Exhibits\Sub_Basin_Boundaries_Aerial.mxd

Figure 3.3 – Sub-Basin Boundaries & Topo



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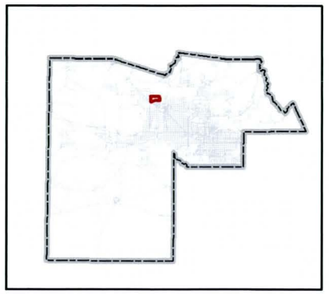

Happy Valley DCR

Legend

- Wittmann ADMSU Sub-Basin Boundary
- Revised Sub-Basin Boundary
- Asante Basins
- Revised TOC
- Wittmann ADMSU TOC
- Wittmann ADMSU CP & ID
- 10 ft Contours
- 2 ft Contours

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Topo

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FIGURE 3.3

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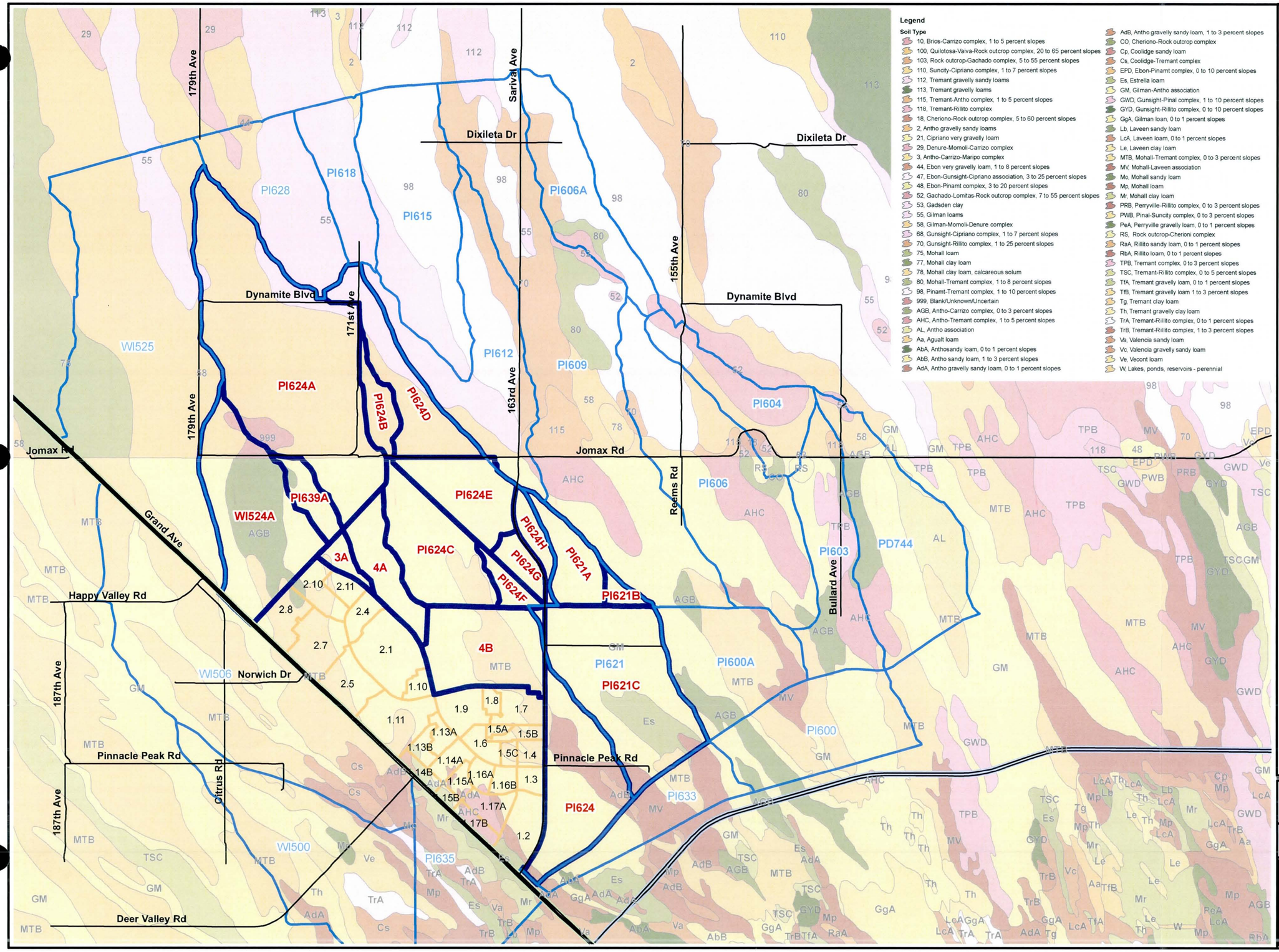
Figure 3.4 – Sub-Basin Boundaries & Soil Type



Legend

Soil Type

- 10, Brios-Carrizo complex, 1 to 5 percent slopes
- 100, Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes
- 103, Rock outcrop-Gachado complex, 5 to 55 percent slopes
- 110, Suncity-Cipriano complex, 1 to 7 percent slopes
- 112, Tremant gravelly sandy loams
- 113, Tremant gravelly loams
- 115, Tremant-Antho complex, 1 to 5 percent slopes
- 118, Tremant-Rillito complex
- 18, Cheriono-Rock outcrop complex, 5 to 60 percent slopes
- 2, Antho gravelly sandy loams
- 21, Cipriano very gravelly loam
- 29, Denure-Momoli-Carrizo complex
- 3, Antho-Carrizo-Maripo complex
- 44, Ebon very gravelly loam, 1 to 8 percent slopes
- 47, Ebon-Gunsight-Cipriano association, 3 to 25 percent slopes
- 48, Ebon-Pinamt complex, 3 to 20 percent slopes
- 52, Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes
- 53, Gadsden clay
- 55, Gilman loams
- 58, Gilman-Momoli-Denure complex
- 68, Gunsight-Cipriano complex, 1 to 7 percent slopes
- 70, Gunsight-Rillito complex, 1 to 25 percent slopes
- 75, Mohall loam
- 77, Mohall clay loam
- 78, Mohall clay loam, calcareous solum
- 80, Mohall-Tremant complex, 1 to 8 percent slopes
- 98, Pinamt-Tremant complex, 1 to 10 percent slopes
- 999, Blank/Unknown/Uncertain
- AGB, Antho-Carrizo complex, 0 to 3 percent slopes
- AHC, Antho-Tremant complex, 1 to 5 percent slopes
- AL, Antho association
- Aa, Aguait loam
- AbA, Anthosandy loam, 0 to 1 percent slopes
- AbB, Antho sandy loam, 1 to 3 percent slopes
- AdA, Antho gravelly sandy loam, 0 to 1 percent slopes
- AdB, Antho gravelly sandy loam, 1 to 3 percent slopes
- CO, Cheriono-Rock outcrop complex
- Cp, Coolidge sandy loam
- Cs, Coolidge-Tremant complex
- EPD, Ebon-Pinamt complex, 0 to 10 percent slopes
- Es, Estrella loam
- GM, Gilman-Antho association
- GWD, Gunsight-Pinal complex, 1 to 10 percent slopes
- GYD, Gunsight-Rillito complex, 0 to 10 percent slopes
- GgA, Gilman loan, 0 to 1 percent slopes
- Lb, Laveen sandy loam
- LcA, Laveen loam, 0 to 1 percent slopes
- Le, Laveen clay loam
- MTB, Mohall-Tremant complex, 0 to 3 percent slopes
- MV, Mohall-Laveen association
- Mo, Mohall sandy loam
- Mp, Mohall loam
- Mr, Mohall clay loam
- PRB, Perryville-Rillito complex, 0 to 3 percent slopes
- PWB, Pinal-Suncity complex, 0 to 3 percent slopes
- PeA, Perryville gravelly loam, 0 to 1 percent slopes
- RS, Rock outcrop-Cherioni complex
- RaA, Rillito sandy loam, 0 to 1 percent slopes
- RbA, Rillito loam, 0 to 1 percent slopes
- TPB, Tremant complex, 0 to 3 percent slopes
- TSC, Tremant-Rillito complex, 0 to 5 percent slopes
- TfA, Tremant gravelly loam, 0 to 1 percent slopes
- TfB, Tremant gravelly loam 1 to 3 percent slopes
- Tg, Tremant clay loam
- Th, Tremant gravelly clay loam
- TrA, Tremant-Rillito complex, 0 to 1 percent slopes
- TrB, Tremant-Rillito complex, 1 to 3 percent slopes
- Va, Valencia sandy loam
- Vc, Valencia gravelly sandy loam
- Ve, Vecont loam
- W, Lakes, ponds, reservoirs - perennial

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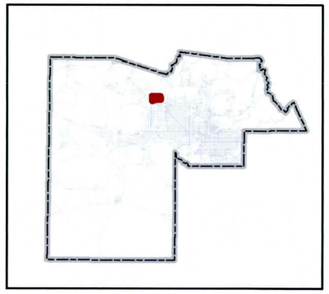

Happy Valley DCR

Legend

- Major Roads
- Wittmann ADMSU Sub-Basin Boundary
- Revised Sub-Basin Boundary
- Asante Basins

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Soil Type

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FIGURE 3.4

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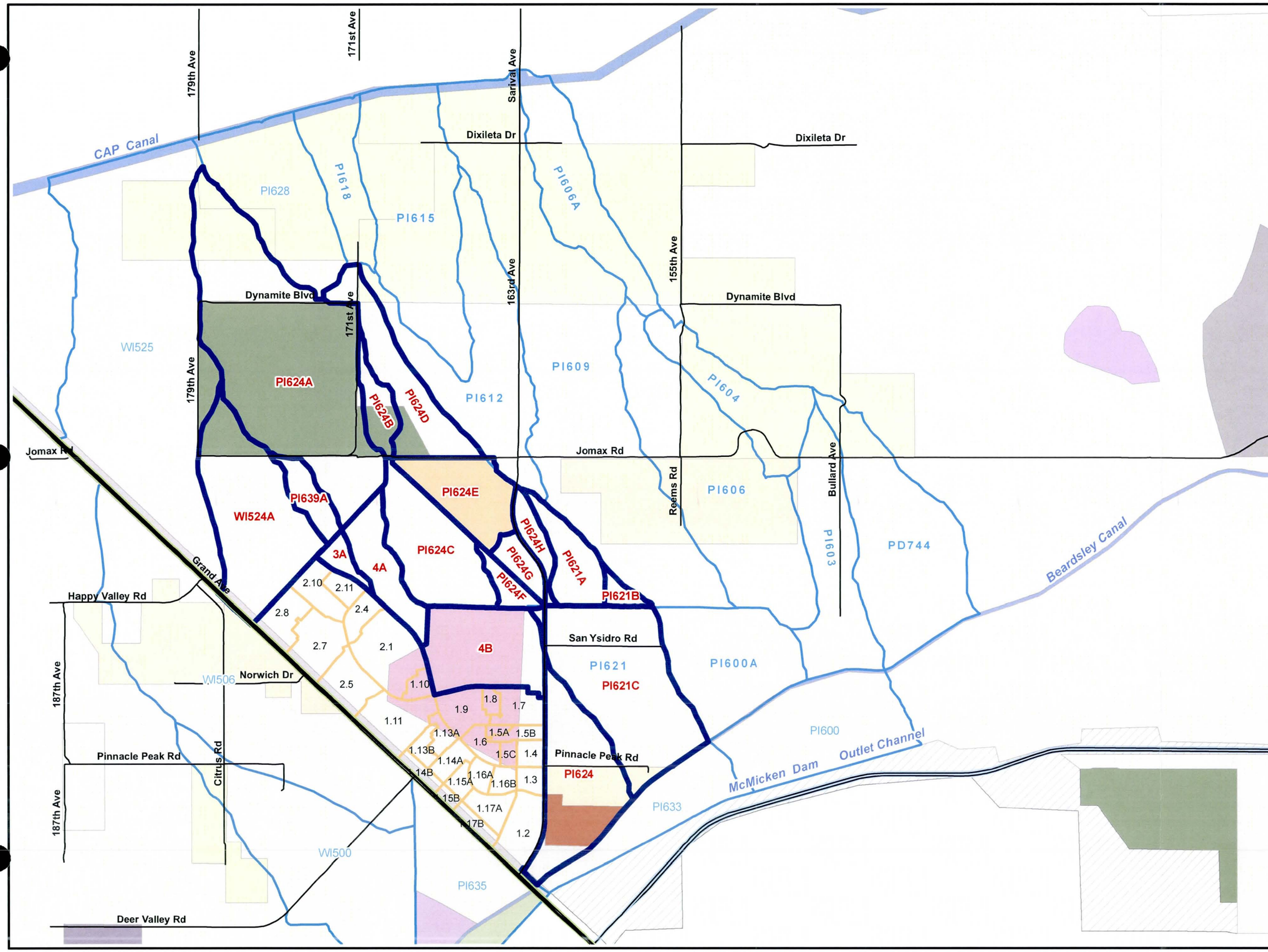
Figure 3.5 – Sub-Basin Boundaries & Land Use



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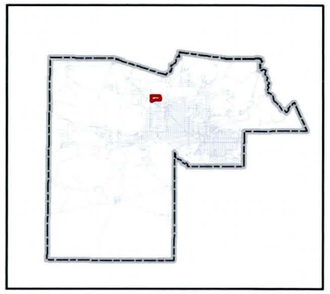

Happy Valley DCR

Legend

- Major Roads
- Revised Sub-Basin Boundary
- Wittmann ADMSU Sub-Basin Boundary
- Asante Basins
- Passive Open Space
- Agriculture
- Rural Residential
- Estate Residential
- SF - Large Lot Residential
- SF - Small Lot Residential
- Specialty Commercial
- General Industrial
- Industrial
- Warehouse/Distribution Centers
- Airports
- Transportation
- Other Employment
- Vacant
- Graded Land
- Water

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Land Use

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FIGURE 3.5

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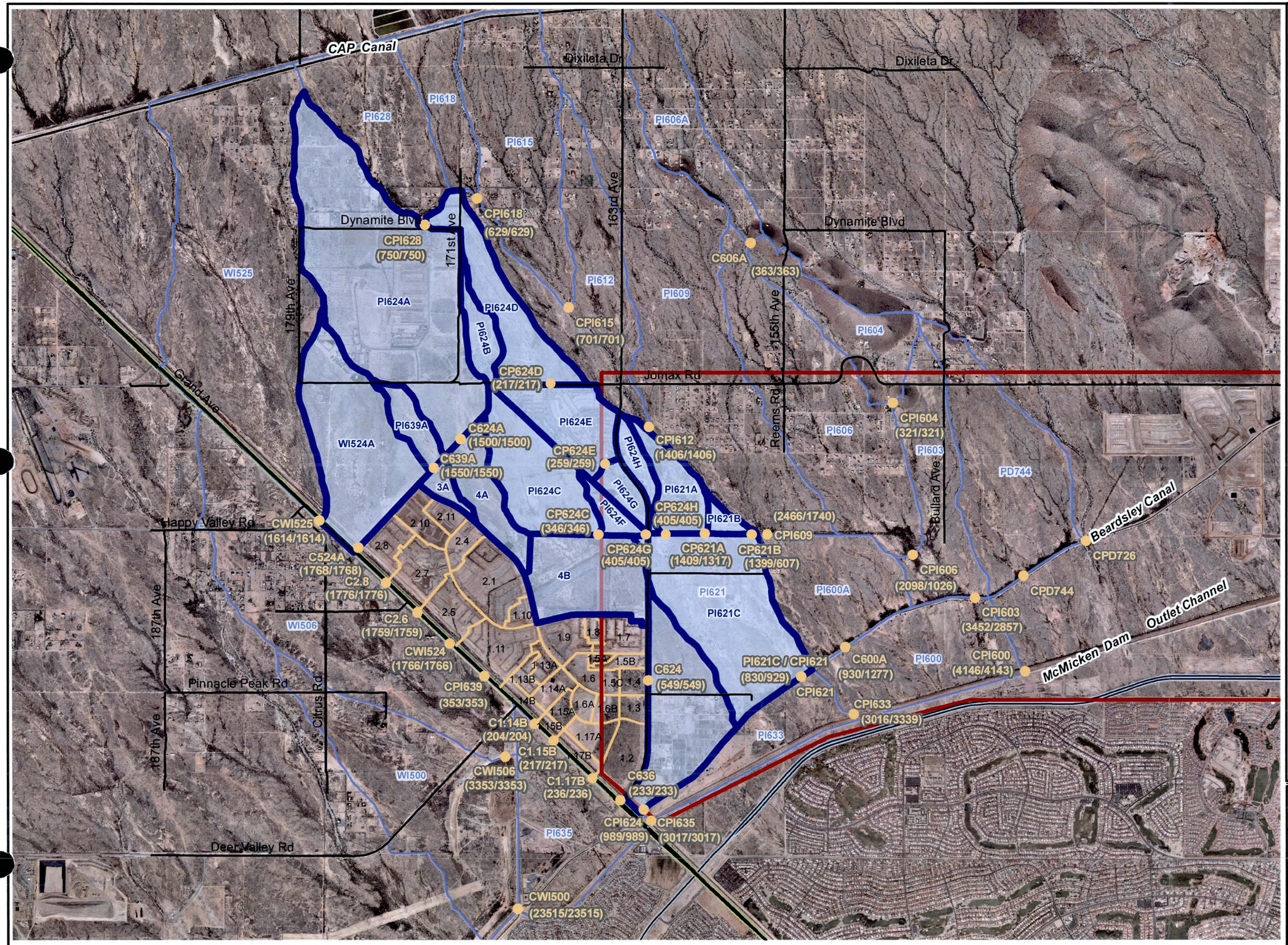
Figure 3.6 – Sub-Basin Boundaries & Hydrologic Results



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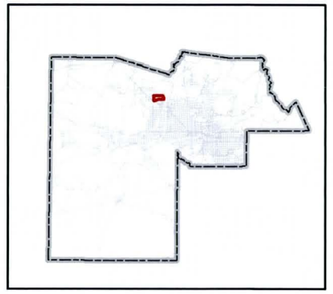

Happy Valley DCR

Legend

- Concentration Point & ID
- Study Area Limits
- Asante_Basins
- Wittmann ADMSU Sub-Basin Boundary
- Revised Sub-Basin Boundary

(701/701) 100-Yr 24-Hr Flow (with Berm cfs/ without Berm cfs)

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Hydrologic Results

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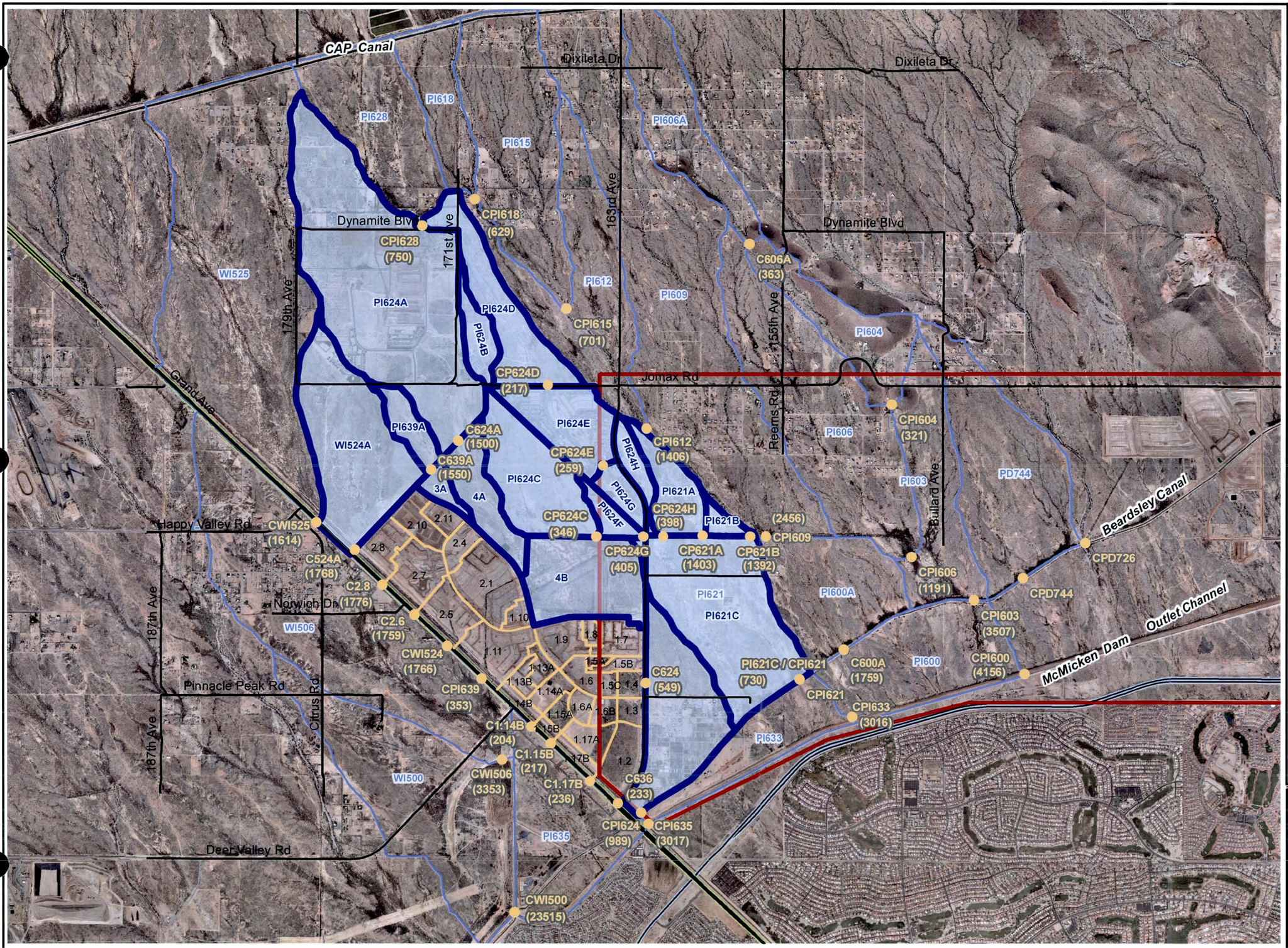
FIGURE 3.6

File: H:\PDATA\45104030\GIS\DCR_Exhibits\Sub_Basin_Boundaries_Hydro.mxd

Figure 3.7 – Sub-Basin Boundaries & Hydrologic Results Preferred Alternative Existing Conditions



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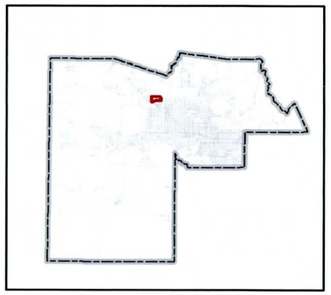

Happy Valley DCR

Legend

- Concentration Point & ID
- Study Area Limits
- Asante_Basins
- Wittmann ADMSU Sub-Basin Boundary
- Revised Sub-Basin Boundary
- (701) 100-Yr 24-Hr Flow

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Hydrologic Results Preferred Alternative Existing Conditions

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DATE 12.07.10

FIGURE 3.7

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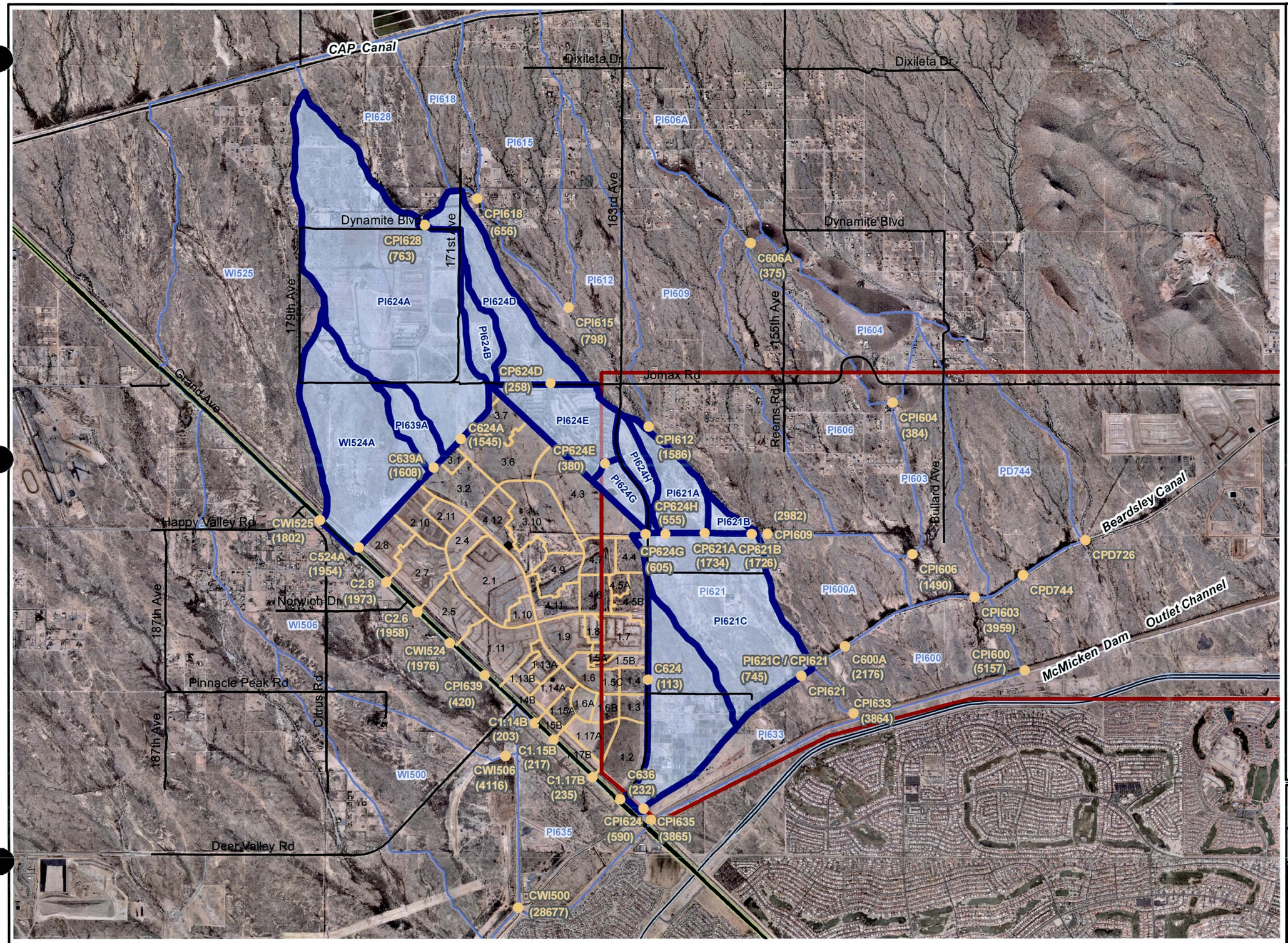
Figure 3.8 – Sub-Basin Boundaries & Hydrologic Results Preferred Alternative Future Conditions



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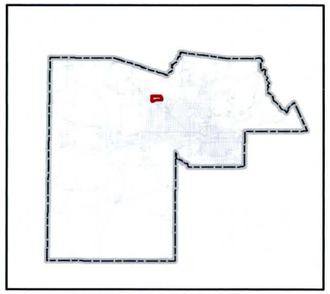

Happy Valley DCR

Legend

- Concentration Point & ID
- Revised_Basins_Final_Merge_FC
- Study Area Limits
- Asante_Basins
- Wittmann ADMSU Sub-Basin Boundary
- (701) 100-Yr 24-Hr Flow

0 750 1,500 3,000 Feet

1 inch = 3,000 feet

Sub-Basin Boundaries & Hydrologic Results Preferred Alternative Future Conditions

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FIGURE 3.8

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CHAPTER 4 – PROPOSED ALTERNATIVES REPORT

4.1 FORMULATION OF PROPOSED ALTERNATIVES

This Proposed Alternatives Report is designed to introduce the reader to the five (5) Proposed Alternatives, including No Action, currently being considered by the Project Stakeholders as part of the Happy Valley Design Concept Report (DCR) process. Each of the following Proposed Alternatives will be evaluated by the District and Project Stakeholders who will ultimately select one Preferred Alternative as the next step in the overall Happy Valley DCR process. The Preferred Alternative may be one of the five Proposed Alternatives presented herein or may be a hybrid of any of the facility components of the five Proposed Alternatives.

For purposes of clarification it is important to make a distinction in the use of terms frequently used to describe the existing and proposed Happy Valley Wash facilities:

Happy Valley Wash – Term used to describe the existing wash generally located along the planned Happy Valley Road alignment (section line) in its existing, natural condition.

Happy Valley Channel – Term used to describe a proposed improved conveyance channel constructed north of the existing Happy Valley Wash location and contiguous to the planned Happy Valley Road improvements designed to be centered upon the section line.

4.2 ALTERNATIVE #1 – FLOW SPLIT WITH BASIN

4.2.1 DESCRIPTION

Alternative #1 – *Flow Split with Basin*, consists of a series of improved conveyance channels running along the north side of the planned Happy Valley Road and the east side of 155th Avenue. One detention basin is proposed to be located at the southerly terminus of 155th Avenue just north of the Beardsley Canal.

The improved conveyance channel along the north side of Happy Valley Road expands in size and capacity as it collects contributing flows from Wash 5, 6, and 9 as it flows easterly from 163rd Avenue to 155th Avenue. Three conveyance channel sizes/sections make up this one mile length of channel. A designed flow split at 155th Avenue would

direct approximately 70% of the flows south (an approximate representation of historic flow patterns without the berm in place) into a new conveyance channel proposed along the east side of 155th Avenue. The remaining 30% flows will continue in a smaller improved conveyance channel extending from the flow split at 155th Avenue to the terminus of the improved conveyance channel section at its confluence with Wash 10. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into a series of box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal.

The 155th Avenue Channel outlets into an approximate 53-acre detention basin that would attenuate flows and bleed off larger events (if needed) along the northerly edge of the Beardsley Canal towards the existing overchute. Contributing flows from both the Happy Valley Channel and the detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year storm.

Table 4.1 – Alternative #1 Channel Conceptual Design Characteristics

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Sect. 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 2	198 feet	1,400	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 3	262 feet	2,400	850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 4	154 feet	700	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
155th Ave. Sect. 1	218 feet	1,700	4,600	5 feet	86 feet	30 feet each side	16 feet on east and west bank	40 feet on east side

* DEI's 100-year 6-hour flow
** Includes 1 foot of freeboard

Table 4.2 – Alternative #1 Basin Conceptual Design Characteristics

Basin	Acreage	Top Width	Depth	Side Slopes
#1	53	325 feet	6 feet	6:1

This proposed elongated basin will function solely for the purpose of detaining flows – it is long, linear flat basin that is relatively "channel-like" in its look and function. This basin will not serve any recreation or multi-use opportunities. In evaluating multi-use and recreation opportunities for the proposed basin, the City of Surprise currently does not envision the need for park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be modified in shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

4.2.2 Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement the character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

4.2.3 Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #1 includes the findings and assumptions identified in Table 4.3. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.3 – Hydraulic Modeling Conditions, Findings, and Assumptions

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	750*	4	0.035	0.004	0.0024	1
HV Section 2	1,400	4	0.035	0.004	0.0019	1
HV Section 3	2,400	4	0.035	0.004	0.0017	1
HV Section 4	700	4	0.035	0.003	0.0024	1
155th Ave. Section 1	1,700	4	0.035	0.006	0.0018	1

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance channel is intended to be absorbed into the 40-foot landscape buffer or 16 feet buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydraulic modeling.

4.2.4 Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel and basin landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

4.2.5 Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

In evaluating multi-use and recreation opportunities for the proposed basin, the City of Surprise currently does not envision the need for a park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be in modified shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

4.2.6 Opportunities and Constraints

1. Alternative #1 represents the preferred Wittmann ADMP alignment, i.e., the existing Happy Valley Wash alignment.

2. Significantly reduces downstream floodplain and flood events for property owners south of Happy Valley Road/Wash.

3. Property owners to the south of Happy Valley Road do not need to design and construct conveyance channels and thereby are enhancing the developable land area upon their properties.

4. Acquisition of property from ASLD for 155th Avenue Channel and detention basin is necessary.

5. Minimizes total linear feet of channel to be constructed; more efficient on conveyance.

6. O&M efficiencies and continuity with maintenance of two larger conveyance channels with overall reduced lineal footage.

7. Basin acquisition, excavation, and landscaping costs equate to 40% of the overall Alternative #1 cost estimate.

8. Basin location increases the developable land area of the ASLD parcel that would otherwise not occur under Alternative #3.

9. Culvert spans in excess of 100 feet are required at 155th Avenue and Happy Valley Road. Additional study would be required for backwater

analysis/freeboard requirements in the 155th Avenue Channel at Happy Valley Road.

10. Though existing wash is not preserved, alternative maintains scenic quality of area by providing improved conveyance channel with enhanced landscaping.

11. Promotes City of Surprise Trails Master Plan by including trail provisions along Happy Valley Channel alignment.

4.2.7 Opinion of Probable Costs

The following is a preliminary estimate of the probable cost to construct the channel and basin facilities for Proposed Alternative #1. The cost estimate included herein attempts to capture the major cost components identified with Proposed Alternative #1.

Table 4.4 – Proposed Alternative #1 Opinion of Probable Cost

Proposed Alternative 1	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		9500	CY	$ 4.00	$ 38,000.00
Landscaping		125400	SF	$ 1.00	$ 125,400.00
Right-of-Way		3.4	AC	$ 40,000.00	$ 136,000.00
Drop Structures		1	Each	$ 4,704.00	$ 4,704.00
SubTotal					**$ 304,104.00**
Happy Valley Section 2					
Channel Excavation		45778	CY	$ 4.00	$ 183,112.00
Landscaping		339900	SF	$ 1.00	$ 339,900.00
Right-of-Way		11.7	AC	$ 40,000.00	$ 468,000.00
Drop Structures		1	Each	$ 12,936.00	$ 12,936.00
SubTotal					**$1,003,948.00**
Happy Valley Section 3					
Channel Excavation		25185	CY	$ 4.00	$ 100,740.00
Landscaping		112200	SF	$ 1.00	$ 112,200.00
Right-of-Way		5.1	AC	$ 40,000.00	$ 204,000.00
Drop Structures		0	Each	$ 25,480.00	$ -
SubTotal					**$ 416,940.00**
Happy Valley Section 4					
Channel Excavation		33704	CY	$ 4.00	$ 134,816.00
Landscaping		462000	SF	$ 1.00	$ 462,000.00
Right-of-Way		12.4	AC	$ 40,000.00	$ 496,000.00
Drop Structures		3	Each	$ 4,312.00	$ 12,936.00
SubTotal					**$1,105,752.00**

Proposed Alternative 1	# Barrels	Quantity	Unit	Unit Cost	Total Cost
155th Avenue Section 1					
Channel Excavation		98815	CY	$ 4.00	$ 395,260.00
Landscaping		607200	SF	$ 1.00	$ 607,200.00
Right-of-Way		23	AC	$ 40,000.00	$ 920,000.00
Drop Structures		8	Each	$ 16,856.00	$ 134,848.00
SubTotal					**$2,057,308.00**
State Land Basin					
Channel Excavation		237456	CY	$ 4.00	$ 949,824.00
Landscaping		2278188	SF	$ 1.00	$2,278,188.00
Right-of-Way		52.3	AC	$ 40,000.00	$2,092,000.00
SubTotal					**$5,320,012.00**
Culverts					
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	291	LF	$ 750.00	$1,527,750.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	165	LF	$ 750.00	$ 371,250.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	202	LF	$ 750.00	$ 757,500.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
SubTotal					**$4,816,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00

Proposed Alternative 1	# Barrels	Quantity	Unit	Unit Cost	Total Cost
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
SubTotal					**$ 204,264.00**
Itemized Project Components					
Excavation					**$ 1,801,752.00**
Landscaping					**$ 3,924,888.00**
Right-of-Way					**$ 4,316,000.00**
Drop Structures					**$ 165,424.00**
Culverts					**$ 5,020,764.00**
Design					**$ 1,522,882.80**
Construction Management					**$ 1,218,306.24**
Contingency					**$ 3,273,848.40**
Total					**$21,243,865.44**
Alternative 1 Total Cost					**$21,243,865.44**

Assumptions made for opinion of probable cost purposes:

1. Channel and basin excavation is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Basin acreage and landscaping costs include a 30% contingency beyond hydrology modeling sizing.

5. Cost estimate includes culvert crossing for vehicular project entry locations as follows: two entrances for Tierra Verde West, one entrance for Tierra Verde East and three entrances off 155th Avenue into the ASLD parcel. Number of entrances and locations based on conformance with the preliminary plat for Tierra Verde East and West and Surprise guidelines for the ASLD parcel.

6. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

7. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

8. Minor cost items such as rip-rap at select culvert locations were not included in this estimate. Although the final costs can expect to be higher, the comparative costs between alternatives are not expected to change as a result of these minor cost items.

9. Excavation unit costs assume a short haul distance and stockpiling of excess material.

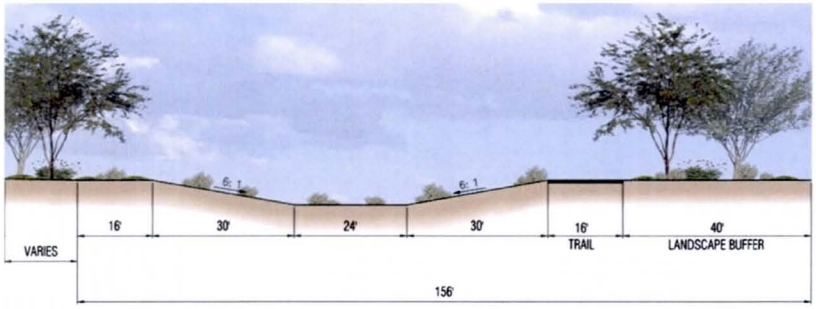
Figure 4.1 - Proposed Alternative 1

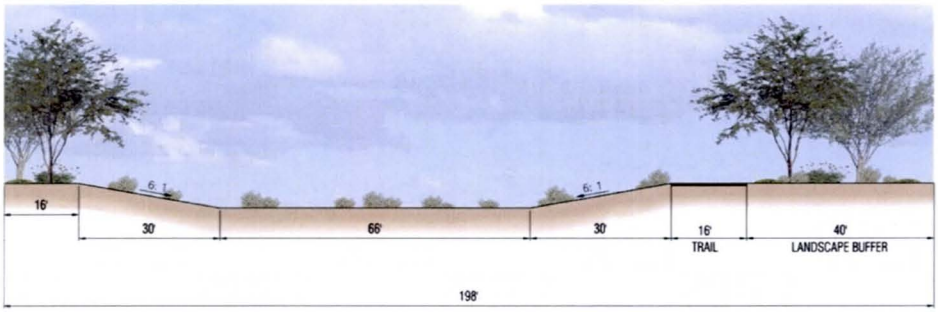
Happy Valley Design Concept Report

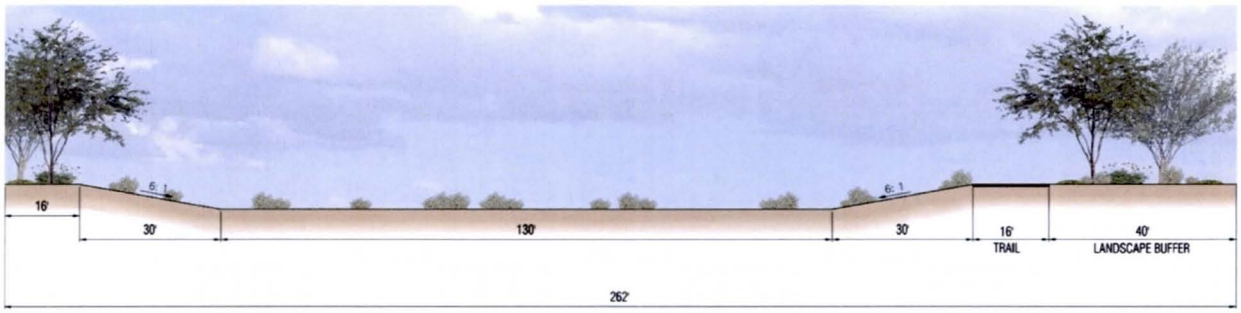
Alternative 1 - Flow Split with Basin

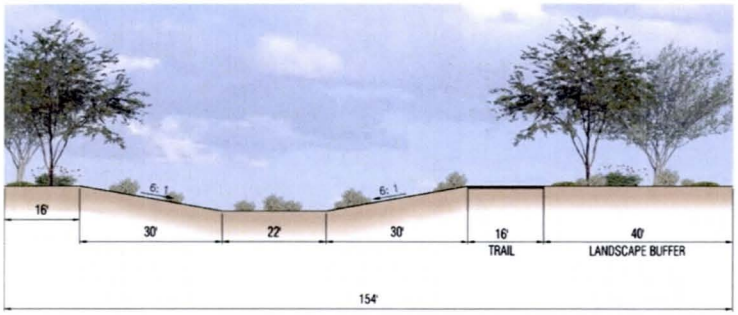
2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

PROPOSED ALTERNATIVE 1 CROSS-SECTIONS





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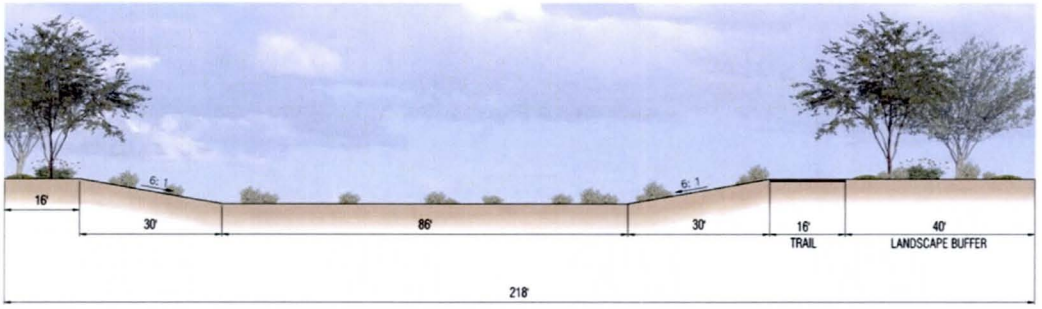
6: 1
16'
30'
22'
30'
16'
TRAIL
40'
LANDSCAPE BUFFER
154'


6: 1
6: 1
16'
30'
86'
30'
16'
TRAIL
40'
LANDSCAPE BUFFER
218'

4.3 ALTERNATIVE #2 – SOUTHERLY FLOWS

4.3.1 DESCRIPTION

Alternative #2 – *Southerly Flows*, consists of a series of improved conveyance channels that, as a practical matter, provide extensions of natural conveyance patterns that would reflect a "no berm" and channel scenario for Happy Valley Channel. In essence, the Happy Valley Channel would be an improved conveyance channel that would convey flows typical of an existing "no berm" condition from 163rd Avenue east to it's confluence with Wash 10 where the improved channel would terminate and give way to its existing natural status south of Happy Valley Road (alignment). In addition, the southerly flows of Wash 5, 6, and 9 would continue their southerly conveyance south of Happy Valley Channel in a southeasterly direction towards the Beardsley Canal where ponding for these wash facilities currently exists.

In general, the improved conveyance channel along the north side of Happy Valley Road maintains a constant size (46-foot channel bottom) from 163rd Avenue to the confluence with Washes 6 & 9 (HV-S1) at which point the Happy Valley channel is reduced in size (8-foot channel bottom) as the majority of the flows from Washes 6 & 9 continue in their southerly direction. This reduced Happy Valley Channel section (HV-S2) is maintained for its full length until its terminus and confluence with Wash 10. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into a series of box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal.

Wash 5 flows (Wash 5 – SHV) would be conveyed south of Happy Valley Road in a southeasterly direction that follows the current topographic low points in the area, somewhat diagonally through the Verdugo and Altamira properties. The proposed channel bottom width is approximately 46-feet. The Wash 5 flows could outlet into a potential detention basin at the southern end of the Altamira property or naturally attenuate over the existing grade and pond in select areas consistent with current drainage patterns. If desired by the District or stakeholders, further consideration for the inclusion of a new overchute or additional storage area could be considered.

Wash 6 & 9 flows (Wash 6 & 9 - SHV) would be conveyed south of Happy Valley Road in a southeasterly direction that follows the current topographic low points in the area, diagonally through the ASLD parcel. The proposed channel bottom width is approximately 106-feet to accommodate the required flows. The Wash 6 & 9 flows could outlet or naturally attenuate over the existing grade and pond in select areas consistent with current drainage patterns. If desired by the District or stakeholders,

further consideration for the inclusion of a new overchute or additional storage area could be considered.

Contributing flows from the Happy Valley Channel, the Wash 5 Channel, and the Wash 6 & 9 channels collectively are planned so as to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year flows.

Table 4.5 – Alternative #2 Channel Conceptual Design Characteristics

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	180 feet	1,100	3,325	5 feet	48 feet	30 each side	16 feet on north and south bank	40 feet on north side
HV Section 2	128 feet	250	3,500	4 feet	8 feet	24 each side	16 feet on north and south bank	40 feet on north side
Wash 5 (south HV Rd.)	190 feet	750*	6,950	4 feet	46 feet	24 each side	16 feet on east bank	40 foot on each side
Wash 6 & 9 (south of HV Rd.)	262 feet	2,000	4,050	5 feet	106 feet	30 each side	16 feet on east bank	40 foot on each side

* DEI's 100-year 6-hour flow
** Includes 1 foot of freeboard

There are no basins proposed in Alternative #2.

4.3.2 Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

4.3.3 Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #2 includes the findings and assumptions identified in Table 4.6. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.6 – Hydraulic Modeling Conditions, Findings, and Assumptions

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	1,100	4	0.035	0.004	0.0020	1
HV Section 2	250	4	0.035	0.003	0.0038	1
Wash 5	750*	4	0.035	0.007	0.0028	1
Wash 6 & 9	2,000	4	0.035	0.007	0.0017	1

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance channel is intended to be absorbed into the 40-foot landscape buffer or 16 foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydraulic modeling.

4.3.4 Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate

the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

4.3.5 Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No basins are proposed in this alternative and as a result, no multi-use opportunities for basins were evaluated for Alternative #2.

4.3.6 Opportunities and Constraints

1. Increase in the number of channels, and therefore total linear feet of constructed channel over Alternative's #1 and #3.

2. Acquisition of private property between the Verdugo property and Happy Valley Road is needed to accommodate the conveyance of Wash 5 flows south of Happy Valley Road.

3. Wash 5 and Wash 6 & 9 south of Happy Valley Road have the potential to restrict land use design due to configuration and alignment near Happy Valley Road.

4. Additional culverts and headwalls needed for Alternative #2 equates to 47% of the estimated total project cost.

5. The Happy Valley Channel width is overall smaller than all other alternatives, thereby reducing the number of culverts needed for vehicular crossing into Tierra Verde.

6. Alternative #2 conveyance channels follow the traditional drainage patterns and therefore bifurcate the Verdugo, Altamira, and ASLD parcels thereby potentially limiting the efficiency of their developable land area.

7. Maintaining southerly flows helps preserve pockets of existing vegetative communities located in ponding areas north of the Beardsley Canal.

8. Multi-use trail opportunities are provided along channel corridors though alignments are not entirely consistent with the City of Surprise Trails Master Plan.

9. Cost estimate includes culvert crossings for vehicular project entry locations as follows: two entrances for Tierra Verde West, one entrance for Tierra Verde East and an internal road crossing between the Verdugo and Altamira properties. Number of entrances and locations based on conformance with the preliminary plat for Tierra Verde East.

10. Though existing Happy Valley Wash is not preserved, alternative maintains scenic quality of area by providing improved conveyance channel with enhanced landscaping.

11. Land costs are significantly less than Alternative's 1, 3, and 4 since no detention basins are included. No major reduction in floodplain or flow rates are realized in this alternative.

4.3.7 Opinion of Probable Costs

The following is a preliminary estimate of the probable cost to construct the channel and basin facilities for Proposed Alternative #2. The cost estimate included herein attempts to capture the major cost components identified with Proposed Alternative #2.

Table 4.7 – Proposed Alternative #2 Opinion of Probable Cost

Proposed Alternative 2	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		48028	CY	$ 4.00	$ 192,112.00
Landscaping		438900	SF	$ 1.00	$ 438,900.00
Right-of-Way		13.7	AC	$ 40,000.00	$ 548,000.00
Drop Structures		2	Each	$ 9,408.00	$ 18,816.00
SubTotal					**$ 1,197,828.00**
Happy Valley Section 2					
Channel Excavation		16593	CY	$ 4.00	$ 66,372.00
Landscaping		420000	SF	$ 1.00	$ 420,000.00
Right-of-Way		10.3	AC	$ 40,000.00	$ 412,000.00
Drop Structures		0	Each	$ 1,568.00	$ -
SubTotal					**$ 898,372.00**
Wash 5 South of Happy Valley					
Channel Excavation		72074	CY	$ 4.00	$ 288,296.00
Landscaping		1000800	SF	$ 1.00	$ 1,000,800.00
Right-of-Way		30.3	AC	$ 40,000.00	$ 1,212,000.00
Drop Structures		10	Each	$ 9,016.00	$ 90,160.00
SubTotal					**$ 2,591,256.00**
Wash 6 & 9 South of Happy Valley					
Channel Excavation		102000	CY	$ 4.00	$ 408,000.00
Landscaping		631800	SF	$ 1.00	$ 631,800.00
Right-of-Way		24.4	AC	$ 40,000.00	$ 976,000.00
Drop Structures		4	Each	$ 20,776.00	$ 83,104.00
SubTotal					**$ 2,098,904.00**
Culverts					
Wash 5 Happy Valley Road 5 - 8 ft x 4 ft box culverts	5	160	LF	$ 600.00	$ 480,000.00
Wash 6 & 9 Happy Valley Road 10 - 10 ft x 4 ft box culverts	10	225	LF	$ 750.00	$ 1,687,500.00
Wash 6 & 9 155th Avenue 10 - 10 ft x 4 ft box culverts	10	214	LF	$ 750.00	$ 1,605,000.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	202	LF	$ 750.00	$ 757,500.00
Tierra Verde West Entrance Road 5 - 10 ft x 4 ft box culverts	5	80	LF	$ 750.00	$ 300,000.00
Tierra Verde West Entrance Road 5 - 10 ft x 4 ft box culverts	5	80	LF	$ 750.00	$ 300,000.00
Tierra Verde East Entrance Road 2 - 8 ft x 4 ft box culverts	2	80	LF	$ 600.00	$ 96,000.00
Wash 5 Crossing 5 - 8 ft x 4 ft box culverts	5	80	LF	$ 600.00	$ 240,000.00
Wash 5 Crossing 5 - 8 ft x 4 ft box culverts	5	80	LF	$ 600.00	$ 240,000.00

Proposed Alternative 2	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Wash 5 Crossing 5 - 8 ft x 4 ft box culverts	5	80	LF	$ 600.00	$ 240,000.00
Wash 6 & 9 Crossing 8 - 10 ft x 4 ft box culverts	8	80	LF	$ 750.00	$ 480,000.00
Wash 6 & 9 Crossing 8 - 10 ft x 4 ft box culverts	8	80	LF	$ 750.00	$ 480,000.00
SubTotal					**$ 6,906,000.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Wash 5 Happy Valley Road 5 - 8 ft x 4 ft box culverts	5	$4,838.00	$ 8,065.00	$ 4,850.00	$ 17,753.00
Wash 6 & 9 Happy Valley Road 10 - 10 ft x 4 ft box culverts	10	$8,310.00	$ 14,249.00	$ 13,059.00	$ 35,618.00
Wash 6 & 9 155th Avenue 10 - 10 ft x 4 ft box culverts	10	$8,310.00	$ 14,249.00	$ 13,059.00	$ 35,618.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde West Entrance Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde West Entrance Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde East Entrance Road 2 - 8 ft x 4 ft box culverts	2	$3,422.00	$ 5,515.00	$ 1,670.00	$ 10,607.00
Wash 5 Crossing 5 - 8 ft x 4 ft box culverts	5	$4,838.00	$ 8,065.00	$ 4,850.00	$ 17,753.00
Wash 5 Crossing 5 - 8 ft x 4 ft box culverts	5	$4,838.00	$ 8,065.00	$ 4,850.00	$ 17,753.00
Wash 5 Crossings 5 - 8 ft x 4 ft box culverts	5	$4,838.00	$ 8,065.00	$ 4,850.00	$ 17,753.00
Wash 6 & 9 Crossing 8 - 10 ft x 4 ft box culverts	8	$7,130.00	$ 12,167.00	$ 10,357.00	$ 29,654.00
Wash 6 & 9 Crossing 8 - 10 ft x 4 ft box culverts	8	$7,130.00	$ 12,167.00	$ 10,357.00	$ 29,654.00
SubTotal					**$ 274,287.00**
Itemized Project Components					
Excavation					**$ 954,780.00**
Landscaping					**$ 2,491,500.00**
Right-of-Way					**$ 3,148,000.00**
Drop Structures					**$ 192,080.00**
Culverts					**$ 7,180,287.00**
Design					**$ 1,396,664.70**
Construction Management					**$ 1,117,331.76**
Contingency					**$ 3,245,594.10**
Total					**$19,726,237.56**
Alternative 2 Total Cost					**$19,726,237.56**

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Basin acreage and landscaping costs include a 30% contingency beyond hydrology modeling sizing.

6. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

7. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

Figure 4.2 - Proposed Alternative 2

Happy Valley Design Concept Report

Alternative 2 - Southerly Flows

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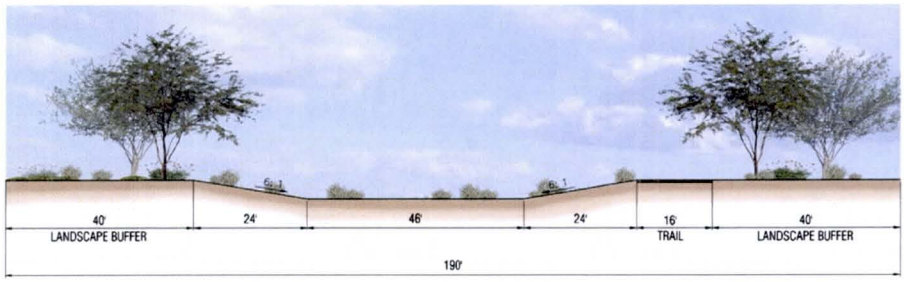
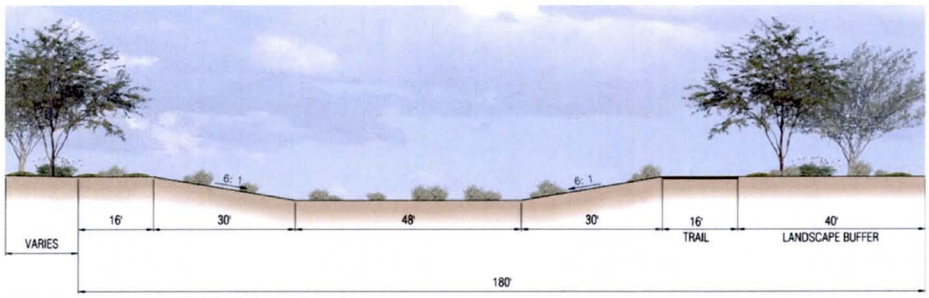
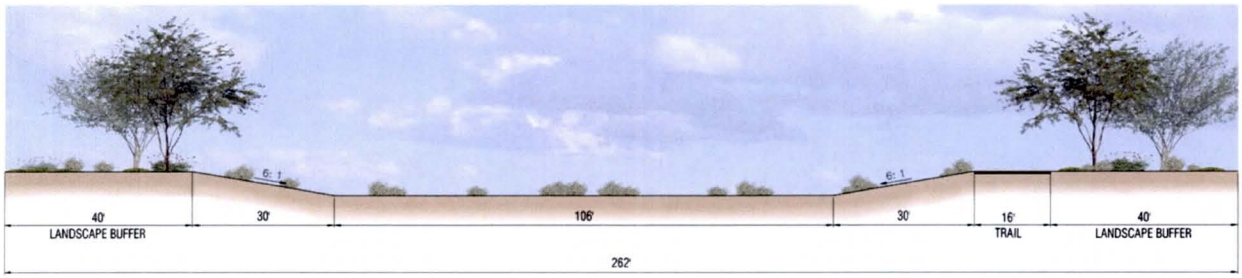
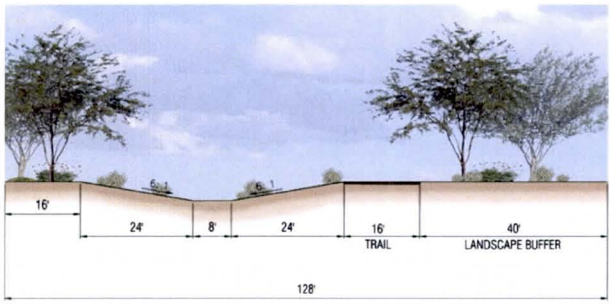
Proposed Alternative 2 Cross-Sections





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TRAIL
40'
LANDSCAPE BUFFER
128'

4.4 ALTERNATIVE #3 – TWO BASINS WITH FLOW SPLIT

4.4.1 DESCRIPTION

Alternative #3 – *Two Basins with Flow Split* includes two detention basins, one to the west end of Happy Valley Channel downstream of the existing 163rd Avenue box culvert, a second, larger basin near the eastern terminus of Happy Valley Channel on the north side of the ASLD property. Improved conveyance channels are proposed along the north side of the future Happy Valley Road and extending south from detention basin #1, through the middle of the Verdugo property and south side of the Altamira property.

The overall conveyance and storage system for Alternative #3 first begins with an approximate 23-acre basin located north of Happy Valley Road, just east of 163rd Avenue. This basin is located and sized in order to capture the previously identified "breakout" flows from Wash 6 to the north and Wash 5 flows from the 163rd Avenue box culverts. Approximately 200-300 cfs would be attenuated in this basin where the remaining flows would be diverted to the east and to the south through a designed flow split at this basin.

The Happy Valley Channel, proposed for the north side and contiguous to future Happy Valley Road improvements, is an improved conveyance channel consisting of three varying sizes from west to east, with the middle (Section 2, from the confluence with Wash 6 & 9 east to the culvert directed to the second detention basin) being the largest in size. Section 3 is again reduced as the second detention basin attenuates flows from the inlet of flows from Section 2.

The second basin near the western terminus of the improved Happy Valley Road Channel is proposed upon the northeast corner of the ASLD parcel and is approximately 48 acres in size. Grade differentials of 14′ to 16′ pose a challenge to the ultimate effectiveness of this basin, which is currently designed to receive approximately 300 cfs of the Happy Valley Channel flows. Additional flow split and culvert structures would be necessary to divert flows from Happy Valley Channel along the north side of the future roadway improvements to the detention basin location south of the Happy Valley Road improvements. This attenuation is needed in order to not exceed the existing flows at the existing overchute of the Beardsley Canal. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into a series of box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal

Wash 5 flows would be conveyed in an improved conveyance channel south of Basin #1. Approximately 425 cfs of flows would be directed to this channel which is no greater than the quantity of flows currently received by Verdugo to the south of the existing Happy Valley Wash. This improved conveyance channel is proposed through the central portions of the Verdugo project and then conveyed to the east along the south side of the Altamira project. The conceptual design of improved conveyance channel for Wash 5 flows is generally consistent with the preliminary drainage design contemplated for both the Verdugo and Altamira projects. These flows would likely be attenuated by a proposed detention basin at the southern end of the Altamira project and/or could outlet to the ASLD property.

Contributing flows from the Happy Valley Channel, the Wash 5 Channel, and the Wash 6 & 9 Channel collectively are planned so as to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year flows.

In evaluating multi-use and recreation opportunities for either proposed basin, the City of Surprise currently does not envision the need for a park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be modified in shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

Table 4.8 – Alternative #3 Channel Conceptual Design Characteristics

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	154 feet	700	1,750	5 feet	22 feet	30 each side	16 feet on north and south bank	40 feet on north side
HV Section 2	212 feet	1,625	3,025	5 feet	80 feet	30 each side	16 feet on north and south bank	40 feet on north side
HV Section 3	192 feet	1,325	1,350	5 feet	60 feet	30 each side	16 feet on north and south bank	40 foot on north side
Wash5 (south of HV Rd.)	162 feet	425	8,650	4 feet	18 feet	24 each side	16 feet on east bank	40 foot on each side

** Includes 1 foot of freeboard

Table 4.9 – Alternative #3 Basin Conceptual Design Characteristics

Basin	Acreage	Top Width (average)	Depth	Side Slopes
#1	23 acres	550 feet	4 feet	6:1
#2	48 acres	975 feet	4 feet	6:1

4.4.2 Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement the character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

4.4.3 Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #1 includes the findings and assumptions identified in Table 4.10. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.10 – Hydraulic Modeling Conditions, Findings, and Assumptions

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	700	4	0.035	0.004	0.0025	1 foot
HV Section 2	1,625	4	0.035	0.004	0.0018	1 foot
HV Section 3	1,325	4	0.035	0.003	0.0019	1 foot
Wash 5 (south of HV Rd.)	425	4	0.035	0.005	0.0035	1 foot

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of these areas observations include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance channel is intended to be absorbed into the 40-foot landscape buffer or 16 foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydraulic modeling.

4.4.4 Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel and basin landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

4.4.5 Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

In evaluating multi-use and recreation opportunities for the proposed basins, the City of Surprise currently does not envision the need for a park or passive recreational facilities

due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be in modified shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

4.4.6 Opportunities and Constraints

1. Right-of-Way for the inclusion of Basin #1 must be acquired from impacted property owner(s) and includes a small segment where grade ties are challenged.

2. Basin #2 location upon ASLD property not ideal for hydrologic efficiencies, i.e., the existing grade from northwest to southeast inhibits the basin's ability to maximize attenuation and challenges constructability with up to 16 feet grade tie-ins needed with Happy Valley Road.

3. Acquisition of private property between the Verdugo property and Happy Valley Road is needed to accommodate the conveyance of Wash 5 flows south of Happy Valley Road.

4. Verdugo and Altamira projects are required to only take flows (approximately 425 cfs) consistent with historic patterns; no upsizing of facilities are necessary.

5. Alternative's #3 and #4 provide the most attenuation of flow rates through stakeholder properties.

6. Multi-use trail opportunities are provided along Happy Valley Channel alignment and is consistent with City of Surprise Trails Master Plan. Additional multi-use trail opportunities offered along Wash 5 improved channel through Verdugo property.

7. Cost estimate includes culvert crossing for vehicular project entry locations as follows: two entrances for Tierra Verde West, one entrance for Tierra Verde East and one presumed vehicular entrance each for Verdugo and Altamira off Pinnacle Peak Road. Number of entrances and locations based on conformance with the preliminary plat for Tierra Verde. Verdugo and Altamira assume Pinnacle Peak Road is required to be constructed for vehicular access requirements by the City of Surprise.

8. Though existing wash is not preserved, alternative maintains scenic quality of area by providing improved conveyance channel with enhanced landscaping.

9. Alternative #3 represents one of the least efficient alternatives in regards to long term operation and maintenance costs due to total linear footage of all channels in addition to the inclusion of two basins.

4.4.7 Opinion of Probable Costs

The following is a preliminary estimate of the probable cost to construct the channel and basin facilities for Proposed Alternative #3. The cost estimate included herein attempts to capture the major cost components identified with Proposed Alternative #3.

Table 4.11 – Proposed Alternative #3 Opinion of Probable Cost

Proposed Alternative 3	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		16852	CY	$ 4.00	$ 67,408.00
Landscaping		231000	SF	$ 1.00	$ 231,000.00
Right-of-Way		6.2	AC	$ 40,000.00	$ 248,000.00
Drop Structures		1	Each	$ 4,312.00	$ 4,312.00
SubTotal					**$ 550,720.00**
Happy Valley Section 2					
Channel Excavation		61620	CY	$ 4.00	$ 246,480.00
Landscaping		399300	SF	$ 1.00	$ 99,300.00
Right-of-Way		14.7	AC	$ 40,000.00	$ 588,000.00
Drop Structures		3	Each	$ 15,680.00	$ 47,040.00
SubTotal					**$ 1,280,820.00**
Happy Valley Section 3					
Channel Excavation		22500	CY	$ 4.00	$ 90,000.00
Landscaping		178200	SF	$ 1.00	$ 178,200.00
Right-of-Way		6	AC	$ 40,000.00	$ 240,000.00
Drop Structures		0	Each	$ 11,760.00	$ -
SubTotal					**$ 508,200.00**
Wash 5 South of Happy Valley					
Channel Excavation		53822	CY	$ 4.00	$ 215,288.00
Landscaping		1245600	SF	$ 1.00	$ 1,245,600.00
Right-of-Way		32.2	AC	$ 40,000.00	$ 1,288,000.00
Drop Structures		4	Each	$ 3,528.00	$ 14,112.00
SubTotal					**$ 2,763,000.00**
163rd Avenue / Happy Valley Basin					
Basin Excavation		201336	CY	$ 4.00	$ 805,344.00
Landscaping		962676	SF	$ 1.00	$ 962,676.00
Right-of-Way		22.1	AC	$ 40,000.00	$ 884,000.00
SubTotal					**$ 2,652,020.00**

Proposed Alternative 3	# Barrels	Quantity	Unit	Unit Cost	Total Cost
State Land Basin					
Basin Excavation		445918	CY	$ 4.00	$ 1,783,672.00
Landscaping		2056032	SF	$ 1.00	$ 2,056,032.00
Right-of-Way		47.2	AC	$ 40,000.00	$ 1,888,000.00
SubTotal					**$ 5,727,704.00**
Culverts					
Wash 5 Happy Valley Road 3 - 8 ft x 4 ft box culverts	3	142	LF	$ 600.00	$ 255,600.00
Wash 5 155th Ave 3 - 8ft x 4 ft box culverts	3	142	LF	$ 600.00	$ 255,600.00
155th Avenue 6 - 10 ft x 4 ft box culverts	6	142	LF	$ 750.00	$ 639,000.00
Happy Valley / State Land 2 - 8 ft x 4 ft box culverts	2	218	LF	$ 600.00	$ 261,600.00
Wash 10 Happy Valley Road 8 - 8 ft x 4 ft box culverts	8	229	LF	$ 600.00	$ 1,099,200.00
Tierra Verde West Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
Tierra Verde West Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
Tierra Verde East Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
SubTotal					**$ 3,807,000.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Wash 5 Happy Valley Road 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 155th Ave 3 - 8ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
155th Avenue 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Happy Valley / State Land 2 - 8 ft x 4 ft box culverts	2	$3,422.00	$ 5,515.00	$ 1,670.00	$ 10,607.00
Wash 10 Happy Valley Road 8 - 8 ft x 4 ft box culverts	8	$6,254.00	$ 10,615.00	$ 8,030.00	$ 24,899.00
Tierra Verde West Entrance Road 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Tierra Verde West Entrance Road 3	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00

Proposed Alternative 3	# Barrels	Quantity	Unit	Unit Cost	Total Cost
- 10 ft x 4 ft box culverts					
Tierra Verde East Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
SubTotal					**$ 190,308.00**
Itemized Project Components					
Excavation					**$ 3,208,192.00**
Landscaping					**$ 5,072,808.00**
Right-of-Way					**$ 5,136,000.00**
Drop Structures					**$ 65,464.00**
Culverts					**$ 3,997,308.00**
Design					**$ 1,747,977.20**
Construction Management					**$ 1,398,381.76**
Contingency					**$ 3,703,131.60**
Total					**$24,329,262.56**
Alternative 3 Total Cost					**$24,329,262.56**

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Basin acreage and landscaping costs include a 30% contingency beyond hydrology modeling sizing.

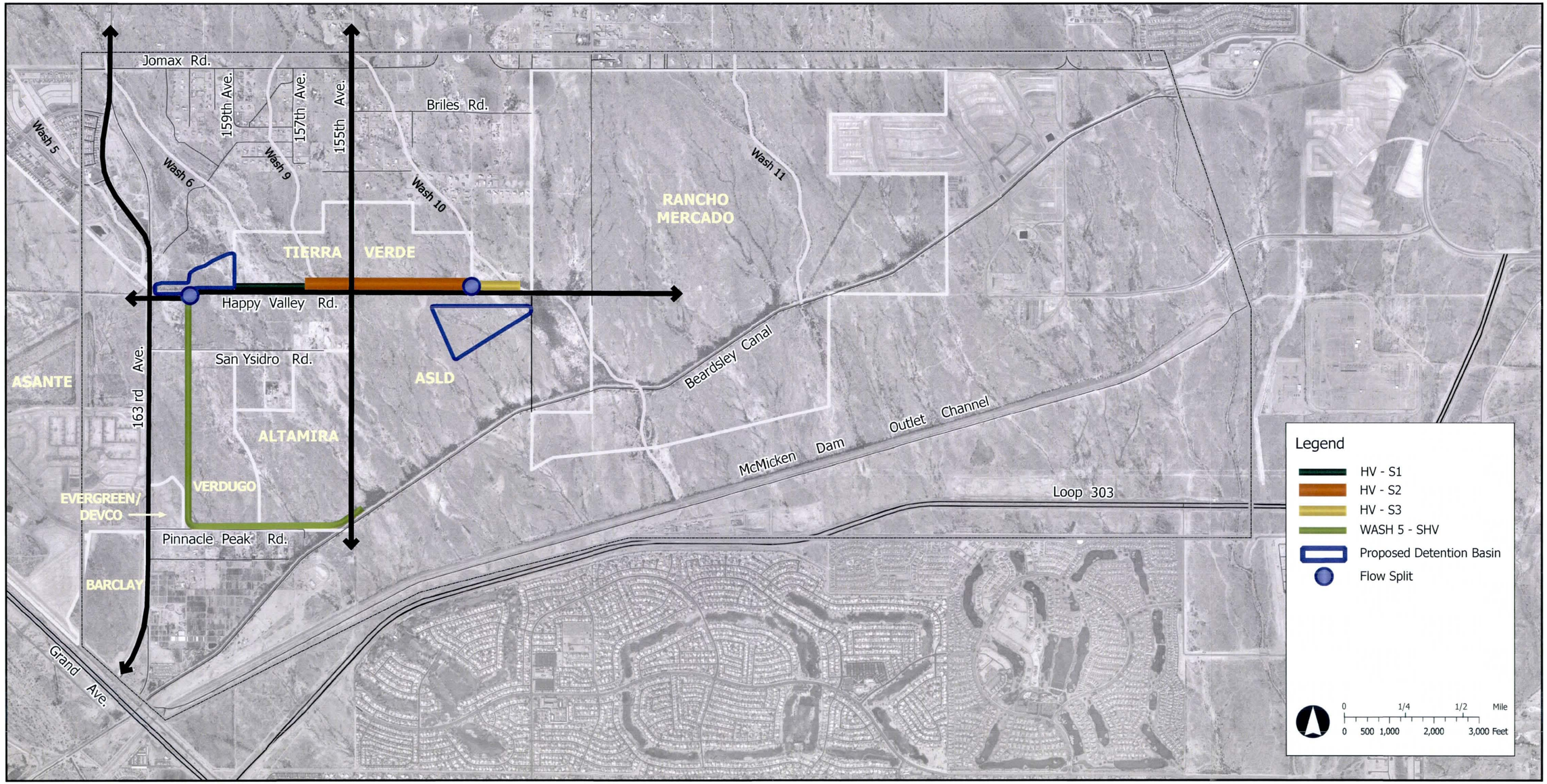
6. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

7. Culverts were identified on Happy Valley Road and 155th Avenue only. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

Figure 4.3 – Proposed Alternative 3

Happy Valley Design Concept Report

Alternative 3 - Two Basins with Flow Split



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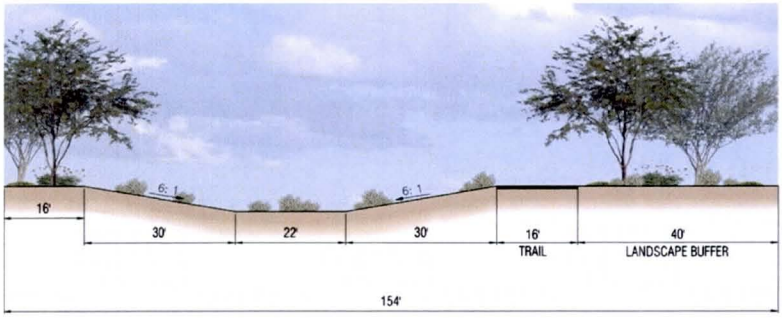
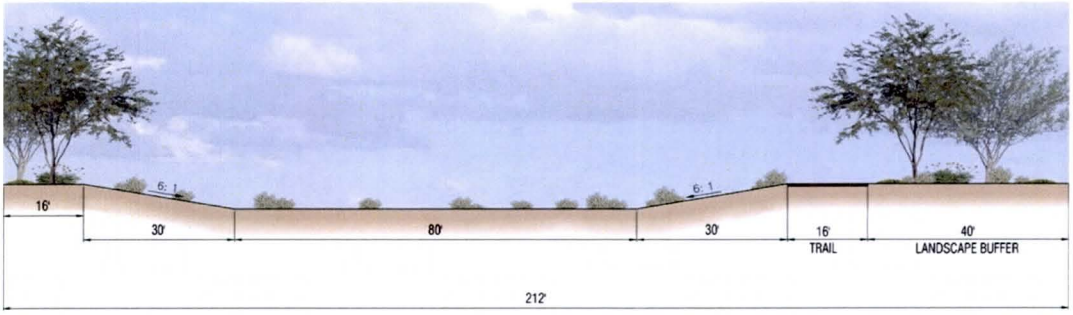
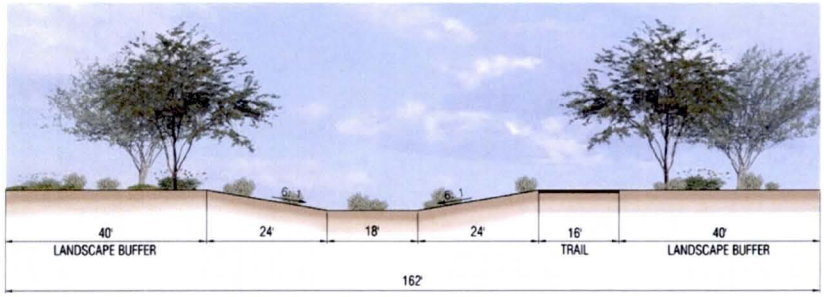
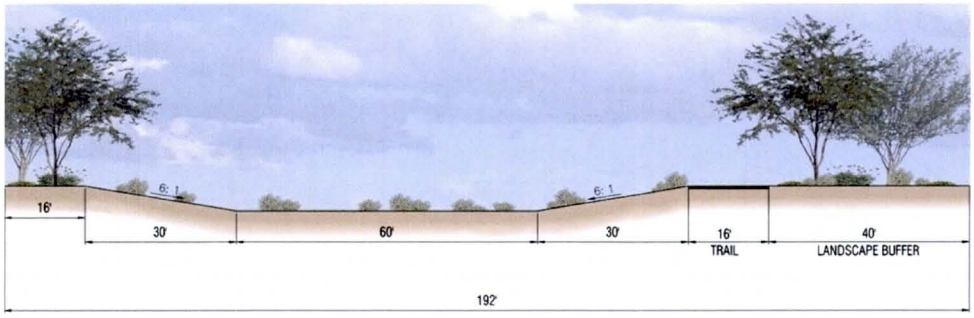
Proposed Alternative 3 Cross-Sections





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TRAIL
40'
LANDSCAPE BUFFER
192'

4.5 ALTERNATIVE #4 – HYBRID SCENARIO

4.5.1 DESCRIPTION

Alternative #4 is the *"Hybrid Scenario"* initially presented in rough concept by the developer consortium at the February 18, 2010 Stakeholder Meeting. This hybrid alternative triggered additional group discussion and District staff involvement to more thoroughly incorporate this alternative into the Happy Valley DCR process and is now introduced and discussed in this Proposed Alternatives Chapter. The rough concept initially introduced has since been refined by the District and is reflected in the discussion and graphics below.

The conveyance channel and basin features contemplated in Alternative #4 represents a mixture or hybrid of individual channel and basin components identified and discussed previously during the Preliminary Alternatives stage of this DCR process. Moreover, Alternative #4 largely represents a hybrid of the conveyance channel and detention basin facilities contained in the Proposed Alternative's #1 and #3.

Alternative #4 includes two detention basins, one to the west end of Happy Valley Channel downstream of the existing 163rd Avenue box culvert, a second, larger basin at the southern terminus of the 155th Avenue channel located on the southern portion of the ASLD property and the private parcel contiguous to the east and tying into the existing Beardsley Canal overchute. Improved conveyance channels are proposed along the north side of the future Happy Valley Road, a second channel extending south from detention basin #1 through the Verdugo project and along south side of the Altamira property. A third improved conveyance channel is proposed along the east side of the planned 155th Avenue.

The overall conveyance and storage system for Alternative #4 first begins with an approximate 23-acre basin located north of Happy Valley Road, just east of 163rd Avenue. This basin is located and sized in order to capture the previously identified "breakout" flows from Wash 6 to the north and Wash 5 flows from the 163rd Avenue box culverts. Approximately 200-300 cfs would be attenuated in this basin where the remaining flows would be diverted to the east and to the south through a designed flow split at this basin.

The Happy Valley Channel, proposed for the north side and contiguous to the future Happy Valley Road improvements, is an improved conveyance channel consisting of three varying sizes from west to east.

Wash 5 flows would be conveyed in an improved conveyance channel south of Basin #1. Approximately 425 cfs would be directed to this channel which is no greater than the quantity of flows currently received by Verdugo to the south of the existing Happy Valley Wash. This improved conveyance channel is proposed through the central portions of the Verdugo project and then conveyed to the east along the south side of the Altamira project. The conceptual design of the improved conveyance channel for Wash 5 flows is generally consistent with the preliminary drainage design contemplated for both the Verdugo and Altamira projects. These flows would likely be attenuated by a proposed detention basin at the southern end of the Altamira project and/or could outlet to the detention basin located on the ASLD property.

Along the Happy Valley Channel, a designed flow split at 155th Avenue would direct approximately 55% of the flows south into an improved conveyance channel proposed along the east side of 155th Avenue.

The 155th Avenue flows are also conveyed in an improved conveyance channel proposed along the east side of the planned 155th Avenue roadway improvements. The 155th Avenue flows would outlet into an approximate 53-acre detention basin that would attenuate flows and bleed off larger events (if needed) along the northerly edge of the Beardsley Canal towards the existing overchute.

Contributing flows from both the Happy Valley Channel and detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year storm. The current basin size, shape, and orientation represents a hydrologically efficient and effective design that captures the 100-year floodplain and having the added benefit of maximizing developable land area which supports the ASLD beneficiary objectives.

In evaluating multi-use and recreation opportunities for either proposed basin, the City of Surprise currently does not envision the need for a park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be in modified shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

Table 4.12 – Alternative #4 Channel Conceptual Design Characteristics

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	154 feet	700	1,750	5 feet	22 feet	30 each side	16 feet on north and south bank	40 feet on north side
HV Section 2	212 feet	1,625	850	5 feet	80 feet	30 each side	16 feet on north and south bank	40 feet on north side
HV Section 3	154 feet	725	3,500	5 feet	22 feet	30 each side	16 feet on north and south bank	40 foot on north side
Wash5 (south of HV Rd.)	162 feet	425	8,650	4 feet	18 feet	24 each side	16 feet on east bank	40 foot on each side
155th Ave. Sect. 1	166 feet	925	4,600	5 feet	34 feet	30 feet each side	16 feet on east and west bank	40 feet on east side

** Includes 1 foot of freeboard

Table 4.13 – Alternative #4 Basin Conceptual Design Characteristics

Basin	Acreage	Top Width	Depth	Side Slopes
#1	23 acres	550 feet	4 feet	6:1
#2	48 acres	325 feet	4 feet	6:1

4.5.2 Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement the character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

4.5.3 Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #4 includes the findings and assumptions identified in Table 4.14. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.14 – Hydraulic Modeling Conditions, Findings, and Assumptions

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	700	4	0.035	0.004	0.0025	1 foot
HV Section 2	1,625	4	0.035	0.004	0.0018	1 foot
HV Section 3	725	4	0.035	0.003	0.0024	1 foot
Wash 5 (south of HV Rd.)	425	4	0.035	0.005	0.0035	1 foot
155th Ave. Sect. 1	925	4	0.035	0.006	0.0022	1 foot

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of these areas observations include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance channel is intended to be absorbed into the 40-foot landscape buffer or 16 foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

4.5.4 Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate

the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel and basin landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

4.5.5 Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

In evaluating multi-use and recreation opportunities for the proposed basins, the City of Surprise currently does not envision the need for a park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be in modified shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

4.5.6 Opportunities and Constraints

1. Acquisition of property from ASLD for 155th Avenue Channel and detention basin and acquisition from private property owner for Basin #1 is necessary.

2. Alternative #4 represents the most linear feet of channel to be constructed of all alternatives considered.

3. Alternative's #3 and #4 provide the most attenuation of flow rates through stakeholder properties.

4. Basin location increases the developable land area of the ASLD parcel that would otherwise not occur under Alternative #3.

5. Right-of-Way for the inclusion of Basin #1 must be acquired from impacted property owner(s) and include a small segment where grade ties are challenged.

6. Acquisition of private property between the Verdugo property and Happy Valley Road is needed to accommodate the conveyance of Wash 5 flows south of Happy Valley Road.

7. Verdugo and Altamira projects are required to only take flows (approximately 425 cfs) consistent with historic patterns; no upsizing of facilities are necessary.

8. Multi-use trail opportunities are provided along channel corridors though alignments not entirely consistent with City of Surprise Trails Master Plan.

9. Though existing wash is not preserved, alternative maintains scenic quality of area by providing improved conveyance channels with enhanced landscaping.

10. Alternative #4 represents the most expensive alternative in regards to long term operation and maintenance costs due to having the most lineal footage of improved channels as well the inclusion of two basins.

4.5.7 Opinion of Probable Costs

The following is a preliminary estimate of the probable cost to construct the channel and basin facilities for Proposed Alternative #4. The cost estimate included herein attempts to capture the major cost components identified with Proposed Alternative #4.

Table 4.15 – Proposed Alternative #4 Opinion of Probable Cost

Proposed Alternative 4	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		16852	CY	$ 4.00	$ 67,408.00
Landscaping		231000	SF	$ 1.00	$ 231,000.00
Right-of-Way		6.2	AC	$ 40,000.00	$ 248,000.00
Drop Structures		1	Each	$ 4,312.00	$ 4,312.00
SubTotal					**$ 550,720.00**
Happy Valley Section 2					
Channel Excavation		17315	CY	$ 4.00	$ 69,260.00
Landscaping		112200	SF	$ 1.00	$ 112,200.00
Right-of-Way		4.1	AC	$ 40,000.00	$ 164,000.00
Drop Structures		3	Each	$ 15,680.00	$ 47,040.00
SubTotal					**$ 392,500.00**
Happy Valley Section 3					
Channel Excavation		33704	CY	$ 4.00	$ 134,816.00

Proposed Alternative 4	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Landscaping		462000	SF	$ 1.00	$ 462,000.00
Right-of-Way		12.4	AC	$ 40,000.00	$ 496,000.00
Drop Structures		3	Each	$ 4,312.00	$ 12,936.00
SubTotal					**$ 1,105,752.00**
Wash 5 South of Happy Valley					
Channel Excavation		53822	CY	$ 4.00	$ 215,288.00
Landscaping		1245600	SF	$ 1.00	$ 1,245,600.00
Right-of-Way		32.2	AC	$ 40,000.00	$ 1,288,000.00
Drop Structures		4	Each	$ 3,528.00	$ 14,112.00
SubTotal					**$ 2,763,000.00**
155th Avenue					
Channel Excavation		54519	CY	$ 4.00	$ 218,076.00
Landscaping		607200	SF	$ 1.00	$ 607,200.00
Right-of-Way		17.5	AC	$ 40,000.00	$ 700,000.00
Drop Structures		7	Each	$ 6,664.00	$ 46,648.00
SubTotal					**$ 1,571,924.00**
163rd Avenue / Happy Valley Basin					
Basin Excavation		201336	CY	$ 4.00	$ 805,344.00
Landscaping		962676	SF	$ 1.00	$ 962,676.00
Right-of-Way		22.1	AC	$ 40,000.00	$ 884,000.00
SubTotal					**$ 2,652,020.00**
State Land Basin					
Basin Excavation		237456	CY	$ 4.00	$ 949,824.00
Landscaping		2278188	SF	$ 1.00	$ 2,278,188.00
Right-of-Way		52.3	AC	$ 40,000.00	$ 2,092,000.00
SubTotal					**$ 5,320,012.00**
Culverts					
Wash 5 Happy Valley Road 3 - 8 ft x 4 ft box culverts	3	142	LF	$ 600.00	$ 255,600.00
Wash 5 155th Ave 3 - 8ft x 4 ft box culverts	3	142	LF	$ 600.00	$ 255,600.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	142	LF	$ 750.00	$ 319,500.00
Happy Valley Road / 155th Ave South 5 - 8 ft x 4 ft box culverts	5	272	LF	$ 600.00	$ 816,000.00
Wash 10 Happy Valley Road 4 - 8 ft x 4 ft box culverts	4	202	LF	$ 600.00	$ 484,800.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00

Proposed Alternative 4	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	80	LF	$ 750.00	$ 240,000.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	80	LF	$ 750.00	$ 240,000.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	80	LF	$ 750.00	$ 240,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	80	LF	$ 600.00	$ 144,000.00
SubTotal					**$ 4,327,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Wash 5 Happy Valley Road 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 155th Ave 3 - 8ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Happy Valley Road / 155th Ave South 5 - 8 ft x 4 ft box culverts	5	$4,838.00	$ 8,065.00	$ 4,850.00	$ 17,753.00
Wash 10 Happy Valley Road 4 - 8 ft x 4 ft box culverts	4	$4,366.00	$ 7,215.00	$ 3,790.00	$ 15,371.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
155th Avenue Entrance Road 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
Wash 5 Crossing 3 - 8 ft x 4 ft box	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00

Proposed Alternative 4	# Barrels	Quantity	Unit	Unit Cost	Total Cost
culverts					
Wash 5 Crossing 3 - 8 ft x 4 ft box culverts	3	$3,894.00	$ 6,365.00	$ 2,730.00	$ 12,989.00
SubTotal					**$ 241,104.00**
Itemized Project Components					
Excavation					**$ 2,460,016.00**
Landscaping					**$ 5,898,864.00**
Right-of-Way					**$ 5,872,000.00**
Drop Structures					**$ 125,048.00**
Culverts					**$ 4,568,604.00**
Design					**$ 1,892,453.20**
Construction Management					**$ 1,513,962.56**
Contingency					**$ 3,915,759.60**
Total					**$26,246,707.36**
Alternative 4 Total Cost					**$26,246,707.36**

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Basin acreage and landscaping costs include a 30% contingency beyond hydrology modeling sizing.

6. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

7. Cost estimate includes culvert crossing for vehicular project entry locations as follows: two entrances for Tierra Verde West, one entrance for Tierra Verde East, three

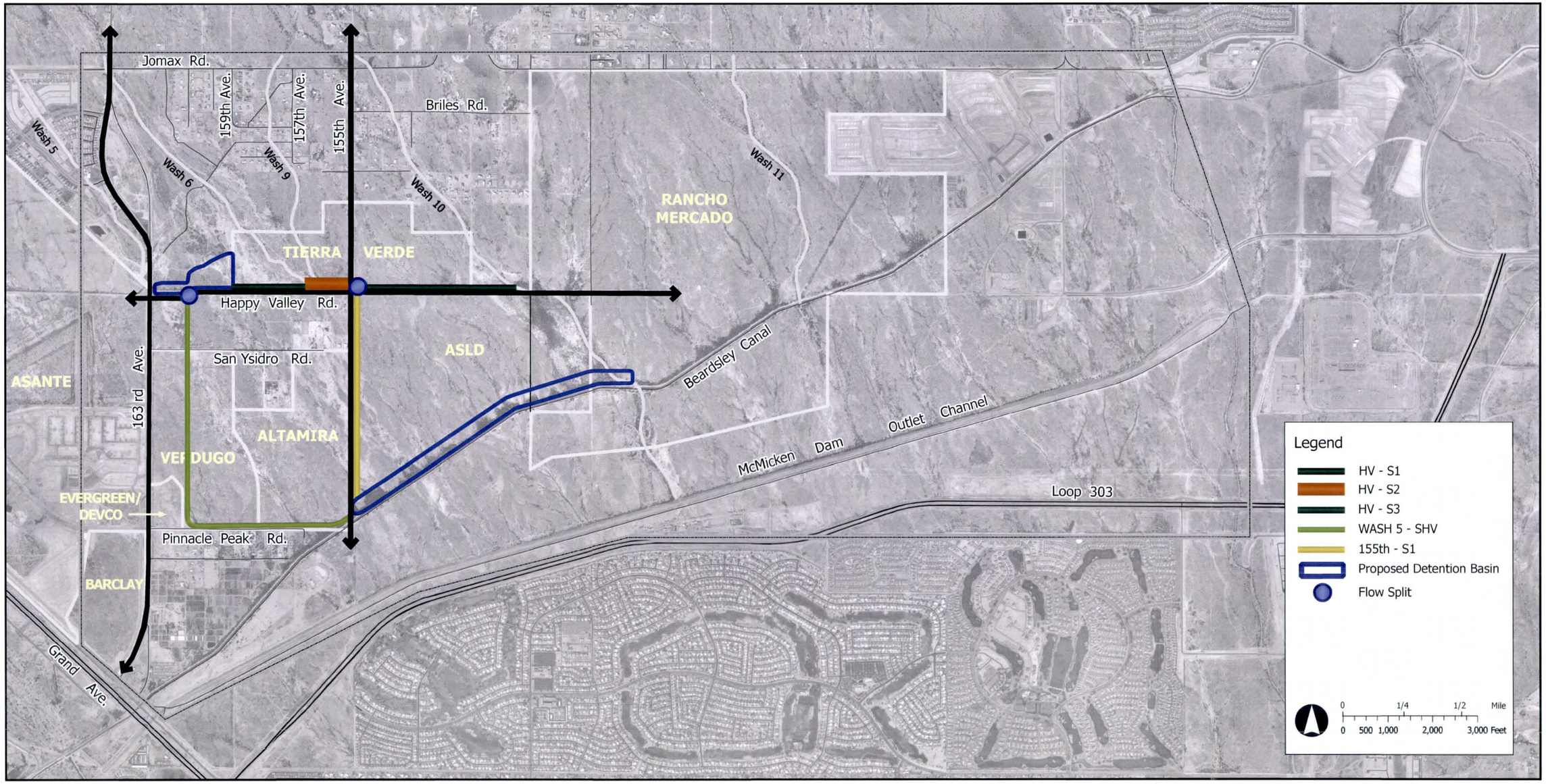
entrances onto ASLD parcel from 155th Avenue and one vehicular entrance each for the Verdugo and Altamira projects off Pinnacle Peak Road. Number of entrances and locations based on conformance with the preliminary plat for Tierra Verde East and presumed City of Surprise requirements.

8. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

Figure 4.4 - Proposed Alternative 4

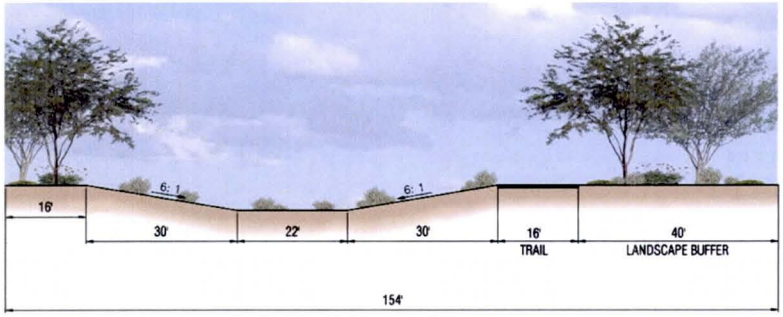
Happy Valley Design Concept Report

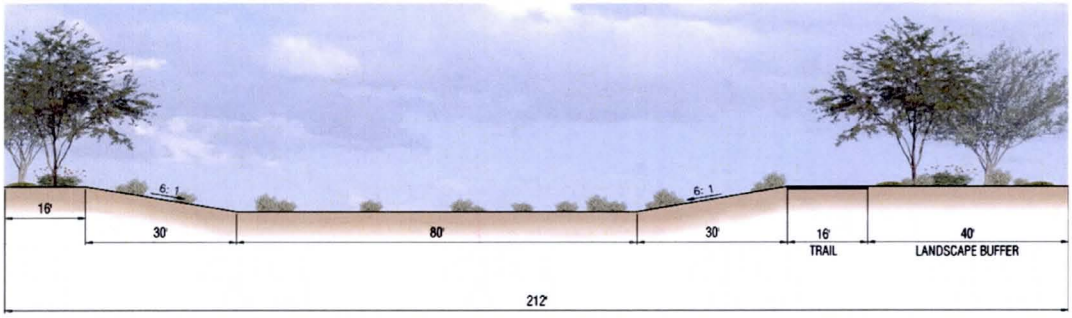
Alternative 4 - Hybrid Scenario

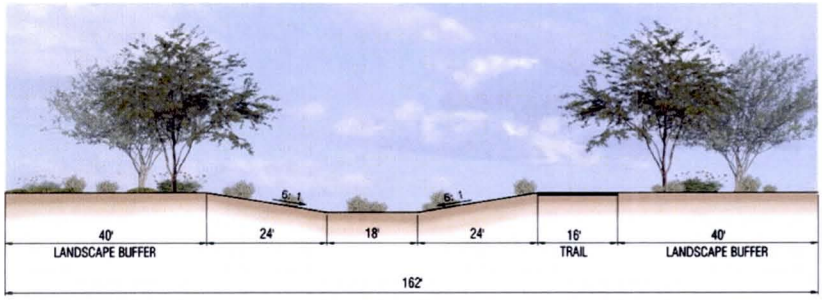


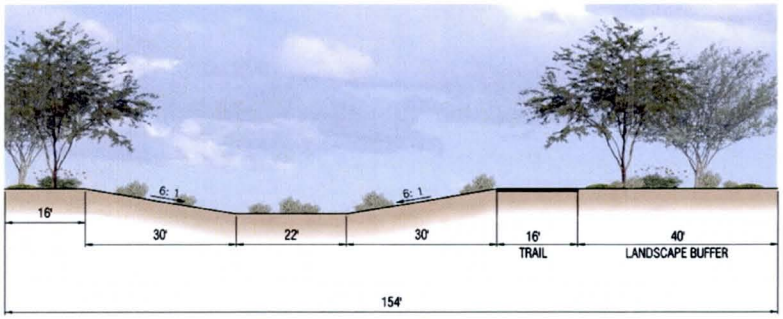
2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

Proposed Alternative 4 Cross-Sections





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30'
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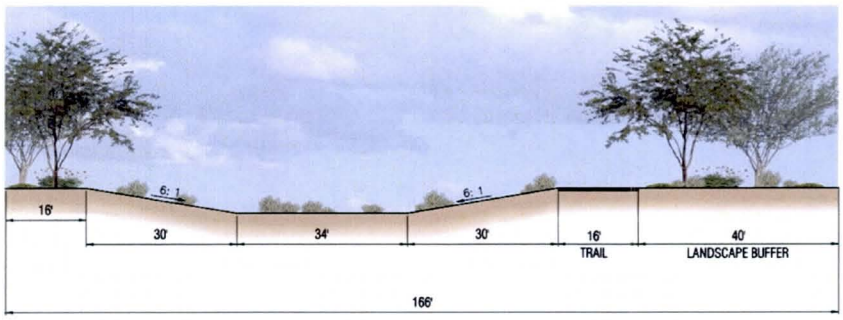
TRAIL
40'
LANDSCAPE BUFFER
154'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6: 1
16'
30'
34'
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TRAIL
40'
LANDSCAPE BUFFER
166'

4.6 ALTERNATIVE #5 – NO ACTION

4.6.1 DESCRIPTION

Alternative #5, the *No Action Alternative* represents what improvements would conceivably be required by each individual property owner to accommodate the conveyance and storage of flows in the event that there was little to no cooperation amongst neighboring property owners/developers. The No Action alternative is in reality "no cooperative action" in that channel and/or basin improvements are proposed independent from one another, thereby creating redundancies and inefficiencies in the overall conveyance system "network", but nevertheless completed in an individual manner and timeline.

A key underlying assumption of the No Action Alternative that remains a constant - each property owner/developer in the No Action scenario must design their respective conveyance and/or retention facilities under their "worst case scenario" and represents what facilities that property owner must design and construct if they were the first property to develop in the area. In addition, the drainage is designed such that each property owner provides at least one 100-year all weather vehicular access point. Generally speaking, the "worst case scenario" for property owners to the north of the Happy Valley Channel alignment suggests that these properties must accept all offsite flows from Washes 5, 6, and 9 and size onsite channels and Happy Valley Channel under the presumption that the berm functions and does not fail. The "worst case scenario" for property owners south of Happy Valley Wash suggests that they must size, design, and construct wash improvements to accept added flows that reflects a "no-berm condition" of Happy Valley Wash. The exception is the Arizona State Land Department (ASLD) parcel, whereby their "worst case scenario" consists of a combination of both of these conditions.

In an individual and isolated manner, the No Action alternative presumes that each of the respective projects would be required to design and construct the following improvements:

4.6.2 TIERRA VERDE

Happy Valley Channel would be designed and constructed along the property frontage that would need to accommodate the flows that would be equivalent to the existing wash condition inclusive of the berm, i.e. "worst case" from a Tierra Verde perspective.

Happy Valley Channel Section 1 would need to be constructed from 163rd Avenue to just upstream of where the Wash 6 breakout flows impact the Happy Valley Wash. This

channel section is approximately 950 feet in length and consists of a 24-foot channel bottom conveying approximately 750 cfs.

Happy Valley Channel Section 2 would be constructed to collect and convey the Wash 6 breakout flows plus flows from the 163rd Avenue culvert. This section extends easterly until a point leading to its confluence with Wash 6 & 9. Section 2 then includes a 4-foot deep (plus one foot of freeboard), 64-foot channel bottom and a total facility width of approximately 196-feet wide. This section would accommodate approximately 1,375 cfs.

Happy Valley Channel Section 3 would increase in size as it is planned to accommodate the increased contributing flows from Wash 6 & 9. Section 3 then would run along the majority of the Tierra Verde property frontage from the Wash 6 & 9 confluence to where breakout occurs to the south. Section 3 will convey 2,400 cfs within a 130-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 262-feet.

Happy Valley Channel Section 4 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 4 then would run along the Tierra Verde property frontage to where the next breakout occurs to the south. Section 4 will convey 2,150 cfs within a 114-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 246 feet.

Happy Valley Channel Section 5 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 5 would then run along the Tierra Verde property frontage until reaching the eastern property boundary. Section 5 would convey 1,600 cfs within an 80-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 212 feet. Termination of Section 5 would require some additional grading to properly discharge flows and is not captured in the cost estimate for Tierra Verde.

Table 4.16 – Alternative #5 Channel Conceptual Design Characteristics – Tierra Verde

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 2	196 feet	1,375	1,700	5 feet	64 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 3	262 feet	2,400	1,850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 4	246 feet	2,150	1,275	5 feet	114 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 5	212 feet	1,600	300	5 feet	80 feet	30 feet each side	16 feet on north and south bank	40 feet on north side

* DEI's 100-year 6-hour flow

Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #5, No Action – Tierra Verde, includes the findings and assumptions identified in Table 4.17. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.17 – Hydraulic Modeling Conditions, Findings, and Assumptions – Tierra Verde

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	750*	4	.035	0.004	0.0024	1 foot
HV Section 2	1,375	4	0.035	0.004	0.0019	1 foot
HV Section 3	2,400	4	0.035	0.004	0.0017	1 foot
HV Section 4	2,150	4	0.035	0.004	0.0017	1 foot
HV Section 5	1,600	3.9	0.035	0.003	0.0018	1 foot

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance cannel is intended to be absorbed into the 40-foot landscape buffer or the 16-foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings

along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No basins are proposed in this alternative and as a result, no multi-use opportunities for basins were evaluated.

Opportunities and Constraints – Tierra Verde

1. The practical application of the No Action Alternative is limiting under the presumption that each project is operating independently and in isolation of one another. The No Action alternative is therefore a more theoretical analysis as opposed to a probable implementation pattern. However, the No Action Alternative provides a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. This fact triggers a multitude of assumptions that must be contemplated in order to carry out the supposed implementation of each independent design solution. One change to any one scenario will alter the assumptions and approach of another project's required design.

2. Inefficiencies and redundant capacity in channel facilities is common due to each project having to independently provide a solution that in no way recognizes nor benefits from adjacent/nearby improvements.

3. Floodplain is significantly reduced for all properties in the study area. Properties south of the existing Happy Valley Wash in particular benefit from reduced floodplain without the burden of constructing Happy Valley Channel facilities.

4. The scenic quality of the Happy Valley Channel is designed and constructed to be thematically consistent with the natural wash today.

5. Economies of scale are lost in the non-uniform design of channels, oversizing/redundancy and cost to construct improved channels, and right-of-way acquisition costs are increased due to the lack of regional cooperation.

6. Operation & Maintenance efficiencies are maximized as one linear channel will accommodate the conveyance of the majority of flows in the study area.

Opinion of Probable Cost – Tierra Verde

The following is a preliminary estimate of the probable costs to construct the channel facilities for The No Action Alternative – Tierra Verde.

Table 4.18 – Proposed Alternative #5 Opinion of Probable Cost – Tierra Verde

Tierra Verde Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		9500	CY	$ 4.00	$ 38,000.00
Landscaping		125400	SF	$ 1.00	$ 125,400.00
Right-of-Way		3.4	AC	$ 40,000.00	$ 136,000.00
Drop Structures		1	Each	$ 4,704.00	$ 4,704.00
SubTotal					**$ 304,104.00**
Happy Valley Section 2					
Channel Excavation		45778	CY	$ 4.00	$ 183,112.00
Landscaping		339900	SF	$ 1.00	$ 339,900.00
Right-of-Way		11.7	AC	$ 40,000.00	$ 468,000.00
Drop Structures		2	Each	$ 12,544.00	$ 25,088.00
SubTotal					**$ 1,016,100.00**
Happy Valley Section 3					
Channel Excavation		54815	CY	$ 4.00	$ 219,260.00
Landscaping		244200	SF	$ 1.00	$ 244,200.00
Right-of-Way		11.1	AC	$ 40,000.00	$ 444,000.00
Drop Structures		1	Each	$ 25,480.00	$ 25,480.00
SubTotal					**$ 932,940.00**
Happy Valley Section 4					

Tierra Verde Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Channel Excavation		34000	CY	$ 4.00	$ 136,000.00
Landscaping		168300	SF	$ 1.00	$ 168,300.00
Right-of-Way		7.2	AC	$ 40,000.00	$ 288,000.00
Drop Structures		2	Each	$ 22,344.00	$ 44,688.00
SubTotal					**$ 636,988.00**
Happy Valley Section 5					
Channel Excavation		6111	CY	$ 4.00	$ 24,444.00
Landscaping		39600	SF	$ 1.00	$ 39,600.00
Right-of-Way		1.5	AC	$ 40,000.00	$ 60,000.00
Drop Structures		0	Each	$ 15,680.00	$ -
SubTotal					**$ 124,044.00**
Culverts					
155th Avenue 9 - 10 ft x 4 ft box culverts	9	142	LF	$ 750.00	$ 958,500.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde East Entrance Road 8 - 10 ft x 4 ft box culverts	8	80	LF	$ 750.00	$ 480,000.00
Tierra Verde East Happy Valley Flow Split 1 1 - 10 ft x 4 ft box culverts	1	150	LF	$ 750.00	$ 112,500.00
Tierra Verde East Happy Valley Flow Split 2 3 - 10 ft x 4 ft box culverts	3	150	LF	$ 750.00	$ 337,500.00
SubTotal					**$ 2,128,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
155th Avenue 9 - 10 ft x 4 ft box culverts	9	$7,720.00	$ 13,208.00	$ 11,708.00	$ 32,636.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde East Entrance Road 8 - 10 ft x 4 ft box culverts	8	$7,130.00	$ 12,167.00	$ 10,357.00	$ 29,654.00
Tierra Verde East Happy Valley Flow Split 1 1 - 10 ft x 4 ft box culverts	1	$3,000.00	$ 4,880.00	$ 900.00	$ 8,780.00
Tierra Verde East Happy Valley Flow Split 2 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
SubTotal					**$ 133,194.00**

Tierra Verde Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Itemized Project Components					
Excavation					$ 600,816.00
Landscaping					$ 917,400.00
Right-of-Way					$ 1,396,000.00
Drop Structures					$ 99,960.00
Culverts					$ 2,741,694.00
Design					$ 575,587.00
Construction Management					$ 460,469.60
Contingency					$ 1,307,961.00
Total					$ 8,099,887.60
Tierra Verde Alternative 5 Total Cost					$ 8,099,887.60

Table 4.19 – No Action Total Cost Estimate Summary – Tierra Verde

Stakeholder Property	No Action Tierra Verde Estimate	Additional Costs Captured on Other Stakeholder Property	Tierra Verde Total Cost to Develop First
Tierra Verde	$8,099,888	$0	$8,099,888

Table 4.19 summarizes the opinion of probable cost estimate for the Tierra Verde project. Additional costs captured as a component of another stakeholder's project (if applicable) are also identified so as to demonstrate the total cost that may be incurred should the Tierra Verde project be the first to develop under the No Action scenario.

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

6. Costs include culverts necessary for entry road improvements identified from the Tierra Verde Preliminary Plat design. This consists of two entrance roads for Tierra Verde West and one entrance road for Tierra Verde East.

7. Additional culverts were identified for Tierra Verde East to accommodate previously identified overtopping conditions at the eastern terminus of Happy Valley Channel Sections three and four.

8. Added costs include 10% for design, 8% for construction management, and 30% for contingency. The contingency is based on the construction items and does not include the cost of land acquisition.

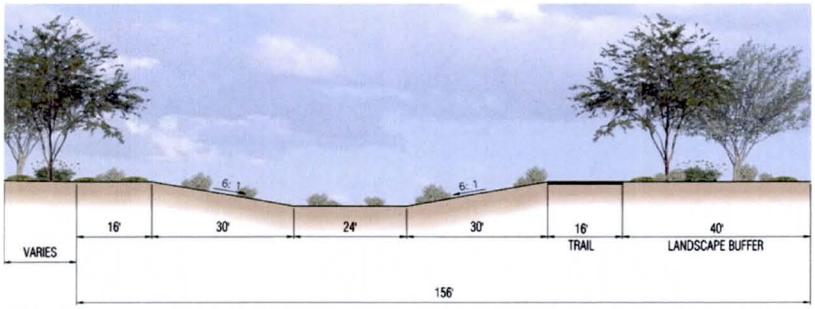
Figure 4.5 - Proposed Alternative 5: Tierra Verde

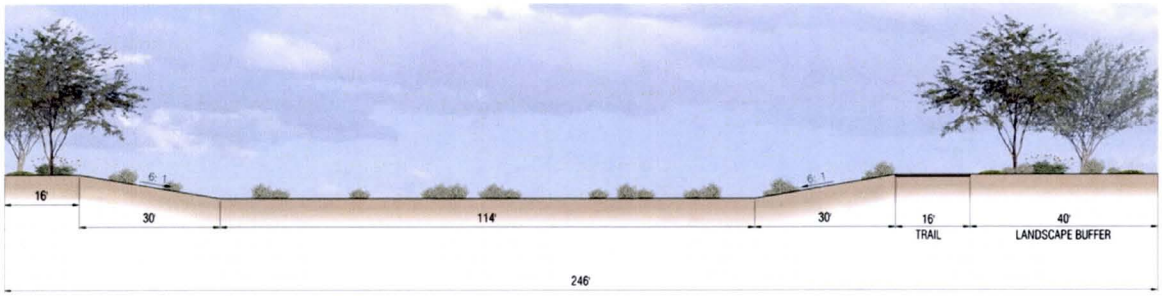
Happy Valley Design Concept Report

Alternative 5 - No Action: Tierra Verde

2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

PROPOSED ALTERNATIVE 5: TIERRA VERDE CROSS-SECTIONS

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4.6.3 Rancho Mercado

Following the presumption that the No Action Alternative identifies the necessary improvements needed without cooperation/facilities built by others and that the project is built first, the Rancho Mercado property would be required to construct the same five Happy Valley Channel sections identified for the Tierra Verde property plus a sixth Happy Valley Channel section. This sixth channel is an extension of Section 5 and provides a linkage from the termination of Happy Valley Channel Section 5 from the eastern terminus of the Tierra Verde property to approximately the confluence of Wash 10 near the Rancho Mercado property line.

Happy Valley Channel Section 1 would need to be constructed from 163rd Avenue to just upstream of where the Wash 6 breakout flows impact the Happy Valley Wash. This channel section is approximately 950 feet in length and consists of a 24-foot channel bottom conveying approximately 750 cfs.

Happy Valley Channel Section 2 would be constructed to collect and convey the Wash 6 breakout flows plus flows from the 163rd Avenue culvert, extending easterly until a point leading to its confluence with Wash 6 & 9. Section 2 then includes a 4-foot deep (plus one foot of freeboard), 64-foot channel bottom and a total facility width of approximately 196-feet wide. This section would accommodate approximately 1,375 cfs.

Happy Valley Channel Section 3 would increase in size as it is planned to accommodate the increased contributing flows from Wash 6 & 9. Section 3 then would run along the majority of the Tierra Verde property frontage from the Wash 6 & 9 confluence to where breakout occurs to the south. Section 3 will convey 2,400 cfs within a 130-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 262-feet.

Happy Valley Channel Section 4 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 4 then would run along the Tierra Verde property frontage to where the next breakout occurs to the south. Section 4 will convey 2,150 cfs within a 114-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 246 feet.

Happy Valley Channel Section 5 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 5 would then run along the Tierra Verde property frontage until reaching the eastern property boundary.

Section 5 would convey 1,600 cfs within an 80-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 212 feet.

Happy Valley Channel Section 6 provides for the easterly extension of the Happy Valley channel beyond the eastern terminus of the Tierra Verde property line to approximately the confluence with Wash 10 near the Rancho Mercado property line. Section 6 is approximately 950 feet in length, has a channel bottom of approximately 80 feet conveying approximately 1,600 cfs.

Table 4.20 – Alternative #5 Channel Conceptual Design Characteristics – Rancho Mercado

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 2	196 feet	1,375	1,700	5 feet	64 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 3	262 feet	2,400	1,850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 4	246 feet	2,150	1,275	5 feet	114 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 5	212 feet	1,600	300	5 feet	80 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 6	212 feet	1,600	950	5 feet	80 feet	30 feet each side	16 feet on north and south bank	40 feet on north side

Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

HYDROLOGIC/HYDRAULIC CONSIDERATIONS

Hydraulic modeling conducted for Proposed Alternative #5, No Action – Rancho Mercado, includes the findings and assumptions identified in Table 4.21. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.21 – Hydraulic Modeling Conditions, Findings, and Assumptions – Rancho Mercado

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	750*	4	.035	0.004	0.0024	1 foot
HV Section 2	1,375	4	0.035	0.004	0.0019	1 foot
HV Section 3	2,400	4	0.035	0.004	0.0017	1 foot
HV Section 4	2,150	4	0.035	0.004	0.0017	1 foot
HV Section 5	1,600	3.9	0.035	0.003	0.0018	1 foot
HV Section 6	1,600	3.9	0.035	0.003	0.0018	1 foot

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance cannel is intended to be absorbed into the 40-foot landscape buffer or the 16-foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No basins are proposed in this alternative and as a result, no multi-use opportunities for basins were evaluated.

Opportunities and Constraints – Rancho Mercado

1. The practical application of the No Action Alternative is limiting under the presumption that each project is operating independently and in isolation of one another. The No Action alternative is therefore a more theoretical analysis as opposed to a probable implementation pattern. However, the No Action Alternative provides a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. This fact triggers a multitude of assumptions that must be contemplated in order to carry out the supposed implementation of each independent design solution. One change to any one

scenario will alter the assumptions and approach of another project's required design.

2. Inefficiencies and redundant capacity in channel facilities is common due to each project having to independently provide a solution that in no way recognizes nor benefits from adjacent/nearby improvements.

3. Floodplain is significantly reduced for all properties in the study area. Properties south of the existing Happy Valley Wash in particular benefit from reduced floodplain without the burden of constructing Happy Valley Channel facilities.

4. The scenic quality of the Happy Valley Channel is designed and constructed to be thematically consistent with the natural wash today.

5. Operation & Maintenance efficiencies are maximized as one linear channel will accommodate the conveyance of the majority of flows in the study area.

6. Facilities necessary for Rancho Mercado under this No Action alternative are likely not consistent with property owner's previous development intentions, represents a considerable off-site improvement requirement for Rancho Mercado and underscores the need for regional cooperation in order for this No Action alternative to be achieved.

Opinion of Probable Cost – Rancho Mercado

The following is a preliminary estimate of the probable costs to construct the channel facilities for The No Action Alternative – Rancho Mercado.

Table 4.22 – Proposed Alternative #5 Opinion of Probable Cost – Rancho Mercado

Rancho Mercado Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 6					
Channel Excavation		19352	CY	$ 4.00	$ 77,408.00
Landscaping		125400	SF	$ 1.00	$ 125,400.00
Right-of-Way		4.6	AC	$ 40,000.00	$ 184,000.00
Drop Structures		1	Each	$ 15,680.00	$ 15,680.00
SubTotal					**$ 402,488.00**
Culverts					
Wash 10 Happy Valley Road 8 - 10 ft x 4 ft box culverts	8	202	LF	$ 750.00	$ 1,212,000.00
SubTotal					$ 1,212,000.00

Rancho Mercado Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Wash 10 Happy Valley Road 8 - 10 ft x 4 ft box culverts	8	$7,130.00	$ 12,167.00	$ 10,357.00	$ 29,654.00
SubTotal					$ 29,654.00
Itemized Project Components					
Excavation					**$ 77,408.00**
Landscaping					**$ 125,400.00**
Right-of-Way					**$ 184,000.00**
Drop Structures					**$ 15,680.00**
Culverts					**$ 1,241,654.00**
Design					**$ 164,414.20**
Construction Management					**$ 131,531.36**
Contingency					**$ 438,042.60**
Additional Cost Captured on Other Properties					**$ 8,099,887.60**
Total					**$10,478,017.76**
Rancho Mercado Alternative 5 Total Cost					**$10,478,017.76**

Table 4.23 – No Action Total Cost Estimate Summary – Rancho Mercado

Stakeholder Property	No Action Rancho Mercado Estimate	Additional Costs Captured on Other Stakeholder Property	Rancho Mercado Total Cost to Develop First
Rancho Mercado	$2,378,130	$8,099,888	$10,478,018

Table 4.23 summarizes the opinion of probable cost estimate for the Rancho Mercado project. Additional costs captured as a component of another stakeholder's project (if applicable) are also identified so as to demonstrate the total cost that may be incurred should the Rancho Mercado project be the first to develop under the No Action scenario.

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

6. Additional culverts were identified for Rancho Mercado to accommodate the crossing of Wash 10 under Happy Valley Road. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

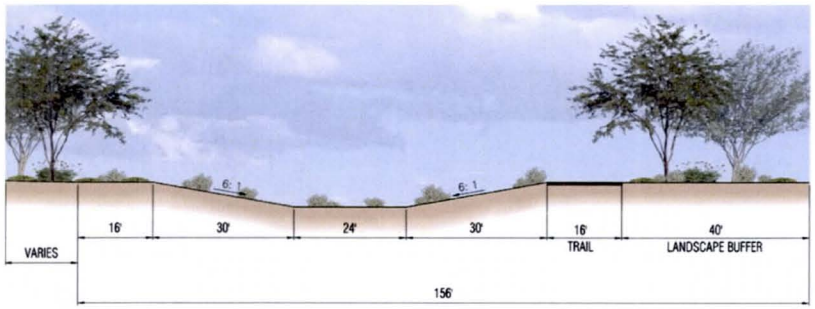
7. Added costs include 10% for design, 8% for construction management, and 30% for contingency. The contingency is based on the construction items and does not include the cost of land acquisition.

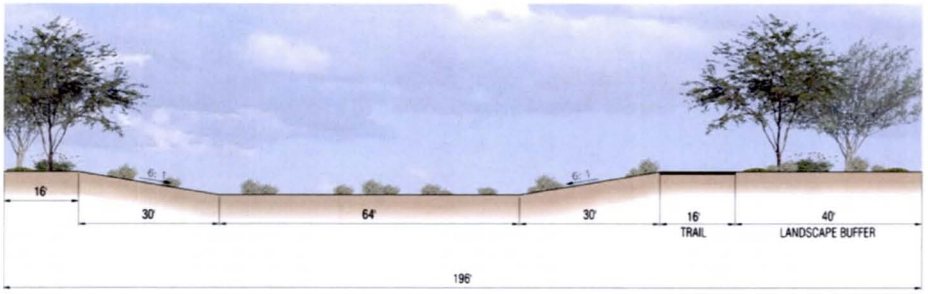
Figure 4.6 - Proposed Alternative 5: Rancho Mercado

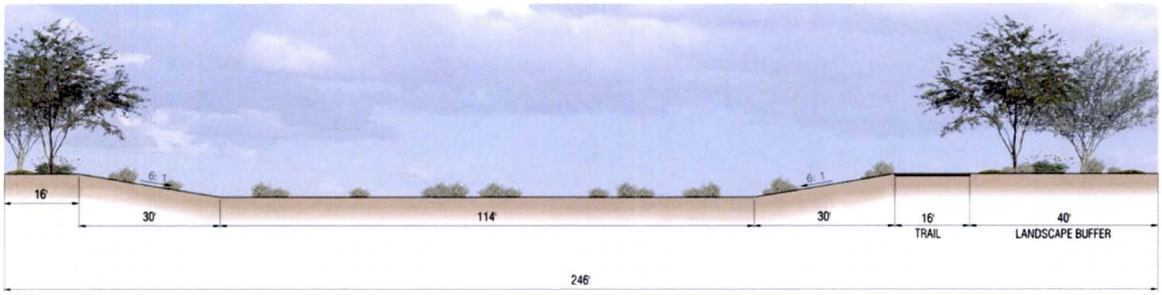
Happy Valley Design Concept Report

Alternative 5 - No Action: Rancho Mercado

PROPOSED ALTERNATIVE 5: RANCHO MERCADO CROSS-SECTIONS



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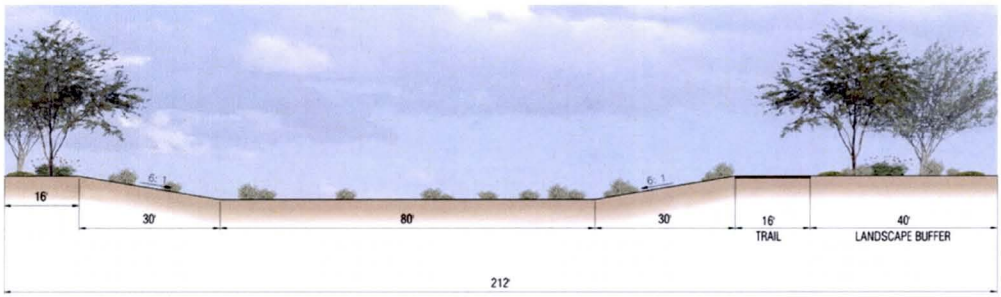
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4.6.4 Arizona State Land Department

The theoretical application of the No Action alternative, with it's key assumption that the property will develop first (prior to others nearby) with no cooperation or benefit from improvements made by adjacent property owners, represents a sharp contrast from the historical development cycle/approach of the Arizona State Land Department (ASLD). The No Action alternative, however does provide a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. Application of the No Action alternative upon the ASLD, coupled with its geographic location downstream of multiple Happy Valley Wash weirs, particularly compounds the design and cost of a No Action solution for the ASLD.

The application of a "worst case scenario" for the ASLD property includes both the "with berm" and "without berm" conditions. The "with berm" condition applies to the area east of 155th Avenue where the Happy Valley Wash will experience overtopping onto the ASLD parcel at two separate previously identified locations. The "without berm" condition is exacerbated and applicable to the ASLD at the overtopping of the Happy Valley Wash with its confluence with Wash 6 and 9 and two upstream breakouts that ultimately cross 155th Avenue.

What this means for the ASLD, in the application of the No Action alternative whereby ASLD in theory develops prior to any other surrounding properties, is that the ASLD would be required to construct Happy Valley Channel Section 1 through 6 to protect Happy Valley Road (presumed as being required for primary project vehicular access) as well as a redundant conveyance channel along the south side of Happy Valley Road to receive and convey the flows being overtopped from the two locations along Happy Valley Channel. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road.

In addition, the ASLD would be required to construct a conveyance channel along 155th Avenue to receive and convey the flows overtopping the Happy Valley Channel at its confluence with Wash 6 and 9 and two upstream breakouts that ultimately cross 155th Avenue. Moreover, a linear detention basin would be necessary at the southern portion of the ASLD property to attenuate the flows and not exceed the existing flows at the Beardsley Canal overchute. These facilities are more specifically described below.

Happy Valley Channel, Section 1 would need to be constructed from 163rd Avenue to just upstream of where the Wash 6 breakout flows impact the Happy Valley Wash. This channel section is approximately 950 feet in length and consists of a 24-foot channel bottom conveying approximately 750 cfs.

Happy Valley Channel Section 2 would be constructed to collect and convey the Wash 6 breakout flows plus flows from the 163rd Avenue culvert, extending easterly until a point leading to its confluence with Wash 6 & 9. Section 2 then includes a 4-foot deep (plus one foot of freeboard), 64-foot channel bottom and a total facility width of approximately 196-feet wide. This section would accommodate approximately 1,375 cfs.

Happy Valley Channel Section 3 would increase in size as it is planned to accommodate the increased contributing flows from Wash 6 & 9. Section 3 then would run along the majority of the Tierra Verde property frontage from the Wash 6 & 9 confluence to where breakout occurs to the south. Section 3 will convey 2,400 cfs within a 130-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 262-feet.

Happy Valley Channel Section 4 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 4 then would run along the Tierra Verde property frontage to where the next breakout occurs to the south. Section 4 will convey 2,150 cfs within a 114-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 246 feet.

Happy Valley Channel Section 5 would decrease in size due to a portion of the flows directed south under existing conditions. Culverts will be constructed to direct the flows south and still provide 100-year access on Happy Valley Road. Section 5 would then run along the Tierra Verde property frontage until reaching the eastern property boundary. Section 5 would convey 1,600 cfs within an 80-foot wide channel bottom, 4-foot deep (plus one foot of freeboard) for an overall facility width of 212 feet.

Happy Valley Channel Section 6 provides for the easterly extension of the Happy Valley channel beyond the eastern terminus of the Tierra Verde property line to approximately the confluence with Wash 10 near the Rancho Mercado property line. Section 6 is approximately 950 feet in length, has a channel bottom of approximately 80 feet conveying approximately 1,600 cfs.

ASLD/Happy Valley Section 1 – Is a proposed channel approximately 1,400 feet in length designed to receive and convey flows from one of the two points of overtopping of the Happy Valley Channel along the north side of Happy Valley Road. This channel section includes an 8-foot channel bottom and a total facility width of 140-feet including the prescribed buffers utilized on all channel sections.

ASLD/Happy Valley Section 2 – The easterly extension of the ASLD/Happy Valley Section 1 at the point where the second weir (culvert under proposed condition) from the Happy Valley Channel contributes its flows to the south. This channel section then is increased to a 26-foot channel bottom to convey the increased flows at approximately 800 cfs for a total facility width of 158 feet including the buffers.

ASLD/155th Avenue Section 1 – This channel section is designed to receive and convey the Wash 6 and 9 flows overtopping the Happy Valley Channel just south of the Happy Valley Road alignment. This channel section is approximately 3,400 feet long and will convey the approximate 900 cfs of flows that will consist of a 32-foot channel bottom

ASLD/155th Avenue Section 2 – This channel section is the southerly extension of the ASLD/155th Avenue Section 1 designed to accommodate the increased flows from the two contributing weirs of Happy Valley Channel. This section consists of a 78-foot channel bottom to convey the approximately 1,600 cfs.

The 155th Avenue flows would outlet into an approximate 53-acre detention basin that would attenuate flows and bleed off larger events (if needed) along the northerly edge of the Beardsley Canal towards the existing overchute. Contributing flows from both the Happy Valley Channel and the detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU for the 100-year storm.

Table 4.24 – Alternative #5 Channel Conceptual Design Characteristics – ASLD

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Section 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 2	196 feet	1,375	1,700	5 feet	64 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 3	262 feet	2,400	1,850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 4	246 feet	2,150	1,275	5 feet	114 feet	30 feet each side	16 feet on north and south bank	40 feet on north

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
								side
HV Section 5	212 feet	1,600	300	5 feet	80 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Section 6	212 feet	1,600	950	5 feet	80 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
ASLD/HV Section 1	140 feet	250	1,400	5 feet	8 feet*	30 feet each side	16 feet on north and south bank	40 feet on one side
ASLD/HV Section 2	158 feet	800	1,850	5 feet	26 feet	30 feet each side	16 feet on north and south bank	40 feet on one side
ASLD/155th Section 1	164 feet	900	3,400	5 feet	32 feet	30 feet each side	16 feet on east and west bank	40 feet on one side
ASLD/155th Section 2	210 feet	1,600	1,200	5 feet	78 feet	30 feet each side	16 feet on east and west bank	40 feet on one side

*This channel can convey up to 500 cfs. An 8-foot channel bottom is a minimum City requirement.

Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #5, No Action – ASLD, includes the findings and assumptions identified in Table 4.25. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.25 – Hydraulic Modeling Conditions, Findings, and Assumptions – ASLD

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	750*	4	.035	0.004	0.0024	1 foot
HV Section 2	1,375	4	0.035	0.004	0.0019	1 foot
HV Section 3	2,400	4	0.035	0.004	0.0017	1 foot
HV Section 4	2,150	4	0.035	0.004	0.0017	1 foot
HV Section 5	1,600	3.9	0.035	0.003	0.0018	1 foot
HV Section 6	1,600	3.9	0.035	0.003	0.0018	1 foot
ASLD/HV Section 1	250	3.9	0.035	0.003	0.0029	1 foot
ASLD/HV Section 2	800	4	0.035	0.004	0.0024	1 foot
ASLD/155th Ave. Section 1	900	4	0.035	0.006	0.0023	1 foot
ASLD/155th Ave. Section 2	1,600	3.9	0.035	0.005	0.0018	1 foot

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance cannel is intended to be absorbed into the 40-foot landscape buffer or the 16-foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No multi-use opportunities for basins were identified as necessary by the City of Surprise and therefore not evaluated as part of this alternative.

Opportunities and Constraints – ASLD

1. The practical application of the No Action alternative is limiting under the presumption that each project is operating independently and in isolation of one another. The No Action alternative is therefore a more theoretical analysis as opposed to a probable implementation pattern. However, the No Action

alternative provides a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. This fact triggers a multitude of assumptions that must be contemplated in order to carry out the supposed implementation of each independent design solution. One change to any one scenario will alter the assumptions and approach of another project's required design.

2. Inefficiencies and redundant capacity in channel facilities is common due to each project having to independently provide a solution that in no way recognizes nor benefits from adjacent/nearby improvements. This is particularly compounded on the ASLD parcel where extreme inefficiencies would exist and the total cost for ASLD is more than twice the cost of the next most expensive solution under the No Action alternative.

3. The existing floodplain is significantly reduced on the ASLD property, but done so in an inefficient and expensive manner.

4. The No Action alternative does not complement the future community character for the ASLD parcel.

5. The scenic quality of the Happy Valley Channel and other supporting channels are maintained to be thematically consistent with the natural wash today.

6. Under the ASLD No Action scenario in particular, economies of scale are lost in the non-uniform design of channels, oversizing/redundancy and cost to construct improved channels, and right-of-way acquisition costs are increased due to the lack of regional cooperation.

7. Operation & Maintenance for this alternative is not very efficient due to the dependence of multiple channels that would contribute to redundant/unnecessary operation and maintenance costs.

8. Implementation and phasing under this scenario is not likely realistic as ASLD will likely be the last property to develop as disposition of ASLD properties typically do not occur until surrounding development has occurred thereby increasing the value of ASLD parcel for disposition.

Opinion of Probable Cost – ASLD

The following is a preliminary estimate of the probable costs to construct the channel facilities for The No Action Alternative – ASLD.

Table 4.26 – Proposed Alternative #5 Opinion of Probable Cost - ASLD

ASLD Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
ASLD 155th Avenue Section 1					
Channel Excavation		38807	CY	$ 4.00	$ 155,228.00
Landscaping		446160	SF	$ 1.00	$ 446,160.00
Right-of-Way		12.7	AC	$ 40,000.00	$ 508,000.00
Drop Structures		6	Each	$ 6,272.00	$ 37,632.00
SubTotal					**$ 1,147,020.00**
ASLD 155th Avenue Section 2					
Channel Excavation		24000	CY	$ 4.00	$ 96,000.00
Landscaping		158400	SF	$ 1.00	$ 158,400.00
Right-of-Way		5.8	AC	$ 40,000.00	$ 232,000.00
Drop Structures		2	Each	$ 15,288.00	$ 30,576.00
SubTotal					**$ 516,976.00**
ASLD Happy Valley Section 1					
Channel Excavation		9852	CY	$ 4.00	$ 39,408.00
Landscaping		184800	SF	$ 1.00	$ 184,800.00
Right-of-Way		4.5	AC	$ 40,000.00	$ 180,000.00
Drop Structures		0	Each	$ 1,568.00	$ -
SubTotal					**$ 404,208.00**
ASLD Happy Valley Section 2					
Channel Excavation		19247	CY	$ 4.00	$ 76,988.00
Landscaping		244992	SF	$ 1.00	$ 244,992.00
Right-of-Way		6.7	AC	$ 40,000.00	$ 268,000.00
Drop Structures		2	Each	$ 5,096.00	$ 10,192.00
SubTotal					**$ 600,172.00**
State Land Basin					
Basin Excavation		237456	CY	$ 4.00	$ 949,824.00
Landscaping		2278188	SF	$ 1.00	$ 2,278,188.00
Right-of-Way		52.3	AC	$ 40,000.00	$ 2,092,000.00
SubTotal					**$ 5,320,012.00**
Culverts					
ASLD 155th Ave Entrance 4 - 10 ft x 4 ft box culverts	4	80	LF	$ 750.00	$ 240,000.00
ASLD 155th Ave Entrance 4 - 10 ft x 4 ft box culverts	4	80	LF	$ 750.00	$ 240,000.00
ASLD 155th Ave Entrance 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
ASLD Happy Valley Entrance 1 - 10 ft x 4 ft box culverts	1	80	LF	$ 750.00	$ 60,000.00

ASLD Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
ASLD Happy Valley Entrance 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
ASLD 155th Ave Culvert Crossing 4 - 10 ft x 4 ft box culverts	4	214	LF	$ 750.00	$ 642,000.00
ASLD 155th Ave Culvert Crossing 3 - 10 ft x 4 ft box culverts	3	214	LF	$ 750.00	$ 481,500.00
SubTotal					**$ 2,202,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
ASLD 155th Ave Entrance 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
ASLD 155th Ave Entrance 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
ASLD 155th Ave Entrance 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
ASLD Happy Valley Entrance 1 - 10 ft x 4 ft box culverts	1	$3,000.00	$ 4,880.00	$ 900.00	$ 8,780.00
ASLD Happy Valley Entrance 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
ASLD 155th Ave Culvert Crossing 4 - 10 ft x 4 ft box culverts	4	$4,770.00	$ 8,003.00	$ 4,953.00	$ 17,726.00
ASLD 155th Ave Culvert Crossing 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
SubTotal					**$ 115,136.00**
Itemized Project Components					
Excavation					**$ 1,317,448.00**
Landscaping					**$ 3,312,540.00**
Right-of-Way					**$ 3,280,000.00**
Drop Structures					**$ 78,400.00**
Culverts					**$ 2,318,636.00**
Design					**$ 1,030,702.40**
Construction Management					**$ 824,561.92**
Contingency					**$ 2,108,107.20**
Additional Cost Captured on Other Properties					**$10,478,017.76**
Total					**$24,748,413.28**
ASLD Alternative 5 Total Cost					**$24,748,413.28**

Table 4.27 – No Action Total Cost Estimate Summary – ASLD

Stakeholder Property	No Action ASLD Estimate	Additional Costs Captured on Other Stakeholder Property	ASLD Total Cost to Develop First
ASLD	$14,270,396	$10,478,018	$24,748,414

Table 4.27 summarizes the opinion of probable cost estimate for the ASLD project. Additional costs captured as a component of another stakeholder's project (if applicable) are also identified so as to demonstrate the total cost that may be incurred should the ASLD project be the first to develop under the No Action scenario.

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

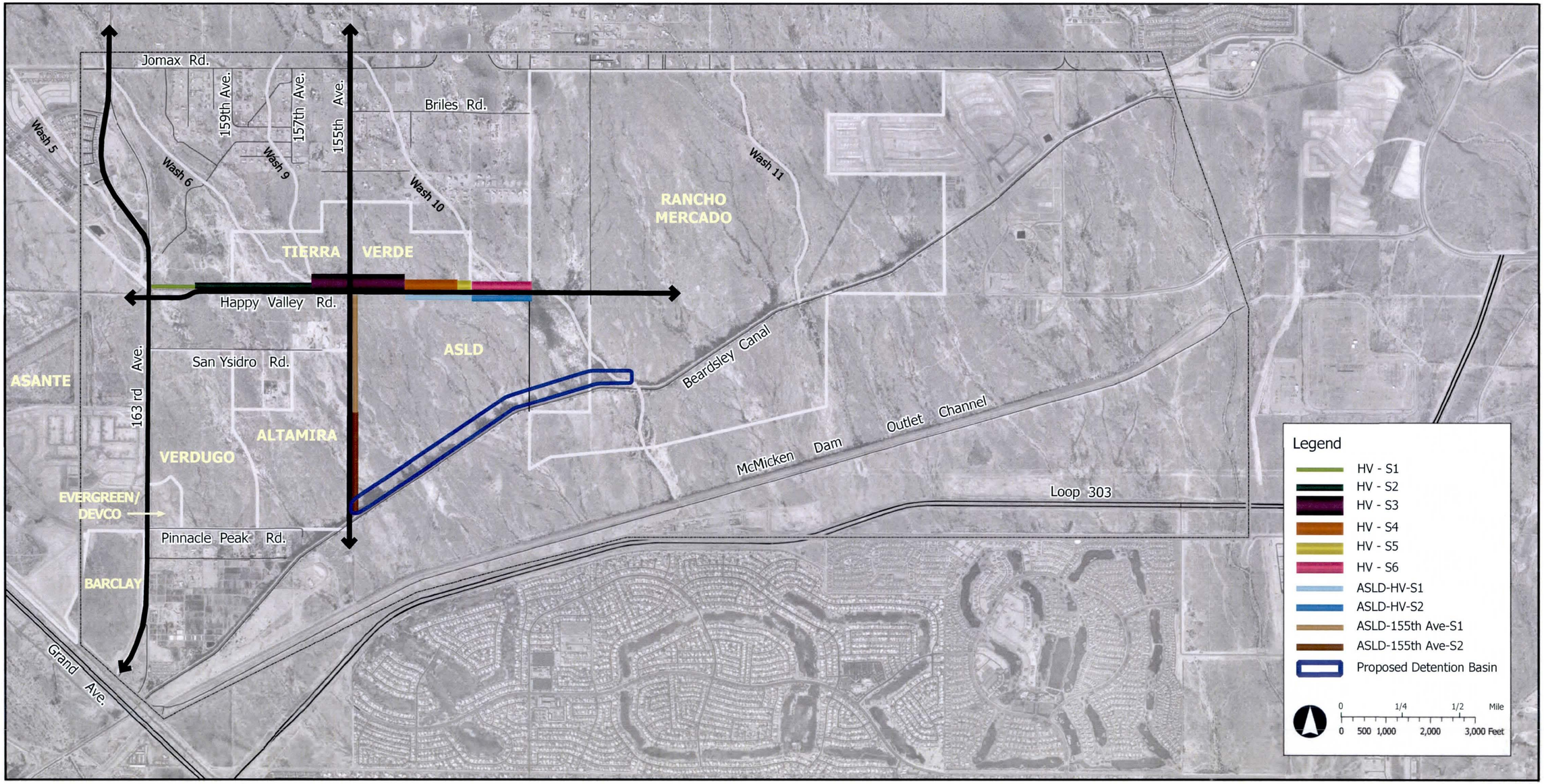
6. Costs include culverts necessary for entry road improvements assumed as necessary and are estimated based upon length of road frontage and presumed residential density for the site. These consist of three entrance roads off 155th Avenue and two entrance roads off of Happy Valley Road.

7. Added costs include 10% for design, 8% for construction management, and 30% for contingency. The contingency is based on the construction items and does not include the cost of land acquisition.

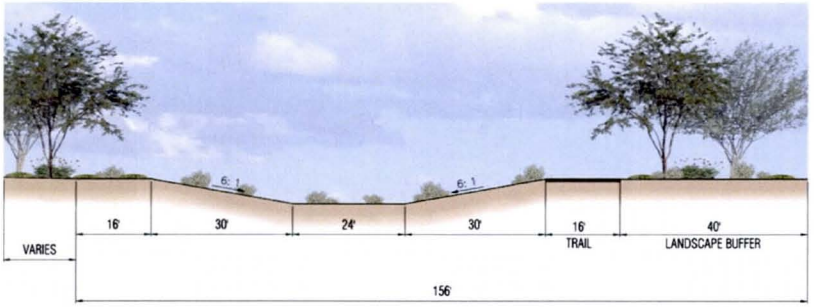
Figure 4.7 - Proposed Alternative 5: ASLD

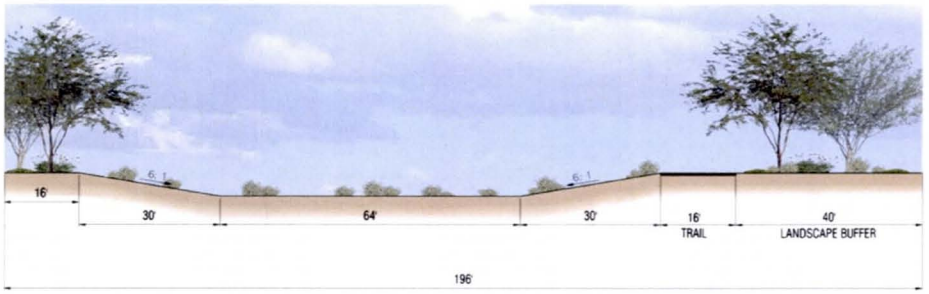
Happy Valley Design Concept Report

Alternative 5 - No Action: ASLD



PROPOSED ALTERNATIVE 5: ARIZONA STATE LAND DEPART CROSS-SECTIONS





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30'
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TRAIL
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LANDSCAPE BUFFER
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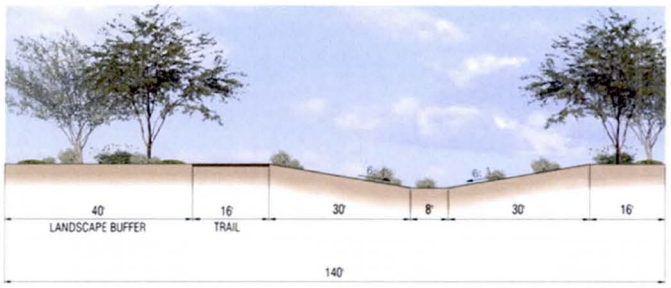
6:1
30'
16'
TRAIL
40'
LANDSCAPE BUFFER
212'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30'
16'
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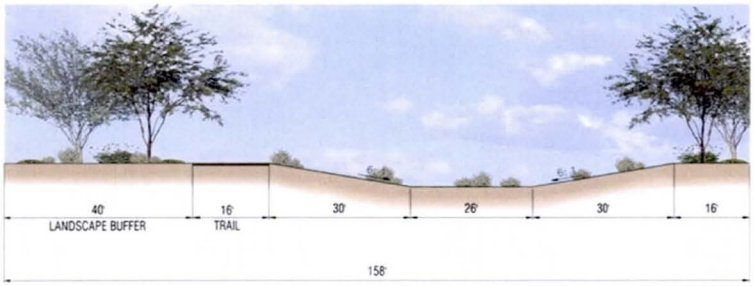
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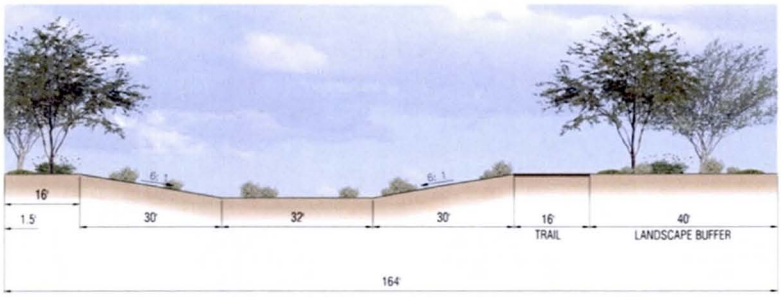
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1.5'
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32'
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16'
TRAIL
40'
LANDSCAPE BUFFER
164'

16'
1.5'
30'
78'
30'
16'
TRAIL
40'
LANDSCAPE BUFFER
210'

4.6.5 Verdugo

The Verdugo project, located south of the Happy Valley Wash alignment, would be tasked with designing and constructing channel facilities for their "worst case scenario" that includes the intercepting the overflows from Happy Valley Wash to the north. This improved collector channel would convey flows through the Verdugo project to the southeast corner of the property where flows would outfall onto the Altamira property and ultimately impound in a likely detention basin on the southern portion of the Altamira property near the north bank of the Beardsley Canal as has historically occurred.

Table 4.28 – Alternative #5 Channel Conceptual Design Characteristics – Verdugo

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
No Action Verdugo Section 1	164 feet	425*	7,125	5 feet	8 feet	30 feet each side	16 feet on one side	40 feet on both sides

* DEI's 100-year, 6 hour flow

Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #5, No Action – Verdugo, includes the findings and assumptions identified in Table 4.29. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.29 – Hydraulic Modeling Conditions, Findings, and Assumptions – Verdugo

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
No Action Verdugo Section 1	425*	4	0.035	0.006	0.003	1 foot

* DEI's 100-year, 6 hour flow

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance cannel is intended to be absorbed into the 40-foot landscape buffer or the 16-foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No multi-use opportunities for basins were identified as necessary by the City of Surprise and therefore not evaluated as part of this alternative.

Opportunities and Constraints – Verdugo

1. The practical application of the No Action Alternative is limiting under the presumption that each project is operating independently and in isolation of one another. The No Action alternative is therefore a more theoretical analysis as opposed to a probable implementation pattern. However, the No Action Alternative provides a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. This fact triggers a multitude of assumptions that must be contemplated in order to carry out the supposed implementation of each independent design solution. One change to any one scenario will alter the assumptions and approach of another project's required design.

2. A stormwater design solution for the Verdugo project under the No Action alternative is less dependent on other offsite facilities and may be implemented more efficiently and cost effectively as compared to other properties.

3. Multi-use trail opportunities are achieved within buffers to enhance and promote bike and pedestrian connectivity between planned communities.

4. Operation & Maintenance efficiencies are maximized as one linear channel will accommodate the conveyance of the majority of flows in the study area. The

channel and trail(s) located in this channel section to be maintained by a Homeowner's Association.

5. Implementation and phasing under this scenario would include a requirement to ensure that the channel is sized to accommodate required flows for Verdugo and Altamira projects to avoid the construction of redundant channels.

6. There are limited implementation and phasing roadblocks.

7. Channel location and conceptual design complement community character and preliminary development plans.

Opinion of Probable Cost – Verdugo

The following is a preliminary estimate of the probable costs to construct the channel facilities for The No Action Alternative – Verdugo.

Table 4.30 – Proposed Alternative #5 Opinion of Probable Cost - Verdugo

Verdugo Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Verdugo Section 1					
Channel Excavation		39794	CY	$ 4.00	$ 159,176.00
Landscaping		882180	SF	$ 1.00	$ 882,180.00
Right-of-Way		21.3	AC	$ 40,000.00	$ 852,000.00
Drop Structures		8	Each	$ 1,568.00	$ 12,544.00
SubTotal					**$ 1,905,900.00**
Culverts					
Verdugo Alta Mira Connector Road 2 - 8 ft x 4 ft box culverts	2	80	LF	$ 600.00	$ 96,000.00
SubTotal					**$ 96,000.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Verdugo Alta Mira Connector Road 2 - 8 ft x 4 ft box culverts	2	$3,422.00	$ 5,515.00	$ 670.00	$ 10,607.00
SubTotal					**$ 10,607.00**
Itemized Project Components					
Excavation					**$ 159,176.00**
Landscaping					**$ 882,180.00**
Right-of-Way					**$ 852,000.00**
Drop Structures					**$ 12,544.00**
Culverts					**$ 106,607.00**
Design					**$ 201,250.70**

Verdugo Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Construction Management					**$ 161,000.56**
Contingency					**$ 348,152.10**
Total					**$ 2,722,910.36**
Verdugo Alternative 5 Total Cost					**$ 2,722,910.36**

Table 4.31 – No Action Total Cost Estimate Summary – Verdugo

Stakeholder Property	No Action Verdugo Estimate	Additional Costs Captured on Other Stakeholder Property	Verdugo Total Cost to Develop First
Verdugo	$2,722,910	$0	$2,722,910

Table 4.31 summarizes the opinion of probable cost estimate for the Verdugo project. Additional costs captured as a component of another stakeholder's project (if applicable) are also identified so as to demonstrate the total cost that may be incurred should the Verdugo project be the first to develop under the No Action scenario.

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

6. Costs include culverts necessary for collector road crossing of channel providing internal vehicular connection between the Verdugo and Altamira projects.

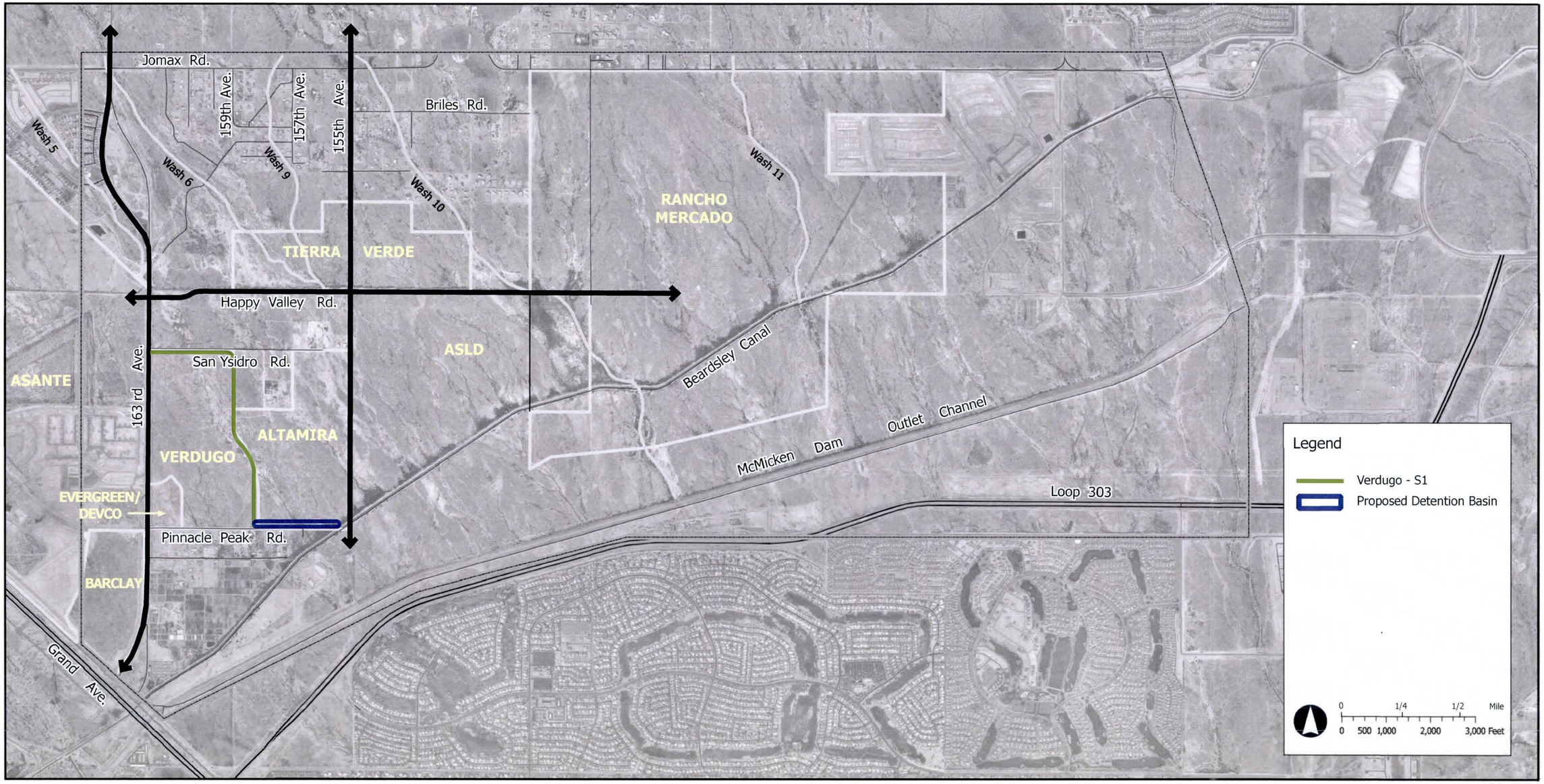
7. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

8. Added costs include 10% for design, 8% for construction management, and 30% for contingency. The contingency is based on the construction items and does not include the cost of land acquisition.

Figure 4.8 - Proposed Alternative 5: Verdugo

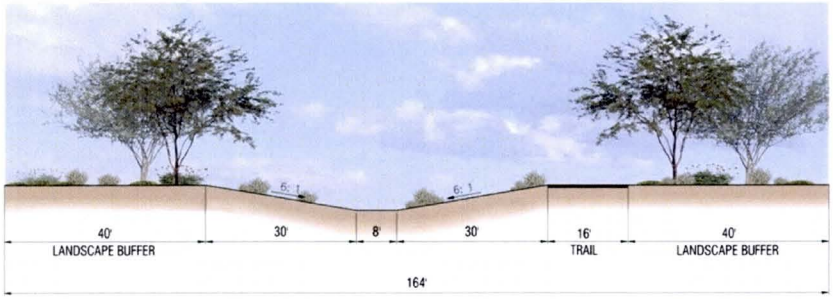
Happy Valley Design Concept Report

Alternative 5 - No Action: Verdugo



2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

PROPOSED ALTERNATIVE 5: VERDUGO CROSS-SECTIONS



4.6.6 ALTAMIRA

The "worst case scenario" for the Altamira project is highlighted and complicated by the fact that the northern portion of this property becomes the recipient of two previously identified breakout flows from the Happy Valley Wash. A 520 cfs breakout flow intersects the northwestern property line and a 182 cfs breakout flow intersects the north property line. This fact creates the need to construct improved conveyance channels that encompass the northern portion of the Altamira property (See Sections S-1, S-2A, S-2B). These various sections then combine and convey through Section S-3 along the southern portion of Altamira's eastern property line and adjacent to 155th Avenue. The total width of the S-3 facility is 154 feet contiguous to the presumed 55-foot half street for 155th Avenue.

Altamira Section 4 is identified as a "contingency channel" that may have to be constructed in the event that the Verdugo project does not develop first (and assumed under the No Action alternative). This 425 cfs of flows from Wash 5 must be conveyed and routed to the detention basin suggested for the southern portion of the Altamira property. Under the No Action alternative assumption, Altamira would be responsible for the construction of this channel.

Other design alternatives, including the acquisition of an offsite easement could potentially reduce the number and/or linear footage of improved conveyance channels upon this northern portion of the Altamira parcel. Evaluation of design solutions that involve the reliance upon other properties is beyond the purview of this alternative as improvements conceived in this study are designed in response to existing conditions, especially in the No Action alternative.

Table 4.32 – Alternative #5 Channel Conceptual Design Characteristics – Altamira

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
No Action Altamira Section 1	166 feet	520	2,300	5 feet	10 feet	30 feet each side	16 feet on one side	40 feet on both sides
No Action Altamira Section 2A	138 feet	182	1,075	4 feet	10 feet	24 feet each side	None	40 feet on both sides
No Action Altamira Section 2B	114 feet	182	1,225	4 feet	10 feet	24 feet each side	16 feet one side	40 feet one side

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
No Action Altamira Section 3	154 feet	700	2,275	5 feet	22 feet	30 feet each side	16 feet both side	40 feet one side
No Action Altamira Section 4	164 feet	425	2,675	5 feet	8 feet	30 feet each side	16 feet on one side	40 feet on both sides

* DEI's 100-year 6-hour flow

A detention basin to attenuate the flows from all four Altamira channel sections is suggested for the southern portion of the Altamira parcel. This detention basin concept appears to be compatible with the Altamira land use plan provided for this project. Conceptually, this basin would have a top width of approximately 160 with a depth of four feet. This basin may bleed off to the east or continue to overtop the Beardsley Canal.

Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement character of the design and surrounding area. Additional soils research and analysis will be necessary to determine if any underground toe protection/stabilization is necessary.

Hydrologic/Hydraulic Considerations

Hydraulic modeling conducted for Proposed Alternative #5, No Action – Altamira, includes the findings and assumptions identified in Table 4.33. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 4.33 – Hydraulic Modeling Conditions, Findings, and Assumptions – Altamira

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
No Action Altamira Section 1	520	3.9	0.035	0.004	0.0028	1 foot
No Action Altamira Section 2A	182	3.3	0.035	0.004	0.0028	1 foot
No Action Altamira Section 2B	182	3.3	0.035	0.005	0.0028	1 foot
No Action Altamira Section 3	700	4	0.035	0.007	0.0025	1 foot
No Action Altamira Section 4	425*	4	0.035	0.006	0.003	1 foot

Stakeholder discussion at the February 18, 2010 progress meeting included dialogue that reviewed the modeling assumptions and approach and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 progress meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance cannel is intended to be absorbed into the 40-foot landscape buffer or the 16-foot buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydrology modeling.

Landscape Theme

The landscape design theme for all improved conveyance channel and basin improvements in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities.

With guidance from the LIA, District staff, and project stakeholders the channel landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The project stakeholders have determined that the process of creating the Preferred Alternative will bring greater definition and clarification with the City of Surprise to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs.

Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

No multi-use opportunities for basins were identified as necessary by the City of Surprise and therefore not evaluated as part of this alternative.

Opportunities and Constraints – Altamira

1. The practical application of the No Action alternative is limiting under the presumption that each project is operating independently and in isolation of one another. The No Action alternative is therefore a more theoretical analysis as opposed to a probable implementation pattern. However, the No Action alternative provides a useful gauge in comparing magnitude of costs between alternatives to project stakeholders. This fact triggers a multitude of assumptions that must be contemplated in order to carry out the supposed implementation of each independent design solution. One change to any one

scenario will alter the assumptions and approach of another project's required design.

2. Inefficiencies and redundant capacity in channel facilities is common due to each project having to independently provide a solution that in no way recognizes or benefits from adjacent/nearby improvements.

3. Multi-use trail opportunities are achieved within buffers to enhance and promote bike and pedestrian connectivity between planned communities.

4. Under the Altamira No Action alternative, economies of scale are lost in the non-uniform design of channels, oversizing/redundancy and cost to construct improved channels, and right-of-way acquisition costs are increased due to the lack of regional cooperation.

5. Operation & Maintenance efficiencies are minimal as multiple linear channels are necessary to accommodate the conveyance of flows that could more efficiently and effectively provide flood protection in other manners.

6. All trails located in this channel section would be maintained by Homeowner's Association.

7. Implementation and phasing under this scenario would include requirement to ensure that channel is sized to accommodate required flows for Verdugo and Altamira projects to avoid the construction of redundant channels.

8. While this alternative requires redundant channels to be built onsite, there are limited implementation and phasing roadblocks.

9. Channels located upon the northern and eastern portions of the Altamira property are potentially redundant and do not complement the community's character. The channel suggested for the western portion of the property and the detention basin appears to complement community character and preliminary development plans.

Opinion of Probable Cost – Altamira

The following is a preliminary estimate of the probable costs to construct the channel facilities for The No Action Alternative – Altamira.

Table 4.34 – Proposed Alternative #5 Opinion of Probable Cost - Altamira

Alta Mira Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Alta Mira Section 1					
Channel Excavation		17037	CY	$ 4.00	$ 68,148.00
Landscaping		358800	SF	$ 1.00	$ 358,800.00
Right-of-Way		8.8	AC	$ 40,000.00	$ 352,000.00
Drop Structures		2	Each	$ 1,960.00	$ 3,920.00
SubTotal					**$ 782,868.00**
Alta Mira Section 2A					
Channel Excavation		5415	CY	$ 4.00	$ 21,660.00
Landscaping		137600	SF	$ 1.00	$ 137,600.00
Right-of-Way		3.4	AC	$ 40,000.00	$ 136,000.00
Drop Structures		1	Each	$ 1,960.00	$ 1,960.00
SubTotal					**$ 297,220.00**
Alta Mira Section 2B					
Channel Excavation		6170	CY	$ 4.00	$ 24,680.00
Landscaping		127400	SF	$ 1.00	$ 127,400.00
Right-of-Way		3.2	AC	$ 40,000.00	$ 128,000.00
Drop Structures		1	Each	$ 1,960.00	$ 1,960.00
SubTotal					**$ 282,040.00**
Alta Mira Section 3					
Channel Excavation		21907	CY	$ 4.00	$ 87,628.00
Landscaping		300300	SF	$ 1.00	$ 300,300.00
Right-of-Way		8	AC	$ 40,000.00	$ 320,000.00
Drop Structures		3	Each	$ 4,312.00	$ 12,936.00
SubTotal					**$ 720,864.00**
Alta Mira Basin					
Basin Excavation		32600	CY	$ 4.00	$ 130,400.00
Landscaping		340705	SF	$ 1.00	$ 340,705.00
Right-of-Way		7.8	AC	$ 40,000.00	$ 312,000.00
SubTotal					**$ 783,105.00**
Culverts					
Alta Mira Pinnacle Peak Entrance 2 - 8 ft x 4 ft box culverts	2	80	LF	$ 600.00	$ 96,000.00
Alta Mira 155th Ave Entrance 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
Alta Mira 155th Ave Entrance 1 - 10 ft x 4 ft box culverts	1	80	LF	$ 750.00	$ 60,000.00
Alta Mira S1 Crossing 2 - 10 ft x 4 ft box culverts	2	80	LF	$ 750.00	$ 120,000.00
SubTotal					**$ 456,000.00**

Alta Mira Proposed Alternative 5 No Action	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Alta Mira Pinnacle Peak Entrance 2 - 8 ft x 4 ft box culverts	2	$3,422.00	$ 5,515.00	$ 1,670.00	$ 10,607.00
Alta Mira 155th Ave Entrance 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Alta Mira 155th Ave Entrance 1 - 10 ft x 4 ft box culverts	1	$3,000.00	$ 4,880.00	$ 900.00	$ 8,780.00
Alta Mira S1 Crossing 2 - 10 ft x 4 ft box culverts	2	$3,590.00	$ 5,921.00	$ 2,251.00	$ 11,762.00
SubTotal					**$ 45,893.00**
Itemized Project Components					
Excavation					**$ 332,516.00**
Landscaping					**$ 1,264,805.00**
Right-of-Way					**$ 1,248,000.00**
Drop Structures					**$ 20,776.00**
Culverts					**$ 501,893.00**
Design					**$ 336,799.00**
Construction Management					**$ 269,439.20**
Contingency					**$ 635,997.00**
Additional Cost Captured on Other Properties					**$ 895,773.00**
Total					**$ 5,505,998.20**
Alta Mira Alternative 5 Total Cost					**$ 5,505,998.20**

Table 4.35 – No Action Total Cost Estimate Summary – Altamira

Stakeholder Property	No Action Altamira Estimate	Additional Costs Captured on Other Stakeholder Property	Altamira Total Cost to Develop First
Altamira	$4,610,225	$895,773	$5,505,998

Table 4.35 summarizes the opinion of probable cost estimate for the Altamira project. Additional costs captured as a component of another stakeholder's project (if applicable) are also identified so as to demonstrate the total cost that may be incurred should the Altamira project be the first to develop under the No Action scenario.

Assumptions made for opinion of probable cost purposes:

1. Channel excavation for all channels is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom) are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Select use of certain design features such as rip-rap at culvert locations was not included in this estimate.

5. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

6. Cost estimate includes culvert crossing for vehicular project entry locations assumed to be as follows: two entrances off 155th Avenue and one entrance off Pinnacle Peak Road. Number of entrances and locations based on assumption from perceived needs from City of Surprise guidelines.

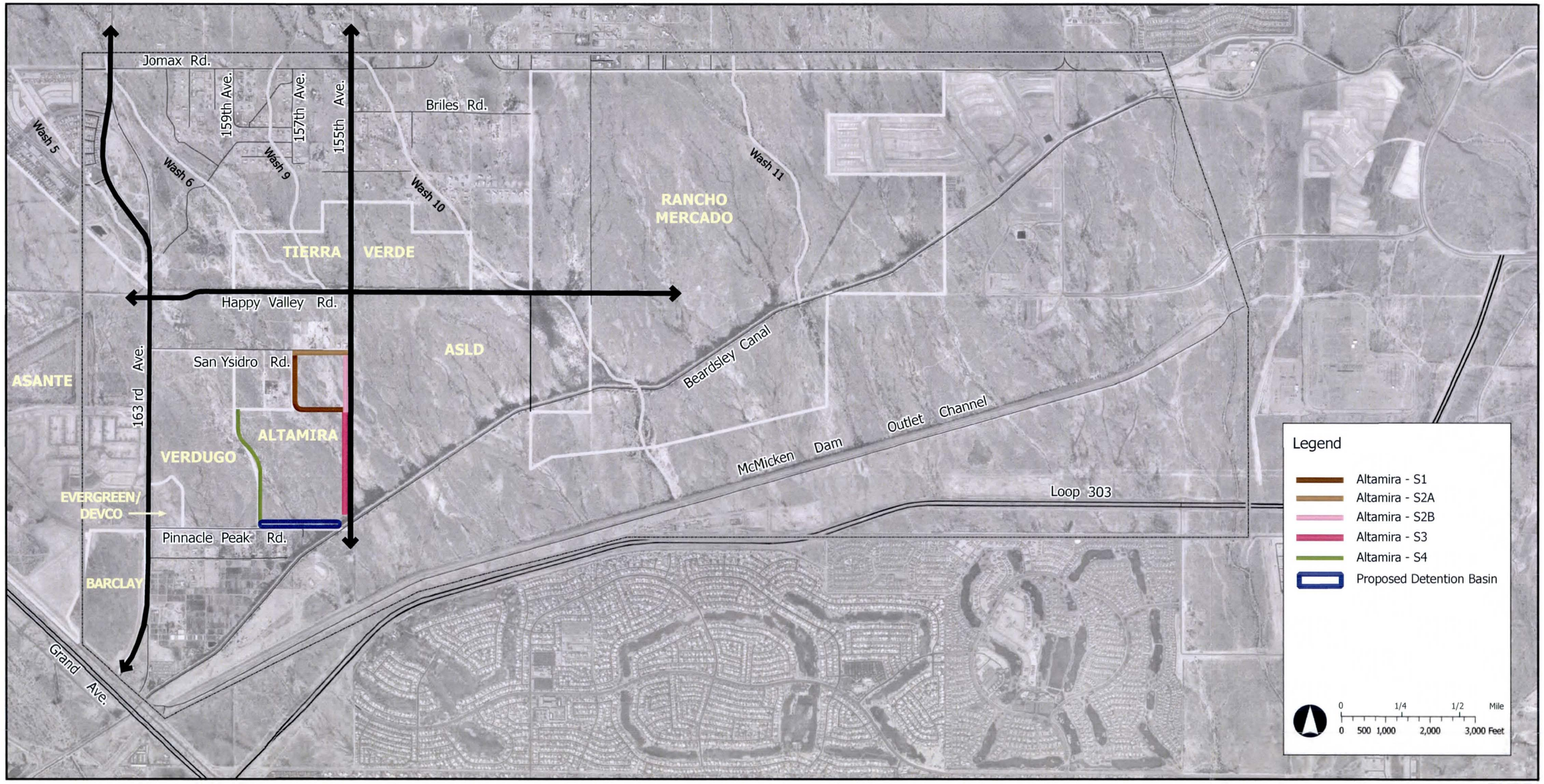
7. On-site culvert improvements for each independent project will be necessary, must be identified in their respective project designs and are not included in this cost estimate.

8. Added costs include 10% for design, 8% for construction management, and 30% for contingency. The contingency is based on the construction items and does not include the cost of land acquisition.

Figure 4.9 - Proposed Alternative 5: Altamira

Happy Valley Design Concept Report

Alternative 5 - No Action: Altamira



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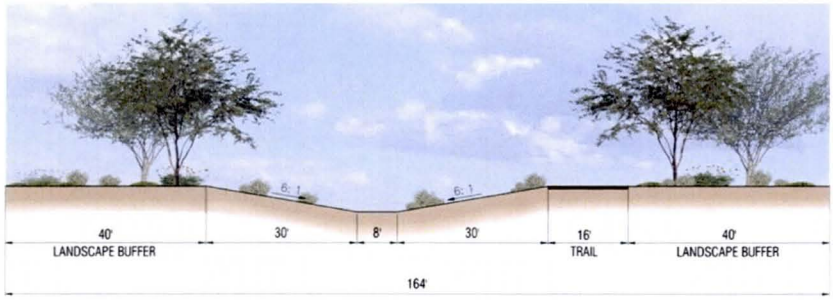
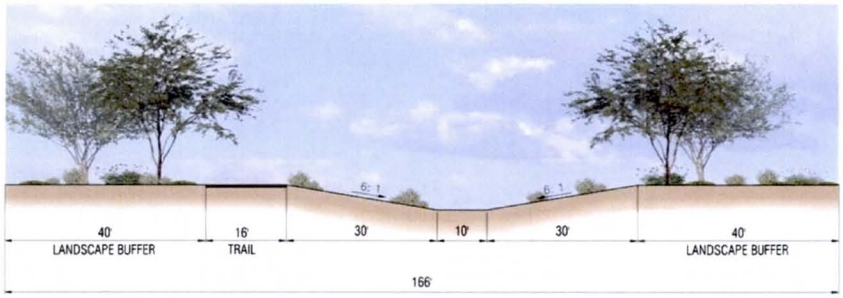
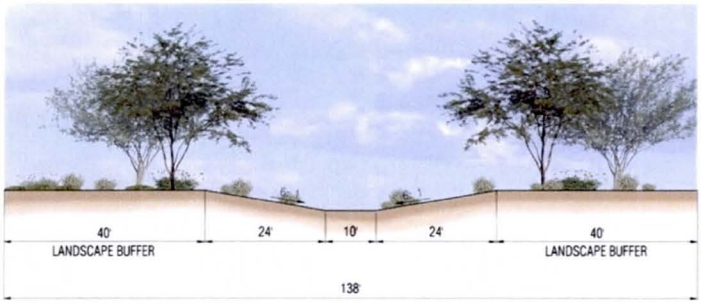
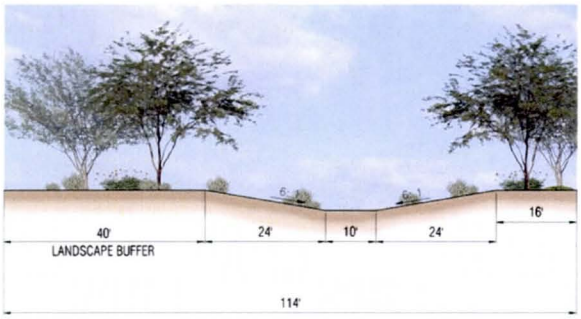
PROPOSED ALTERNATIVE 5: ALTAMIRA CROSS-SECTIONS








6:1
6:1
40'
LANDSCAPE BUFFER
24'
10'
24'
16'
114'

6:1
6:1
40'
LANDSCAPE BUFFER
16'
TRAIL
30'
22'
30'
16'
154'

CHAPTER 5 – PREFERRED ALTERNATIVE: FLOW SPLIT WITH BASIN

5.1 INTRODUCTION

The Happy Valley Design Concept Report (DCR) process, through the guidance of Project Stakeholders, has identified a Preferred Alternative recommended for design of conceptual 15% plans. The Project Stakeholders and Project Team have conducted a systematic evaluation of multiple proposed alternatives that has been narrowed to one Preferred Alternative.

This Preferred Alternatives Chapter is designed to:

1) Instruct the reader on the process and rationale for the Project Stakeholder selection of the Preferred Alternative,

2) Introduce findings from additional analyses conducted, and how those findings influence the Preferred Alternative concept design, and

3) Describe, illustrate, provide preliminary cost estimating, and identify future considerations for the design and implementation processes for the Preferred Alternative.

5.2 SELECTION OF THE PREFERRED ALTERNATIVE

On August 9, 2010, a Project Stakeholder Meeting was held. The purpose of the meeting was to review and evaluate the five Proposed Alternatives and recommend one Preferred Alternative. The Happy Valley DCR project objective was to select a Preferred Alternative that provided regional efficiencies that was beneficial and equitable for the maximum number of stakeholders as possible. Under that premise, the Project Team evaluated each of the alternatives generally using the following criteria:

1) Alternative Eliminates or Significantly Reduces Floodplain
2) Alternative Complements Community Character
3) Alternative Minimizes Construction Costs/Achieves Regional Synergies
4) Alternative Maximizes Operation and Maintenance Efficiencies

The Project Stakeholders recognized that there wasn't a single perfect solution and that each alternative had certain advantages and disadvantages. The Project Stakeholders recommendation of the Preferred Alternative attempted to achieve maximum equity and efficiency for the "greater good".

After a review of the five Proposed Alternatives generally utilizing the four criteria above, the Project Stakeholders recommended Proposed Alternative #1 as the Preferred Alternative. The Project Stakeholders noted that this Preferred Alternative is the most efficient in reducing the existing floodplain, which was a central objective throughout the Happy Valley DCR process. Simply put, the Preferred Alternative represents the smallest floodplain footprint while maximizing the amount of developable property for the vast majority of the stakeholders for the alternatives studied. The Preferred Alternative closely resembles the original Wittmann ADMP preferred alignment.

In addition, the Project Stakeholders recognized that the Preferred Alternative best reflects the community character in the area for all stakeholder properties. The Verdugo and Alta Mira properties appear to benefit the most by eliminating their respective floodplains without having to construct facilities. It has been suggested by the ASLD that the 155th Avenue channel could be constructed on either the east or west side of the 155th Avenue roadway facility. City of Surprise staff have suggested that their preference is along the east side of 155th Avenue due to the existence of a 18-inch sewer line in this area. And unless there was a certified levee along Happy Valley Wash, this alternative represents the best case condition for the ASLD as well.

The Project Stakeholders also recognized that this Preferred Alternative is likely the least expensive to construct when all direct and indirect costs were compared to the other Proposed Alternatives. When compared to the other four Proposed Alternatives, this Preferred Alternative has the smallest channel footprint at 12,475 lineal feet and is the second least expensive in probable ROW acquisition costs. This Preferred Alternative is also the least expensive in terms of operation and maintenance (O&M) costs that will be borne by either the City of Surprise or individual HOA's. The estimated O&M costs for the Preferred Alternative are anywhere from 16% to 30% less expensive than the other Proposed Alternatives.

Through the discussion at the August 9, 2010 Stakeholders Meeting, the Project Stakeholders unanimously recommended the Preferred Alternative without having to go through the planned ranking exercise. The Project Stakeholders did recognize that the Preferred Alternative was favored over the other Proposed Alternatives, but also noted that there were several issues relating to construction costs and specifics of implementation that were of considerable importance but not yet resolved. As such, the Project Stakeholders desired to establish a "disclaimer" for inclusion in this report that the Project Stakeholders also desire the option of still deferring to the "No Action Alternative" in the event that specific implementation measures are unable to be worked out or afforded by the stakeholders. These items identified by the Project Stakeholders for further consideration are described in more detail in Section 5.12.

5.3 Description of the Preferred Alternative

The Happy Valley DCR Preferred Alternative – *Flow Split with Basin*, (Refer to Figure 5.1) consists of a series of improved conveyance channels running along the north side of the planned Happy Valley Road and the east side of 155th Avenue. One detention basin is proposed to be located at the southerly terminus of 155th Avenue just north of the Beardsley Canal.

The improved conveyance channel along the north side of Happy Valley Road expands in size and capacity as it collects contributing flows from Wash 5, 6, and 9 as it flows easterly from 163rd Avenue to 155th Avenue. Three conveyance channel sizes/sections make up this one mile length of channel. Section 3 of the Happy Valley Channel is the largest and carries approximately 2,450 cfs.

A designed flow split at 155th Avenue would direct approximately 1,730 cfs or 70% of the flows south (an approximate representation of historic flow patterns without the berm in place) into a new conveyance channel proposed along the east side of 155th Avenue. The remaining 30% flows (approximately 720 cfs) will continue in a smaller improved conveyance channel extending from the flow split at 155th Avenue to the terminus of the improved conveyance channel section at its confluence with Wash 10. At this location, the Happy Valley Channel and Wash 10 combined flows would be directed into box culverts crossing under Happy Valley Road south into the existing condition section of Wash 10 and on to the existing overchute of the Beardsley Canal.

The 155th Avenue Channel outlets into an approximate 53-acre detention basin that would attenuate flows and bleed off storm events along the northerly edge of the Beardsley Canal towards the existing overchute. Contributing 100-year flows from both the Happy Valley Channel and the detention basin are planned to not exceed the existing capacity of the overchute as identified in the Wittmann ADMSU. Table 5.1 below summarizes the design characteristics for each of the Preferred Alternative channel sections.

Table 5.1 – Preferred Alternative Channel Conceptual Design Characteristics

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer
HV Sect. 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 2	198 feet	1,400	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 3	262 feet	2,450	850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
HV Sect. 4	154 feet	720	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side
155th Ave. Sect. 1	218 feet	1,730	4,600	5 feet	86 feet	30 feet each side	16 feet on east and west bank	40 feet on east side

* DEI's 100-year 6-hour flow

** Includes 1 foot of freeboard

The proposed elongated basin will function solely for the purpose of detaining flows – it is a long, linear flat basin. In evaluating the potential for multi-use and recreation opportunities for the proposed basin, the City of Surprise currently does not envision the need for a park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be modified in shape and orientation to accommodate a variety of supportive multi-use recreation opportunities. The relatively flat and elongated configuration of the basin design poses a concern for localized ponding in the facility. The inclusion of drywells to alleviate this condition, complemented by a proactive operations and maintenance plan that includes provisions for vector control are suggested.

Table 5.2 – Preferred Alternative Basin Conceptual Design Characteristics

Basin	Acreage	Top Width	Depth	Side Slopes
#1	53	325 feet	6 feet	6:1

5.4 Flood Protection Structural Methods

All improved conveyance channels will consist of Soft Structural and Semi-Soft Structural Methods whereby the superstructure is constructed of earthen materials with the overall channel form to emulate surrounding natural land forms. Materials and textures from the surrounding landscape will be utilized. Hard structural components will be utilized at inlets, outlets, flow splits, and drop structures as deemed necessary but will complement the character of the design and surrounding area. Though a preliminary soils analysis has been conducted, a more detailed soils analysis will be necessary to better determine the toe protection/bank stabilization of the channel.

5.5 Hydraulic Considerations

Hydraulic modeling conducted for the Preferred Alternative includes the findings and assumptions identified in Table 5.3. Each channel has been modeled and sized to accommodate the 100-year, 24-hour flow.

Table 5.3 – Hydraulic Modeling Conditions, Findings, and Assumptions

Channel Section	Flow (cfs)	Velocity (ft/sec)	n-value	Existing Longitudinal Slope (ft/ft)	Design Slope (ft/ft)	Freeboard (ft)
HV Section 1	750*	4	0.035	0.004	0.0024	1
HV Section 2	1,400	4	0.035	0.004	0.0019	1
HV Section 3	2,450	4	0.035	0.004	0.0017	1
HV Section 4	720	4	0.035	0.003	0.0024	1
155th Ave. Section 1	1,730	4	0.035	0.006	0.0018	1

* DEI's 100-year 6-hour flow

Stakeholder discussion at the February 18, 2010 Progress Meeting included dialogue that reviewed the modeling assumptions, approach, and resulting channel and basin sizing, which drew more insight as a result of the newly introduced hybrid alternative at the February 18, 2010 Progress Meeting. These understandings were discussed in relation to the conceptual design of each improved conveyance channel and basin sizing. Some of the areas of observation include:

- The existing flat longitudinal slope in the region, when combined with the use of a velocity of four (4) feet per second will require further engineering analysis for design and constructability concerns. Drop structures are required as a result.

- The area necessary to "daylight" an improved conveyance channel is intended to be absorbed into the 40-foot landscape buffer or 16 feet buffer adjacent to the road.

- An acknowledgement is made that additional investigation is necessary to review area soil types and the potential for erosion and scour at final design. Findings of these studies may alter the velocities used in hydraulic modeling.

5.6 Additional Hydraulic Analysis for the Preferred Alternative

Additional analyses were performed to determine the appropriate channel sizing and composition of the Preferred Alternative. Different variables were adjusted to create unique iterations of the Preferred Alternative. These variations included modifying the side slope, Manning's "n" value, velocity, and evaluating the estimated bank full and 10-year flow for two scenarios. Nine iterations were considered with differing impact to the overall facility width and characteristics. Refer to the tables that illustrate the calculated result for each iteration.

Table 5.4 – Preferred Alternative: Base Condition

Side Slopes 6:1, Velocity 4 ft/sec, n-value 0.035

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0024
HV Sect. 2	198 feet	1,400	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0019
HV Sect. 3	262 feet	2,450	850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0017
HV Sect. 4	154 feet	720	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0024
155th Ave. Sect. 1	218 feet	1,730	4,600	5 feet	86 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4	0.035	0.0018

Table 5.5 – Preferred Alternative Iteration 1

Side Slopes 8:1, Velocity 4 ft/sec, n-value 0.035

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (8:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	170 feet	750*	950	5 feet	18 feet	40 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0025
HV Sect. 2	210 feet	1,400	2,575	5 feet	58 feet	40 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0021
HV Sect. 3	274 feet	2,450	850	5 feet	122 feet	40 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0018
HV Sect. 4	166 feet	720	3,500	5 feet	14 feet	40 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0028
155th Ave. Sect. 1	228 feet	1,730	4,600	5 feet	76 feet	40 feet each side	16 feet on east and west bank	40 feet on east side	4	0.035	0.002

Notes: Total Facility 10-14 feet wider, Bottom Width 6-10 feet narrower, Side Slopes 10 feet wider each side, steeper slope

Table 5.6 – Preferred Alternative Iteration 2

Side Slopes 4:1, Velocity 4 ft/sec, n-value 0.035

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (4:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	144 feet	750*	950	5 feet	32 feet	20 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0021
HV Sect. 2	188 feet	1,400	2,575	5 feet	76 feet	20 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0017
HV Sect. 3	250 feet	2,450	850	5 feet	138 feet	20 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0016
HV Sect. 4	142 feet	720	3,500	5 feet	30 feet	20 feet each side	16 feet on north and south bank	40 feet on north side	4	0.035	0.0021
155th Ave. Sect. 1	206 feet	1,730	4,600	5 feet	94 feet	20 feet each side	16 feet on east and west bank	40 feet on east side	4	0.035	0.0017

Notes: Total Facility 10-12 feet narrower, Bottom Width 8-10 feet wider, Side Slopes 10 feet narrower each side, less steep slope

Table 5.7 – Preferred Alternative Iteration 3

Side Slopes 6:1, Velocity 3 ft/sec, n-value 0.035

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	172 feet	750*	950	5 feet	40 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3	0.035	0.0012
HV Sect. 2	228 feet	1,400	2,575	5 feet	96 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3	0.035	0.0010
HV Sect. 3	314 feet	2,450	850	5 feet	182 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3	0.035	0.0009
HV Sect. 4	170 feet	720	3,500	5 feet	38 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3	0.035	0.0012
155th Ave. Sect. 1	258 feet	1,730	4,600	5 feet	126 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	3	0.035	0.0009

Notes: Total Facility 16-52 feet wider, Bottom Width 16-52 feet wider, less steep slope, constructability/maintenance issues

Table 5.8 – Preferred Alternative Iteration 4

Side Slopes 6:1, Velocity 5 ft/sec, n-value 0.035

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	148 feet	750*	950	5 feet	16 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	5	0.035	0.004
HV Sect. 2	180 feet	1,400	2,575	5 feet	48 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	5	0.035	0.0032
HV Sect. 3	234 feet	2,450	850	5 feet	102 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	5	0.035	0.0027
HV Sect. 4	146 feet	720	3,500	5 feet	14 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	5	0.035	0.004
155th Ave. Sect. 1	196 feet	1,730	4,600	5 feet	64 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	5	0.035	0.003

Notes: Total Facility 8-28 feet narrower, Bottom Width 8-28 feet narrower, steeper slope, increased erosion protection measures

Table 5.9 – Preferred Alternative Iteration 5

Side Slopes 6:1, Velocity 4 ft/sec, n-value 0.040

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	158 feet	750*	950	5 feet	26 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.04	0.003
HV Sect. 2	200 feet	1,400	2,575	5 feet	68 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.04	0.0024
HV Sect. 3	262 feet	2,450	850	5 feet	130 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.04	0.0022
HV Sect. 4	154 feet	720	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.04	0.0032
155th Ave. Sect. 1	218 feet	1,730	4,600	5 feet	86 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4	0.04	0.0024

Notes: Total Facility 0-2 feet wider, Bottom Width 0-2 feet wider, steeper slope

Table 5.10 – Preferred Alternative Iteration 6

Side Slopes 6:1, Velocity 4 ft/sec, n-value 0.030

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	158 feet	750*	950	5 feet	26 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.03	0.0017
HV Sect. 2	198 feet	1,400	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.03	0.0014
HV Sect. 3	266 feet	2,450	850	5 feet	134 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.03	0.0012
HV Sect. 4	154 feet	720	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.03	0.0018
155th Ave. Sect. 1	220 feet	1,730	4,600	5 feet	88 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4	0.03	0.0013

Notes: Total Facility 0-4 feet wider, Bottom Width 0-4 feet wider, less steep slopes, constructability/maintenance issues

Table 5.11 – Preferred Alternative Iteration 7

Side Slopes 6:1, Velocity 4 ft/sec, n-value 0.025

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	156 feet	750*	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.025	0.0012
HV Sect. 2	198 feet	1,400	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.025	0.0010
HV Sect. 3	266 feet	2,450	850	5 feet	128 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.025	0.0009
HV Sect. 4	154 feet	720	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4	0.025	0.0012
155th Ave. Sect. 1	220 feet	1,730	4,600	5 feet	88 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4	0.025	0.0009

Notes: Total Facility 0-4 feet wider, Bottom Width -2-2 feet difference, less steep slopes, constructability/maintenance issues

Table 5.12 – Preferred Alternative Iteration 8

Side Slopes 6:1, Velocity varies ft/sec, n-value 0.035, maintains existing slope with bank full flow

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	156 feet	299	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3.7	0.035	0.004
HV Sect. 2	198 feet	772	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4.2	0.035	0.004
HV Sect. 3	266 feet	841	841	5 feet	128 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3.6	0.035	0.004
HV Sect. 4	154 feet	510	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4.3	0.035	0.004
155th Ave. Sect. 1	220 feet	899	4,600	5 feet	88 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4.6	0.035	0.0056

Table 5.13 – Preferred Alternative Iteration 9

Side Slopes 6:1, Velocity varies ft/sec, n-value 0.035, maintains existing slope with estimated 10-year flow

Channel Section	Total Facility Width	Flow (cfs)	Linear Feet	Channel Depth**	Channel Bottom Width	Side Slopes (6:1)	Multi-Use Trail/ Maintenance	Buffer	Velocity (ft/sec)	n - value	Design Slope (ft/ft)
HV Sect. 1	156 feet	375	950	5 feet	24 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3.9	0.035	0.004
HV Sect. 2	198 feet	700	2,575	5 feet	66 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4.1	0.035	0.004
HV Sect. 3	266 feet	1,200	841	5 feet	128 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	4.1	0.035	0.004
HV Sect. 4	154 feet	350	3,500	5 feet	22 feet	30 feet each side	16 feet on north and south bank	40 feet on north side	3.9	0.035	0.004
155th Ave. Sect. 1	220 feet	850	4,600	5 feet	88 feet	30 feet each side	16 feet on east and west bank	40 feet on east side	4.5	0.035	0.0056

A Project Team meeting to review the variations and findings was held. The Project Team evaluated the differing velocities, their erosive characteristics, and the effect on the sediment movement based on the prescribed channel configuration and presumed soils types. This meeting resulted in a consensus among the Project Team to maintain the channels in as natural state as possible and to provide minimum bank protection.

The channels will need to be maintained in the future based on this design guidance. It is anticipated that there will be some local erosion and sedimentation within the channels and basin. It was agreed that the original characteristics of the Preferred Alternative should be used. Three surface soil samples were obtained by the FCMDC in the Happy Valley Wash to determine if the permissive design velocity of 4 ft/s was reasonable. The sediment yield, the equilibrium slope, and scour depth were calculated for each of the five channel segments of the Preferred Alternative based on the soil samples. Refer to Appendix B for a map of the soil sample locations and the size distribution tabular data.

The particle-size distribution curve for each sample is provided on the following pages.

Table 5.14 – Soil Sample 1

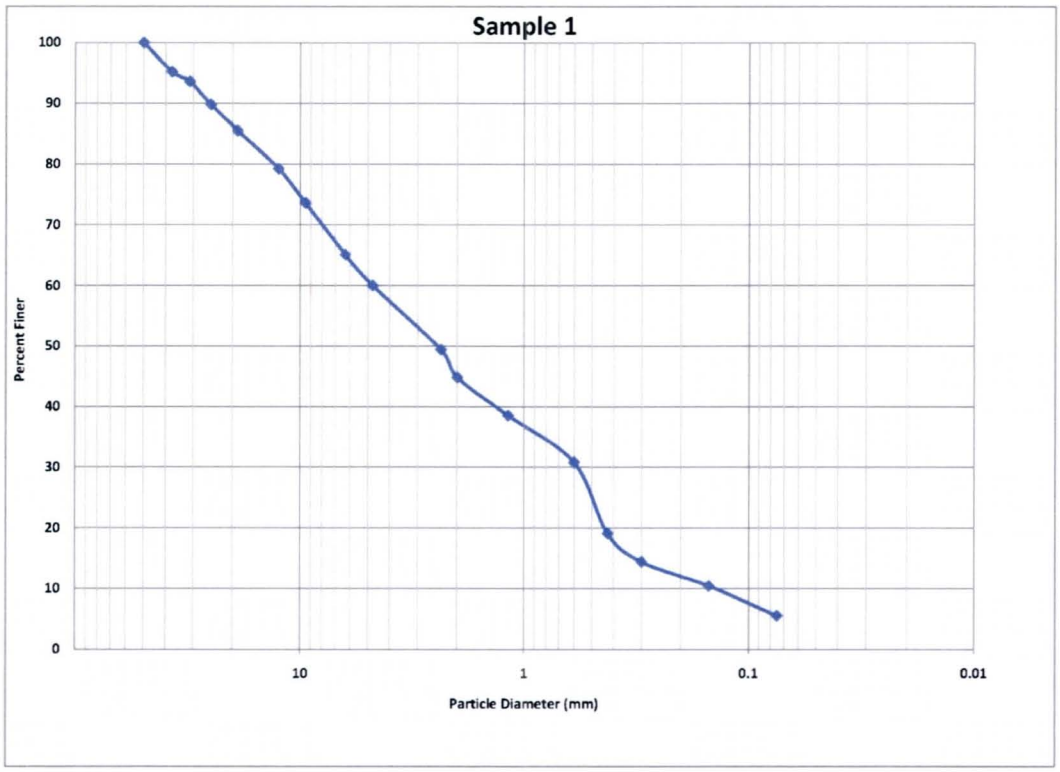


Table 5.15 – Soil Sample 2

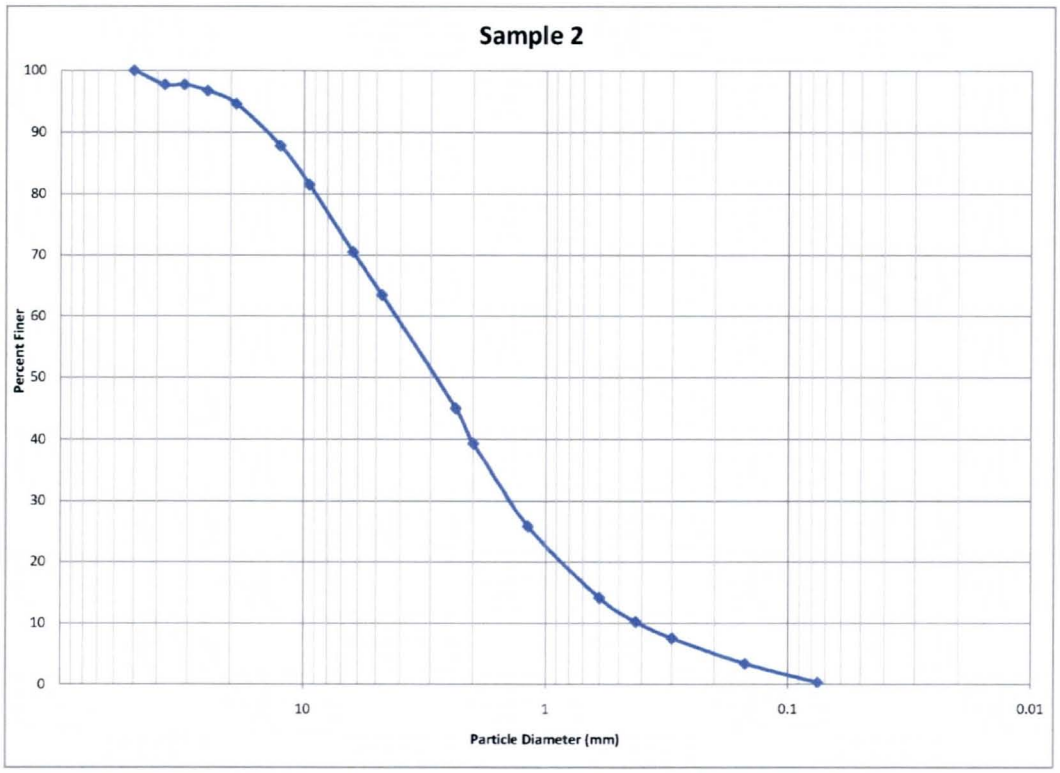
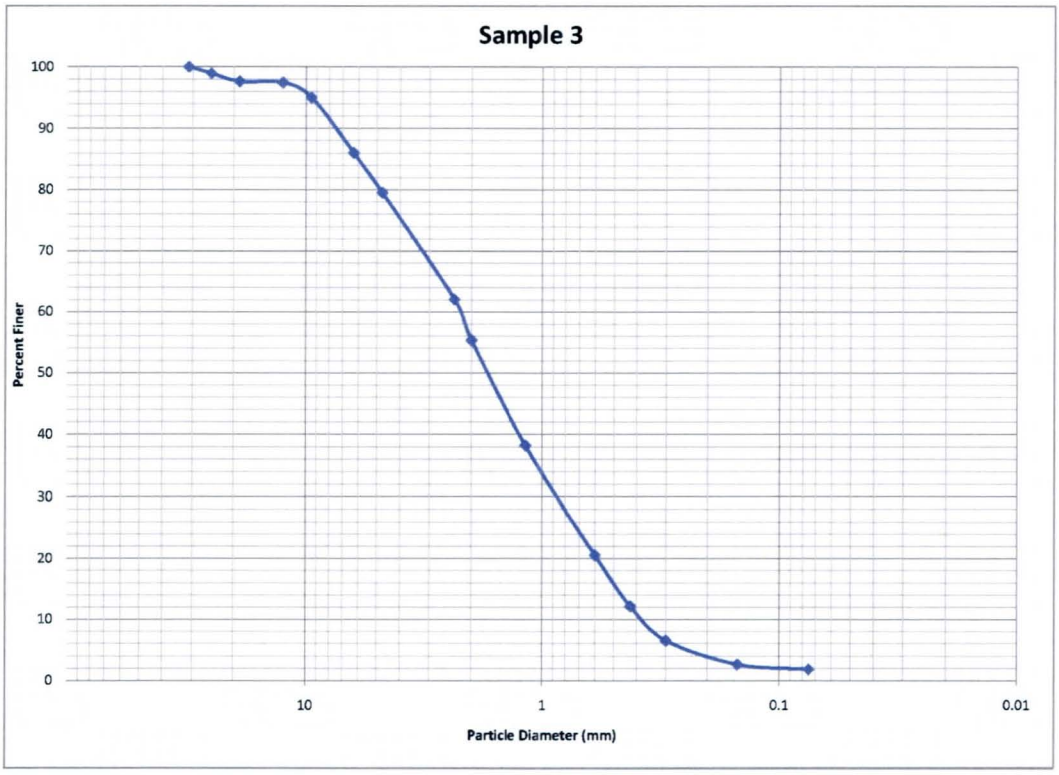


Table 5.16 – Soil Sample 3



5.6.1 Permissible Velocity

The D_{50} for the three soil samples ranges between 1.7 mm and 2.8 mm. The soil can best be described as between a very coarse sand and a very fine gravel according to the Sediment Grade Scale (Table 11.1 June 2010 Draft Hydraulics Manual) based on the resulting particle size distribution D_{50}. Table 6.1 Maximum Permissible Velocities (January 1996 Hydraulics Manual) has a permissible velocity for fine sand (noncolloidal) of 2.5 ft/s and fine gravel as 5.0 ft/s. Although there is not a direct correlation in the soil class name, it is reasonable to assume that the permissible velocity is higher than 2.5 ft/s and lower than 5.0 ft/s. The assumption of 4 ft/s appears to be realistic for purposes of the creation of 15% concept plans for the Happy Valley DCR based on the preliminary soils data.

Figure 1: Basic Allowable Velocity for Earthen Channels, from Arizona State Standard 5-96 relates D_{75} to the basic allowable velocity. The D_{75} for the three soil samples ranges between 4 mm and 11 mm. Figure 1 shows the basic allowable velocity is between 4 ft/s and 5.3 ft/s for the three soil samples using the sediment laden curve.

5.6.2 Equilibrium Slope Analysis

The Project Team felt that an equilibrium slope analysis using DDMSW 4.6.0 was necessary to evaluate the Conceptual 15% Plans for the Preferred Alternative. The equilibrium slope analysis requires a pivot point, a point where neither scour nor deposition occurs. There is only one existing pivot point which is the Beardsley Canal overchute. However, culverts and drop structures will act as pivot points in the Preferred Alternative so the distance from the pivot points are relatively short. In addition, the dominant discharge, usually the 10-year peak discharge, should be used. Since, the 100-year 24-hour peak discharge was the only return period analyzed as part of the Happy Valley DCR, the 10-year peak discharge was estimated using 35% of the 100-year peak discharge as outlined in the April 2010 River Mechanics Manual for DDMSW. The equilibrium slope equation varies depending on if the wash or channel is sediment laden or clear water flow. The study area was assumed to be in a sediment laden condition based on the evidence of sediment deposition at the 163rd Avenue culvert and the confluences of Wash 6, 9, and 10 with the Happy Valley Wash.

The intent was to use DDMSW 4.6.0 to calculate the sediment laden equilibrium slope for each channel section for the Preferred Alternative. This requires a representative supply reach and a representative study reach. The Equilibrium Slope Analysis Section Location Map in Appendix B shows the supply and study reach locations. However, several of the channel sections have multiple supply reaches contributing to the study

reach (HV SEC 1, HV SEC 2, and HV SEC 3). For example, HV SEC 3 receives flow and sediment from HV SEC 2 and from Wash 6 and Wash 9. The DDMSW 4.6.0 software does not allow for multiple supply reaches to be calculated for one study reach. DDMSW 4.6.0 was used to calculate each individual supply reach and an Excel Spreadsheet was used to sum the Total Bed Material Discharge when multiple supply reaches exist. The slope of the study reach was then changed in DDMSW until the Total Bed Material Discharge of the study reach was equal to the total supply reach. This process of iteration was used to determine the equilibrium slope of the study reach.

In theory, if the design slope of the channel is set to the equilibrium slope then the sediment would be carried without deposition or scour within the channel. However, this is not practical for several of the channel reaches due to the constraints of connecting to the existing 163rd Avenue culvert and other fixed elevations such as the Beardsley Canal overchute and Wash 10. In addition, if the equilibrium slope was used as the channel design slope some of the channel section velocities would increase beyond the design of 4 ft/s. The design of the conceptual 15% plans used the permissible velocity method instead of the equilibrium slope to determine the channel slope.

The results do provide an indication of if the channel section will scour or deposit based on the methodology. A channel slope steeper than the equilibrium slope will scour and a channel slope flatter than the equilibrium slope will deposit. The results are shown in Table 5.17 below. The equilibrium slope shown is a rounded estimate. In general, the design slopes are near the equilibrium slope with the exception of HV SEC 2 and HV SEC 4. Due to the existing Wash 10 elevations and acceptable channel depths there are limitations to meeting the channel equilibrium slopes for these two sections. A sediment basin may need to be considered as part of the design to intercept the breakout flow of Wash 6 that drains to HV SEC 2. Also, the slope of HV SEC1 and 155th Ave SEC 1 could be increased at the design stage by modifying the drop structures without having a major impact to the permissible velocity.

Table 5.17 – Equilibrium Slope Analysis Results

Cross Section	Design Slope	Equilibrium Slope	State
HV SEC 1	0.0024	0.0027	Deposition
HV SEC 2	0.0019	0.0052	Deposition
HV SEC 3	0.0017	0.0016	Scour
HV SEC 4	0.0024	0.0048	Deposition
155TH AVE SEC 1	0.0018	0.0023	Deposition

5.6.3 Sediment Yield

The sediment yield is the amount of sediment produced at a given point in the watershed. Sediment yield is a function of many parameters and can be highly variable. The sediment yield was calculated for each of the five cross sections associated with the Preferred Alternative using DDMSW 4.6.0. These results should give a general estimate of the annual sediment yield and the 100-year storm sediment yield.

The sediment yield requires the soil and land use data for the sediment watershed. Refer to Appendix B for the sediment watershed landuse and soils maps. The Happy Valley DCR made the assumption that the sediment watershed extends only to the CAP Canal. In other words, the CAP Canal acts as a sediment sink and intercepts sediment upstream of the canal. Therefore, the sediment transported through the Preferred Alternative is generated south of the CAP Canal.

The slope length is highly variable and subject to interpretation for an undeveloped desert watershed with multiple channels. The slope length for this analysis was developed using a weighed average of several of the possible slope lengths for each subwatershed. A map showing the slope lengths used for the weighted average is located in Appendix B.

The results of the sediment yield analysis are provided in the Table 5.18 below. Sediment traps and additional sediment storage in the detention basin may be designed as part of the future design. Future evaluation of the sediment yield will be necessary as part of the design process to refine the channel sediment yield and determine the sediment yield for the basin.

Table 5.18 – Sediment Yield Results

Cross Section	100-Year Storm Total Yield (ac-ft)	Annual Total Yield (ac-ft)
HV SEC 1	0.18	0.01
HV SEC 2	3.57	0.20
HV SEC 3	4.47	0.25
HV SEC 4	1.34	0.07
155TH AVE SEC 1	3.13	0.17

5.6.4 Scour Depth

Scour was calculated for each of the five channel cross sections associated with the Preferred Alternative using DDMSW 4.6.0. The components of the scour depth consist of long term, general, local, bedform, and low flow. Long term scour was calculated using the equilibrium slope analysis for sediment laden flow. Four of the five channel sections show deposition but HV Sec 3 shows scour. General scour was calculated using the Lacey equation. Local scour was calculated using the Schoklitsch equation for grade control structures. The Schoklitsch equation calculates the scour depth below a structure on an unprotected channel bed. The scour depth shown in Table 5.19 is if the channel bed is unprotected and provides justification for providing bank protection at the drop structures. The bank protection at the drop structures will be designed during the final design stage. Bedform scour was calculated using DDMSW 4.6.0. The low flow scour was estimated to be 1.5 ft, the average when no field data is available. A factor of safety of 1.3 was applied to each component to obtain the scour depth and the components were summed to obtain the total scour depth. Please refer to the Table 5.20 below for the findings. Additional erosion protection will be required where Washes 6, 9, 10, and Wash 6 breakout enter the Preferred Alternative channels, at culverts, at the basin entrance and exit, and at drop structures. This additional analysis will be part of the design stage of the project.

Table 5.19 – Drop Structure Scour Without Bank Protection

Cross Section	Local Scour (ft)
HV SEC 1	5.14
HV SEC 2	4.08
HV SEC 3	-
HV SEC 4	8.68
155TH AVE SEC 1	5.69

Table 5.20 – Scour Analysis Findings

Cross Section	Long Term Scour (ft)	General Scour (ft)	Bedform Scour (ft)	Low Flow Scour (ft)	Total Scour (ft)
HV SEC 1	-	0.99	0.35	1.95	3.3
HV SEC 2	-	1.22	0.42	1.95	3.6
HV SEC 3	0.11	1.44	0.46	1.95	4.0
HV SEC 4	-	1.04	0.34	1.95	3.3
155TH AVE SEC 1	-	1.29	0.43	1.95	3.7

5.7 Landscape Theme

The landscape design theme for all improved conveyance channel and basin facilities in the project study area will include a blend of Semi-Natural Sonoran Desert and Natural Lower Sonoran Desert Riparian design themes. The blending of either theme will promote the use of decomposed granite gravels for ground cover and the inclusion of Mesquite, Bursage, and Creosote as signature species for plantings along wash corridors. Emphasis will be maintained on configuring channels to replicate the scale and authenticity of natural conveyance systems in the study area. Care will be given to the selection and use of prominent species along natural washes yet give opportunity to link to the landscaping designs of adjacent roadway facilities and planned residential communities. The landscape themes for channel and basin facilities are best illustrated on Figures 5.2 and 5.3.

With guidance from the LIA, District staff, and project stakeholders, the channel and basin landscape design themes are compatible for the project study area and are utilized in determining the opinion of probable costs for select items. The future design and construction of the Happy Valley Channel and coordination with the City of Surprise in the design and construction of adjacent roadways and residential communities will bring greater definition to the inclusion of specific planting species that tie together existing codes and adjacent community landscape designs to ensure compatibility of the landscape character in this area.

5.8 Multiple-Use Opportunities

Each improved conveyance channel will include at least one and potentially two multi-use (walking, jogging, biking) trails located on channel banks within a designated 16-foot corridor that will also serve as a vehicular maintenance road. Multi-use trails will primarily include a tread surface composed of a natural earthen or decomposed granite surface.

In evaluating multi-use and recreation opportunities for the proposed basin, the City of Surprise currently does not envision the need for park or passive recreational facilities due to currently satisfied levels of service for community and neighborhood parks within the project study area. Should a multi-use or recreation need be identified in the future, the basin could be modified in shape and orientation to accommodate a variety of supportive multi-use recreation opportunities.

5.9 Preferred Alternative Opportunities and Constraints

In the evaluation of the Preferred Alternative, a series of opportunities and constraints posed by the implementation of this alternative include:

1. The Preferred Alternative represents the preferred Wittmann ADMP alignment, i.e., the existing Happy Valley Wash alignment.

2. The Preferred Alternative significantly reduces downstream floodplain and flood events for property owners south of Happy Valley Road/Wash.

3. Property owners to the south of Happy Valley Road do not need to design and construct conveyance channels and thereby are enhancing the developable land area upon their properties.

4. Acquisition of property from ASLD for the 155th Avenue Channel and detention basin is necessary.

5. The Preferred Alternative minimizes the total linear feet of channel to be constructed; more efficient on conveyance.

6. The Preferred Alternative provides O&M efficiencies and continuity with the maintenance of two larger conveyance channels with overall reduced lineal footage.

7. The acquisition, excavation, and landscaping costs of the basin equate to 22% of the overall Preferred Alternative cost estimate.

8. The basin location increases the developable land area of the ASLD parcel that would otherwise not occur under the existing floodplain configuration.

9. Culvert spans in excess of 100 feet are required at 155th Avenue and Happy Valley Road. Additional study would be required for backwater analysis/freeboard requirements.

10. Though the existing wash is not preserved, the Preferred Alternative maintains or enhances the community character and scenic quality of the area by providing an improved conveyance channel with enhanced landscaping.

11. The Preferred Alternative promotes City of Surprise Trails Master Plan by including trail provisions along the Happy Valley Channel alignment.

5.10 Opinion of Probable Costs

The following is a preliminary estimate of the probable costs to construct the Preferred Alternative of the Happy Valley Channel and basin facilities. The opinion of probable cost estimate included herein attempts to capture the major cost components identified with the Preferred Alternative. Project Stakeholders desired to include and evaluate a range of cost estimates reflecting varying costs for certain unit costs and right-of way costs so as to provide a more thorough barometer of what combination of cost scenarios may exist, particularly in today's economy and construction market laced with price volatility. Table 5.21 establishes the "low" cost estimate and Table 5.22 identifies the upper end cost estimate. The low cost only provides one culvert crossing for each stakeholder and assumes the other crossings will be

provided by the individual property owner. The high cost includes an estimate of multiple culvert crossings as part of the regional project cost.

Table 5.21 – Preferred Alternative Opinion of Probable Low Cost

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		9500	CY	$ 2.00	$ 19,000.00
Landscaping		125400	SF	$ 1.00	$ 125,400.00
Right-of-Way		3.4	AC	$ 20,000.00	$ 68,000.00
Drop Structures		1	Each	$ 4,704.00	$ 4,704.00
SubTotal					**$ 217,104.00**
Happy Valley Section 2					
Channel Excavation		45778	CY	$ 2.00	$ 91,556.00
Landscaping		339900	SF	$ 1.00	$ 339,900.00
Right-of-Way		11.7	AC	$ 20,000.00	$ 234,000.00
Drop Structures		1	Each	$ 12,936.00	$ 12,936.00
SubTotal					**$ 678,392.00**
Happy Valley Section 3					
Channel Excavation		25185	CY	$ 2.00	$ 50,370.00
Landscaping		112200	SF	$ 1.00	$ 112,200.00
Right-of-Way		5.1	AC	$ 20,000.00	$ 102,000.00
Drop Structures*		0	Each	$ 25,480.00	$ -
SubTotal					**$ 264,570.00**
Happy Valley Section 4					
Channel Excavation		33704	CY	$ 2.00	$ 67,408.00
Landscaping		462000	SF	$ 1.00	$ 462,000.00
Right-of-Way		12.4	AC	$ 20,000.00	$ 248,000.00
Drop Structures		3	Each	$ 4,312.00	$ 12,936.00
SubTotal					**$ 790,344.00**
155th Avenue Section 1					
Channel Excavation		98815	CY	$ 2.00	$ 197,630.00
Landscaping		607200	SF	$ 1.00	$ 607,200.00
Right-of-Way		23	AC	$ 20,000.00	$ 460,000.00
Drop Structures		8	Each	$ 16,856.00	$ 134,848.00
SubTotal					**$ 1,399,678.00**
State Land Basin					
Basin Excavation		237456	CY	$ 2.00	$ 474,912.00
Landscaping		1338348	SF	$ 1.00	$ 1,338,348.00
Right-of-Way		52.3	AC	$ 20,000.00	$ 1,046,000.00
SubTotal					**$ 2,859,260.00**

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Culverts					
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	291	LF	$ 750.00	$ 1,527,750.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	165	LF	$ 750.00	$ 371,250.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	202	LF	$ 750.00	$ 757,500.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde West Entrance Road 6-10 ft x 4 ft box culverts*	6	80	LF		$ -
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts*	7	80	LF		$ -
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts*	7	80	LF		$ -
SubTotal					**$ 3,616,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde West Entrance Road 6-10 ft x 4 ft box culverts*	6				$ -
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts*	7				$ -
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts*	7				$ -
SubTotal					**$ 127,230.00**
Itemized Project Components					
Excavation					**$ 900,876.00**
Landscaping					**$ 2,985,048.00**
Right-of-Way					**$ 2,158,000.00**
Drop Structures					**$ 165,424.00**

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Culverts					**$ 3,743,730.00**
Design					**$ 995,307.80**
Construction Management					**$ 796,246.24**
Contingency					**$ 2,338,523.40**
Total					**$14,083,155.44**
Preferred Alternative Total Cost					**$14,083,155.44**

* Culvert cost not included as part of Preferred Alternative low cost.

Table 5.22 – Preferred Alternative Opinion of Probable High Cost

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Happy Valley Section 1					
Channel Excavation		9500	CY	$ 4.00	$ 38,000.00
Landscaping		125400	SF	$ 1.00	$ 125,400.00
Right-of-Way		3.4	AC	$ 40,000.00	$ 136,000.00
Drop Structures		1	Each	$ 4,704.00	$ 4,704.00
SubTotal					**$ 304,104.00**
Happy Valley Section 2					
Channel Excavation		45778	CY	$ 4.00	$ 183,112.00
Landscaping		339900	SF	$ 1.00	$ 339,900.00
Right-of-Way		11.7	AC	$ 40,000.00	$ 468,000.00
Drop Structures		1	Each	$ 12,936.00	$ 12,936.00
SubTotal					**$1,003,948.00**
Happy Valley Section 3					
Channel Excavation		25185	CY	$ 4.00	$ 100,740.00
Landscaping		112200	SF	$ 1.00	$ 112,200.00
Right-of-Way		5.1	AC	$ 40,000.00	$ 204,000.00
Drop Structures		0	Each	$ 25,480.00	$ -
SubTotal					**$ 416,940.00**
Happy Valley Section 4					
Channel Excavation		33704	CY	$ 4.00	$ 134,816.00
Landscaping		462000	SF	$ 1.00	$ 462,000.00
Right-of-Way		12.4	AC	$ 40,000.00	$ 496,000.00
Drop Structures		3	Each	$ 4,312.00	$ 12,936.00
SubTotal					**$1,105,752.00**
155th Avenue Section 1					
Channel Excavation		98815	CY	$ 4.00	$ 395,260.00
Landscaping		607200	SF	$ 1.00	$ 607,200.00

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
Right-of-Way		23	AC	$ 40,000.00	$ 920,000.00
Drop Structures		8	Each	$ 16,856.00	$ 134,848.00
SubTotal					**$2,057,308.00**
State Land Basin					
Channel Excavation		237456	CY	$ 4.00	$ 949,824.00
Landscaping		1338348	SF	$ 1.00	$1,338,348.00
Right-of-Way		52.3	AC	$ 40,000.00	$2,092,000.00
SubTotal					**$4,380,172.00**
Culverts					
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	291	LF	$ 750.00	$1,527,750.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	165	LF	$ 750.00	$ 371,250.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	202	LF	$ 750.00	$ 757,500.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	80	LF	$ 750.00	$ 360,000.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	80	LF	$ 750.00	$ 180,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	80	LF	$ 750.00	$ 420,000.00
SubTotal					**$4,816,500.00**
Culvert Headwalls and Aprons		**Inlet Wing**	**Outlet Wing**	**Outlet Apron**	
Happy Valley Road / 155th Ave South 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
Wash 10 Happy Valley Road 5 - 10 ft x 4 ft box culverts	5	$5,360.00	$ 9,044.00	$ 6,304.00	$ 20,708.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde West Entrance Road 6 - 10 ft x 4 ft box culverts	6	$5,950.00	$ 10,085.00	$ 7,655.00	$ 23,690.00
Tierra Verde East Entrance Road 3 - 10 ft x 4 ft box culverts	3	$4,180.00	$ 6,962.00	$ 3,602.00	$ 14,744.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00

Preferred Alternative	# Barrels	Quantity	Unit	Unit Cost	Total Cost
155th Avenue Entrance Road 7 - 10 ft x 4 ft box culverts	7	$6,540.00	$ 11,126.00	$ 9,006.00	$ 26,672.00
SubTotal					**$ 204,264.00**
Itemized Project Components					
Excavation					**$ 1,801,752.00**
Landscaping					**$ 2,985,048.00**
Right-of-Way					**$ 4,316,000.00**
Drop Structures					**$ 165,424.00**
Culverts					**$ 5,020,764.00**
Design					**$ 1,428,898.80**
Construction Management					**$ 1,143,119.04**
Contingency					**$ 2,991,896.40**
Total					**$19,852,902.24**
Preferred Alternative Total Cost					**$19,852,902.24**

Assumptions made for opinion of probable cost purposes:

1. Channel and basin excavation is presumed to be entirely cut below existing grade.

2. Landscaping assumes that the entire channel area including side slopes and buffers (except channel bottom), are to be landscaped in accordance with District landscaping guidelines and policies.

3. It is presumed that any land area necessary for conveyance channels and basins will need to be purchased. To the extent that any properties are donated for channel conveyance or basin purposes, the overall project cost would be reduced accordingly.

4. Basin acreage and landscaping costs include a 30% contingency beyond hydrology modeling sizing.

5. High cost estimate includes culvert crossings for vehicular project entry locations as follows: two entrances for Tierra Verde West, one entrance for Tierra Verde East and three entrances off 155th Avenue into the ASLD parcel. Number of entrances and locations based on conformance with the preliminary plat for Tierra Verde East and West and City of Surprise guidelines for the ASLD parcel.

6. Culverts assume standard ADOT box sizing. Culvert sizing was approximated. Future modeling will be necessary to confirm actual size.

7. On-site culvert improvements for each independent project will be necessary and must be identified in their respective project designs and are not included in this cost estimate.

8. Design costs and minor cost items such as rip-rap at select culvert locations were not included in this estimate.

9. Excavation unit costs assume a short haul distance and stockpiling of excess material.

5.11 Benefited Area

Project Stakeholders recommended at the Final Stakeholder Meeting on December 13, 2010 that the Happy Valley DCR Report would be enhanced by the inclusion of a map that preliminarily illustrates what properties in the study area directly benefit from the construction of the Preferred Alternative. This "benefited area" then includes those properties that would tangibly and measurably benefit from the construction of the Preferred Alternative whereby the existing FEMA designated floodplain would be eliminated or substantially reduced. These properties then may be considered for inclusion as a financial stakeholder in the creation of any improvement district or comparable funding mechanism that equitably defines contributions towards the regional improvements. Figure 5.4 illustrates a preliminary identification of those properties that are likely to be included in a potential benefited area. It is suggested that as the Preferred Alternative moves forward to the design stage that a more in-depth analysis is needed to finalize the benefit to each property and what their respective pro-rata share contribution would be to the regional improvements.

5.12 Further Considerations: Design and Implementation

The Project Stakeholders and Project Team have given considerable evaluation to various proposed alternatives and concepts that has provided direction in the selection of the Preferred Alternative. Through this analysis, it is believed that the Preferred Alternative achieves the original project objective of maximizing regional efficiencies that are beneficial and equitable for the maximum number of stakeholders.

The Preferred Alternative has been designed to conceptual 15% plans to demonstrate that the concept is feasible for future design. Additional design and analysis will be necessary to complete the final design of the Preferred Alternative. The future design may differ from the conceptual 15% plans provided as part of this project. As the Happy Valley Channel is carried forward from the DCR stage to the design and implementation stages, some observations for further consideration include the following:

Determination of Precise Happy Valley Channel and Happy Valley Road Alignments – Project Stakeholders continue to collaborate with the City of Surprise to determine the mutually agreeable location of the future Happy Valley Road facility. The existing intersection of Happy Valley Road and 163rd Avenue (shifted south of the Happy Valley section line to the

west) and the location of the existing Happy Valley Wash bear influence on the final location, right-of-way cost, and construction of the roadway facility. It is intended that the Happy Valley Channel will be constructed to the north of the Happy Valley Road facility. Further consideration should be given to the possibility of maintaining the existing Happy Valley Wash in order to minimize disturbance and could be achieved by widening the channel along the north bank. These possibilities become more likely if designed and constructed in conjunction with the Happy Valley Road facility. Should the City of Surprise be interested in proceeding forward with a regional project, the City is encouraged to submit a Prioritization Procedure Request to the District for consideration of this project into the District CIP.

HEC-RAS Analysis of Preferred Alternative – The five different cross sections were designed based on Manning's normal depth calculations. It is recommended that a HEC-RAS model of the Preferred Alternative be performed to verify that the cross sections have adequate capacity and freeboard with the culverts and drop structures.

Permissible Velocities – Further investigation at the pre-design stage is needed to give final determination of the permissible velocity for the improved channels using varying Mannings "n" values. Though added studies were included as a part of this report, future emphasis should be placed on the consideration or likelihood of self-armoring and evaluate if an increase in permissible velocities and a resulting decrease in the channel width is a possibility for the improved conveyance channels. This issue was brought up by Project Stakeholders at the Final Stakeholder Meeting on December 13, 2010.

Channel ROW Survey – A formal survey and legal description for the Happy Valley Channel will be necessary prior to formal design and should be integrated with the final Happy Valley Road location.

Additional Soils Analysis – As previously noted, a more in-depth soils analysis that includes core samples will be necessary. This analysis will more thoroughly determine if any variation to permissible velocities is needed and to more accurately ascertain the scour depth and any design mitigations that may be necessary to minimize scour and erosion of the channel. Additional Stakeholder concern that rilling may occur on the 6:1 side slope and that the potential use of gravel mulch may be necessary and should be evaluated further at the design stage.

Additional Design Considerations – The addition of sediment basins and a low flow channel are items that may be considered as part of the design. Currently, the basin bottom is flat but a sediment basin or provision for dry well(s) may be added to the upstream side to help facilitate maintenance and minimize vector concerns. A proactive operations and

maintenance plan with funding support will also be necessary. Also sediment traps may be added at the confluence of the washes to capture sediment. A low flow channel may help eliminate some of the standing water due to the flat slopes of the channel and erosion occurring from smaller frequency storms.

Currently, the box culverts located at 155th Avenue and Happy Valley Road were proposed to be at the same invert elevation. However, if the invert of the culvert directing the water south is elevated so the low flows are directed east this may help eliminate some of the nuisance flows in a large portion of the flat basin. This should be evaluated further at the design stage.

Detention Basin vs. 155th Avenue Overchute Evaluation - At the Final Stakeholder Meeting on December 13, 2010, renewed stakeholder interest into evaluating the possibility of constructing an overchute at 155th Avenue and the Beardsley Canal in lieu of the detention basin on ASLD property was discussed. An overchute at 155th Avenue was previously contemplated as a design component of Proposed Alternative #2 but was not advanced due to cost consideration as well as the overall selection of the Preferred Alternative (previously Proposed Alternative #1) that did not contemplate the overchute. A thorough cost/benefit analysis that also evaluates the implementation/cost/timing pro's and con's of these two different design solutions might be warranted and investigated at the design stage.

Beardsley Canal Overchute Analysis – This DCR used the existing Beardsley Canal overchute analysis contained in the Wittmann ADMSU. As part of the future project design, the overchute should be surveyed and further analysis provided to verify the capacity of the overchute.

Community Entrance Road Locations – Once the number of project entrances and their respective roadway widths are defined, additional analysis will be necessary to evaluate the culvert crossings. It may be possible to increase the culvert slope of some of the future entrance road culverts and eliminate some of the drop structures. This will help eliminate deposition at the culverts and the additional energy generated by the increased slope can be dissipated with rip rap required for the culvert exits.

Project Phasing Opportunities – In the future evaluation of design components and stakeholder funding obligations, additional evaluation of various phasing opportunities should be considered. Beyond the scope and purvue of this project, phasing consideration to construction of project facilities should evaluate the possibility of dividing the project features. The District by example could be responsible for constructing all or portions of the outfall facilities with the City in likely conjunction with property owner stakeholders

constructing the Happy Valley Channel improvements. This facility could perhaps be constructed in conjunction with the improvement of Happy Valley Road. Additional phasing scenarios should be explored to minimize Project Stakeholder construction costs and efficiently construct facilities as needed.

Channel Buffer Widths – At the Final Stakeholder Meeting on December 13, 2010, the Project Stakeholders expressed a desire to include an observation in this report regarding the appropriate width of the channel buffers that are conceptually identified as 40-feet in this DCR report. Because this buffer is conceptual in nature, further design of the channel shall contemplate varying buffer widths that takes into account the proximity of the channel facility in relation to the Happy Valley Road, adjacent community features, and land uses and operation and maintenance needs. Buffer widths may also be modified to be consistent with previously approved City zoning or platting approvals or as otherwise approved by the City of Surprise.

Collaboration with ASLD – The Preferred Alternative design includes a 53 acre detention basin primarily located on ASLD property. This property, regardless of ownership, is situated in the ponding area of the Beardsley Canal overchute and the property is entirely within the current FEMA designated floodplain. This property then is the likely recipient of a detention basin at this location thereby making the majority of the remaining parcel suitable for development. The ASLD has made clear their desire to receive open space "credit" from the City of Surprise in the evaluation of a future development plan for the site.

It will be important for the Project Stakeholders to collaborate with the ASLD to make necessary provisions for the acquisition of this property, perhaps giving incentives to ASLD to achieve their objectives. Continued collaboration with ASLD by involving them in the pre-design and design stages to seek their support will aid the facilitiation of these design processes.

With regards to funding implementation, Project Stakeholders should draft an agreement that contemplates provisions to incur upfront project construction costs associated with enhancing the ASLD parcel and seek creative repayment options from the ASLD. Repayment options could include include a negotiated agreement, stipulation of development or other instrument that would require recouping of pro-rata share of construction costs with the future entitlement and/or disposition of the ASLD property.

Define Pro-Rata Share/Funding Responsibilities of Construction Costs – A key consideration identified by the Project Stakeholders at the August 9, 2010 Stakeholder Meeting. Property owner stakeholders should collaborate with the FCDMC and City of Surprise to

craft a mutually supportive and equitable funding approach and defined "benefited area" to construct regional improvements that benefit all project stakeholders. The timing and phasing and operation and maintenance of improvements should be evaluated in this process.

Different methods of funding opportunities may include:

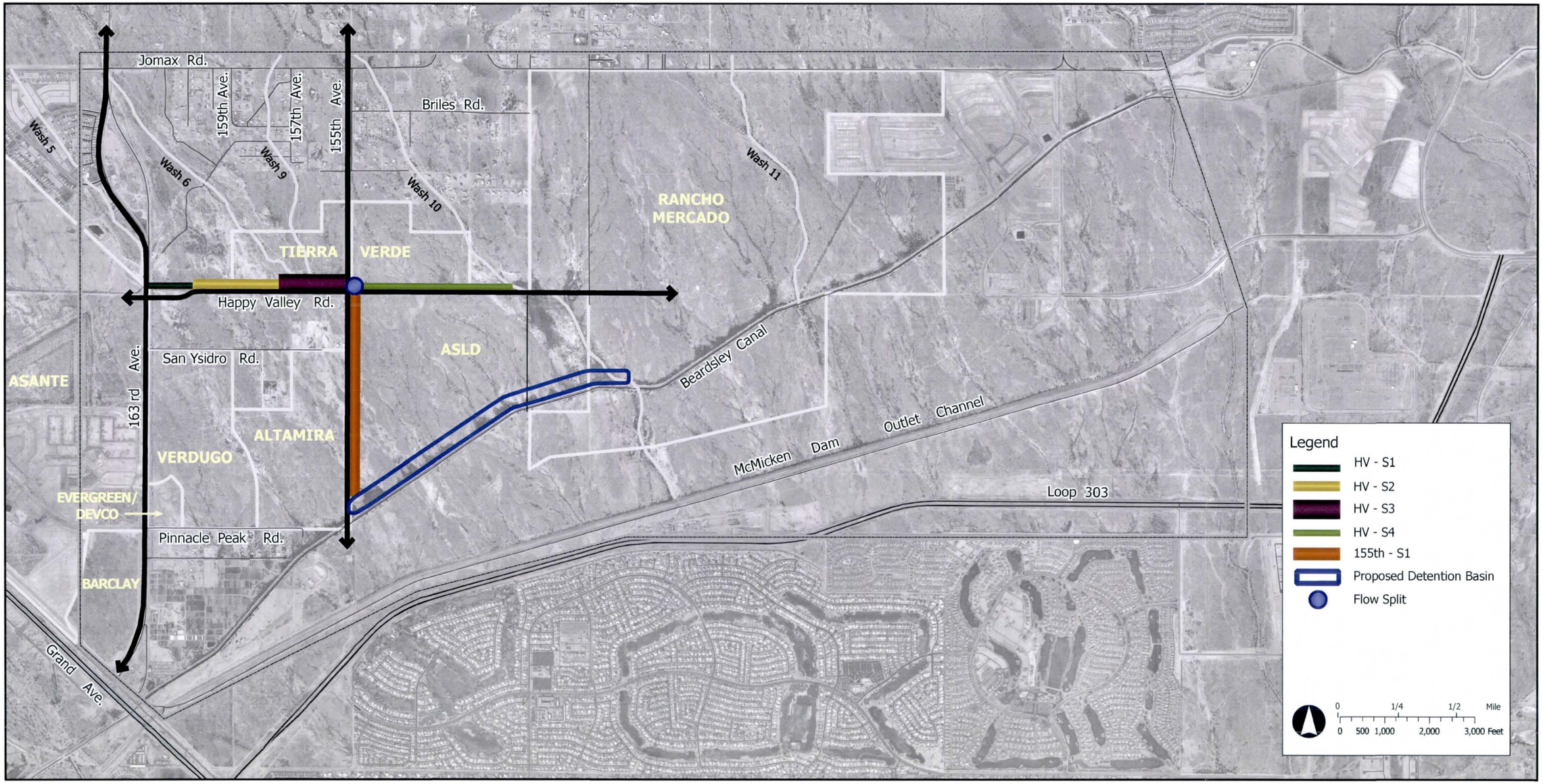
1) A request to the FCDMC of a CIP project whereby a 50/50 (City of Surprise/FCDMC) cost share is plausible for District-eligible improvements.

2) Property owner stakeholders explore the use of a Community Facilities District, Improvement District or similar mechanism with the City of Surprise to construct the Happy Valley Channel improvements. Happy Valley Road improvements may be contemplated as a component of these funding sources as well.

3) In the absence of a regional solution and the synergies that a regional solution brings, the "No Action Alternative" would require each property owner stakeholder to design and construct their individual improvements that are likely to be inefficient in design and cost.

Figure 5.1 – Preferred Alternative

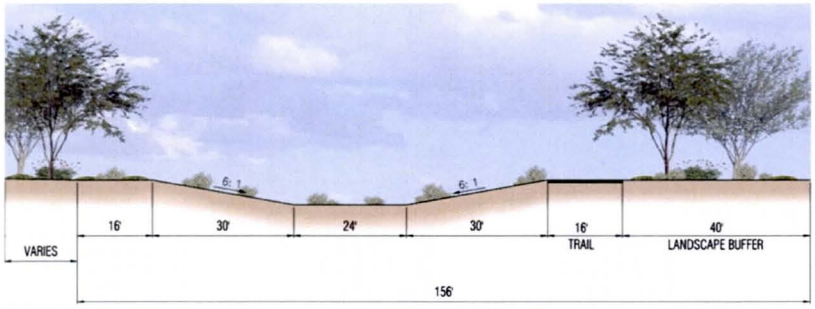
Happy Valley Design Concept Report
Preferred Alternative



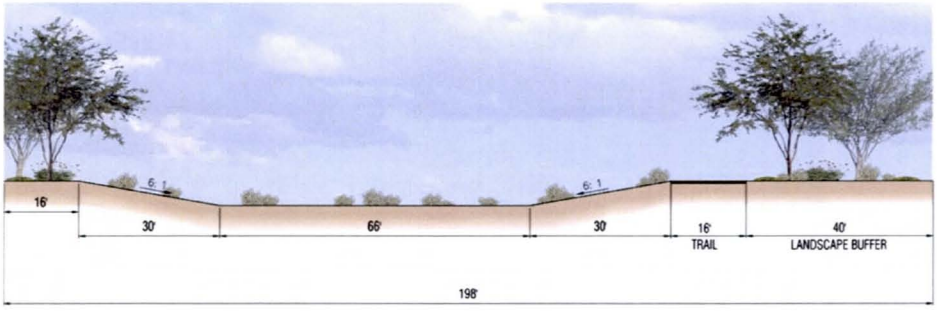
2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

Figure 5.2 – Preferred Alternative: Cross Sections

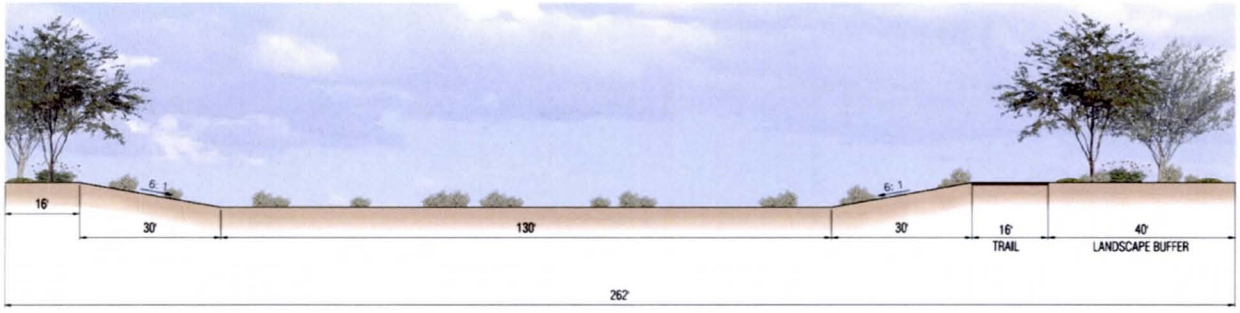
PREFERRED ALTERNATIVE CROSS-SECTIONS



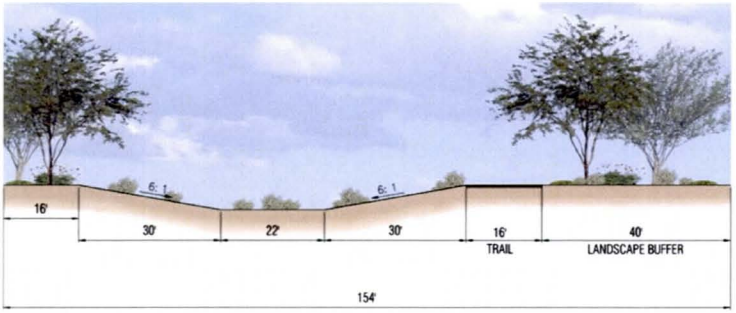
Preferred Alternative: Happy Valley Section 1



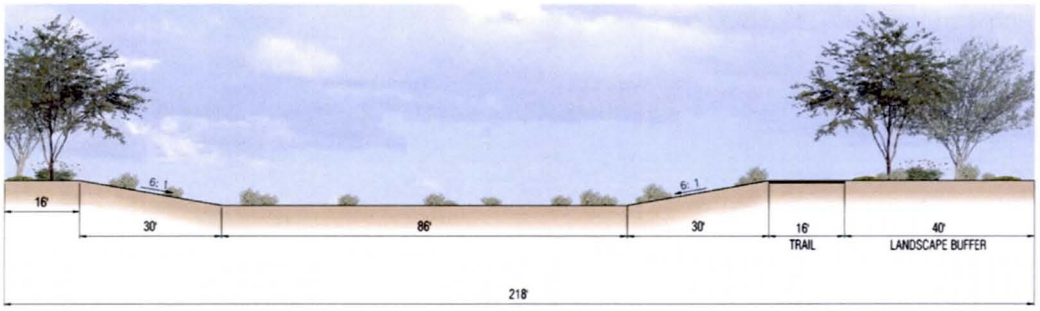
Preferred Alternative: Happy Valley Section 2



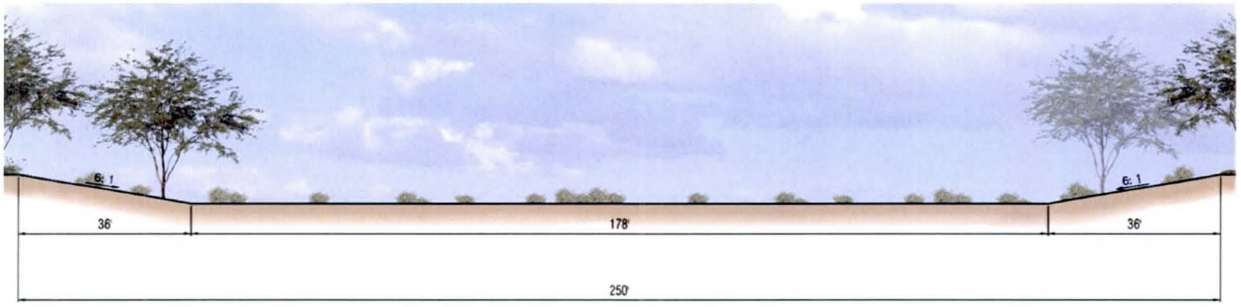
Preferred Alternative: Happy Valley Section 3



Preferred Alternative: Happy Valley Section 4



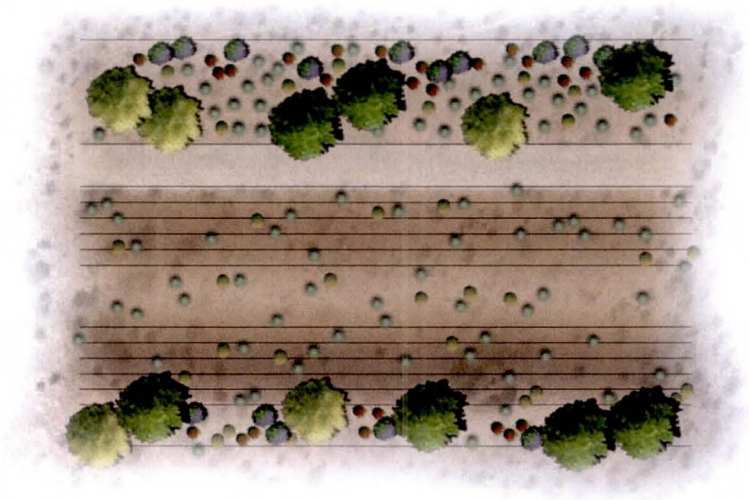
Preferred Alternative: 155th Avenue Section 1



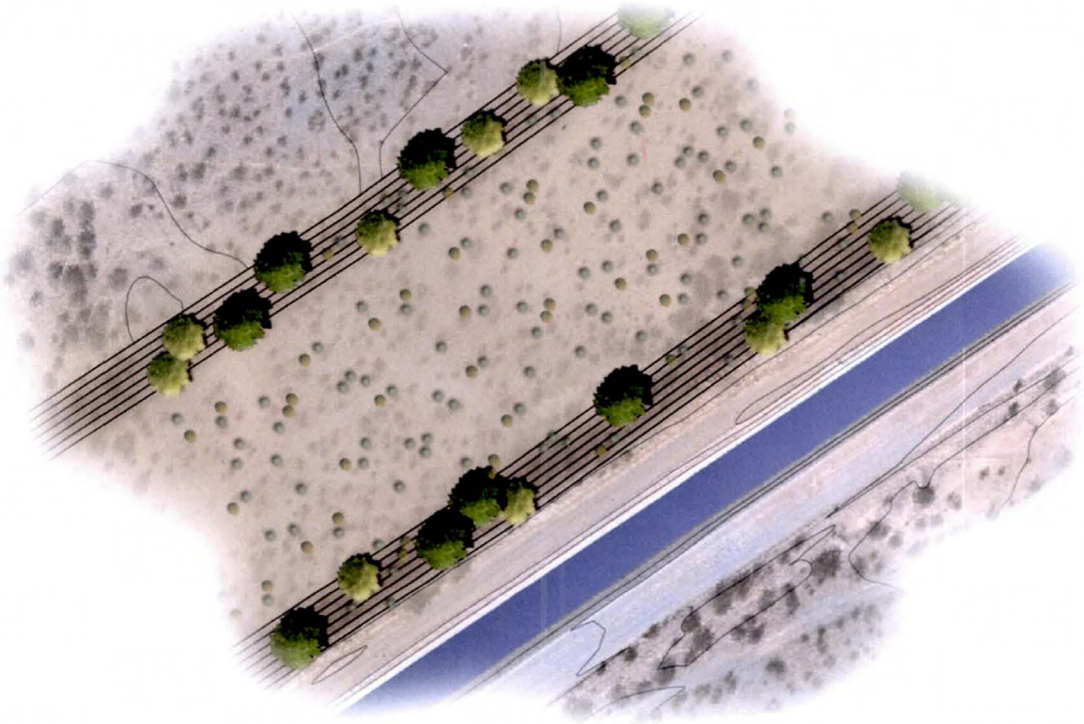
Preferred Alternative: Detention Basin

Figure 5.3 – Preferred Alternative: Plan View

PREFERRED ALTERNATIVE PLAN VIEW



Preferred Alternative: Typical Channel



Preferred Alternative: Typical Basin

Figure 5.4 – Benefited Area Map

Happy Valley Design Concept Report

Preferred Alternative - Benefited Area

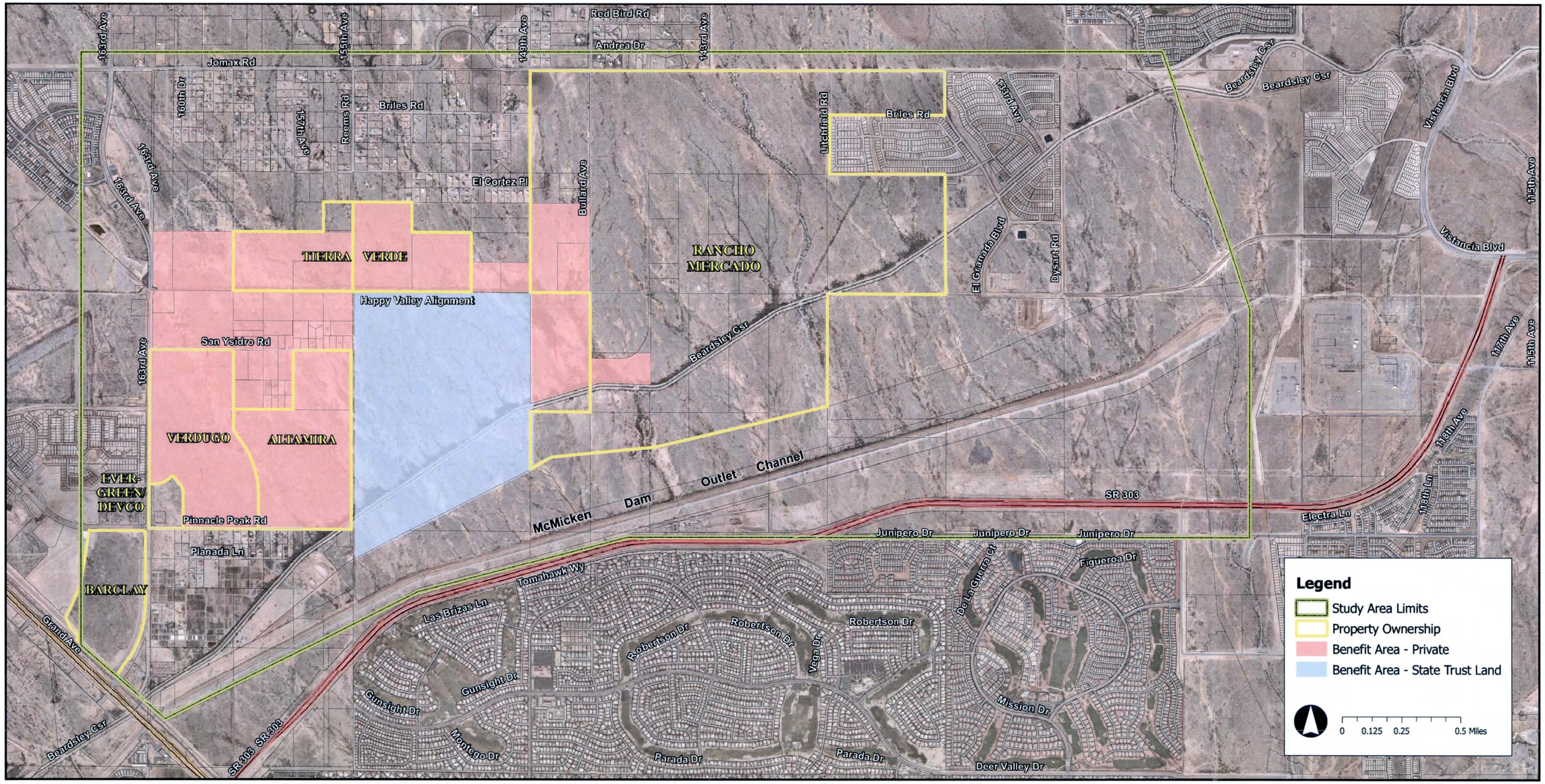


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Figure 5.5 – Conceptual 15% Plans

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

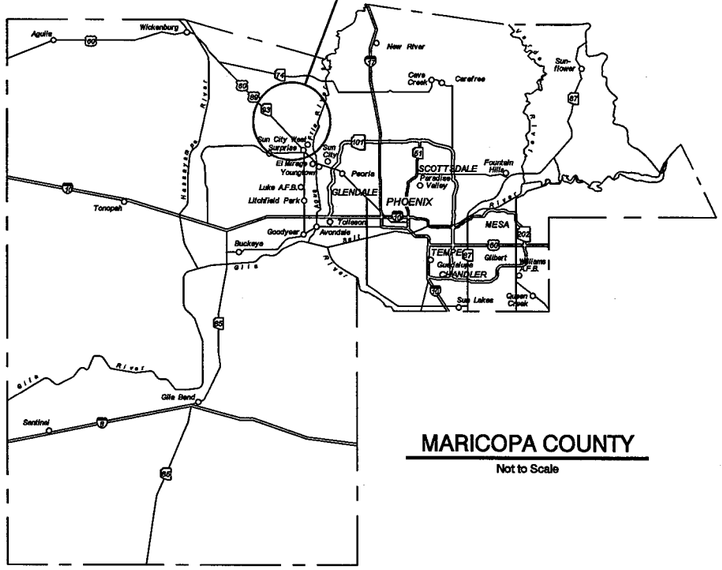
CONCEPTUAL 15% PLANS FOR

HAPPY VALLEY DCR

PCN 344.02.20

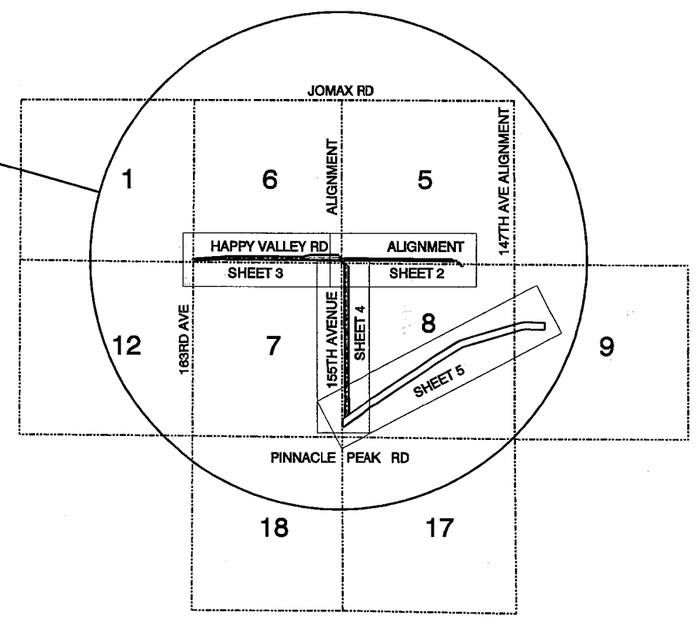
FCD CONTRACT NO. 2008C012

PROJECT LOCATION



MARICOPA COUNTY

Not to Scale



VICINITY MAP

Not to Scale

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

ISSUE RECOMMENDED BY:

PROJECT MANAGER DATE

ISSUED FOR PUBLIC BIDDING BY:

CHIEF ENGINEER & GENERAL MANAGER DATE

BOARD OF DIRECTORS OF THE FLOOD CONTROL DISTRICT

DON STAPLEY - CHAIRMAN

DISTRICT 1	FULTON BROCK
DISTRICT 2	DON STAPLEY
DISTRICT 3	ANDY KUNASEK
DISTRICT 4	MAX WILSON
DISTRICT 5	MARY ROSE WILCOX

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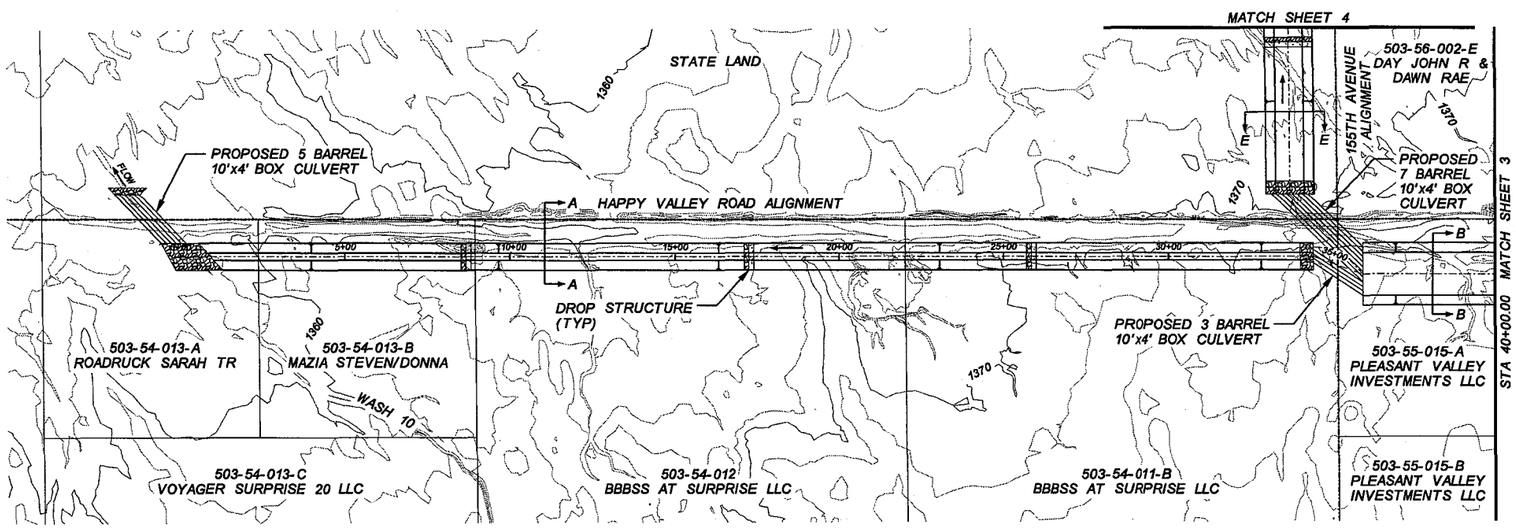

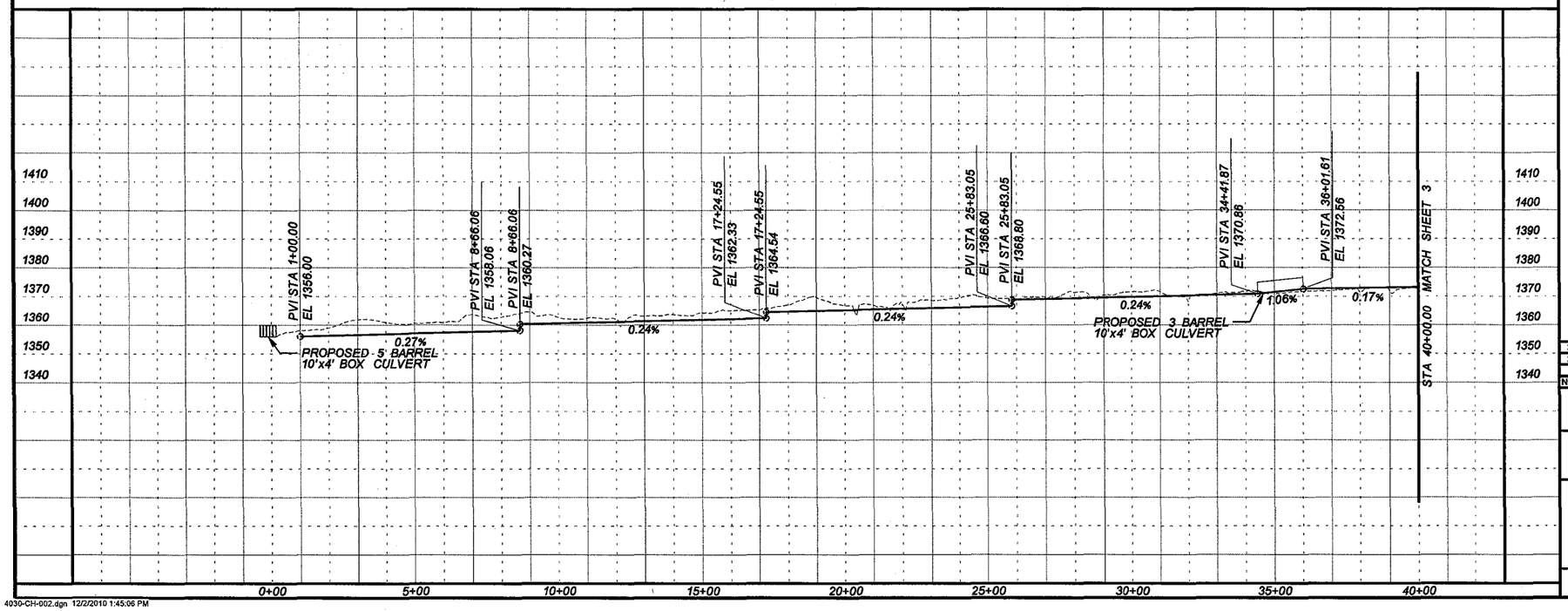

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☐ REMOVE ☐

○ CONSTRUCT ○

DESIGN PARAMETERS

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Q100=720 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

SECTION B
Q100=2,450 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

SECTION E
Q100=1,730 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

GENERAL NOTES

1. THESE PLANS ARE CONCEPTUAL AND NOT INTENDED FOR CONSTRUCTION.

2. UTILITY LOCATIONS ARE SCHEMATIC.

3. THIS PLAN WAS PREPARED USING 2 FT CONTOUR DATA PROVIDED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY FROM AERIAL PHOTOGRAPHS FLOWN IN APRIL 2002 BY LANDATA AIRBORNE SYSTEMS, INC.
COORDINATES
HORIZONTAL: NAD83 ARIZONA STATE PLANE-CENTRAL ZONE
VERTICAL: NAVD 88

TWO WORKING DAYS BEFORE YOU DIG, CALL
263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

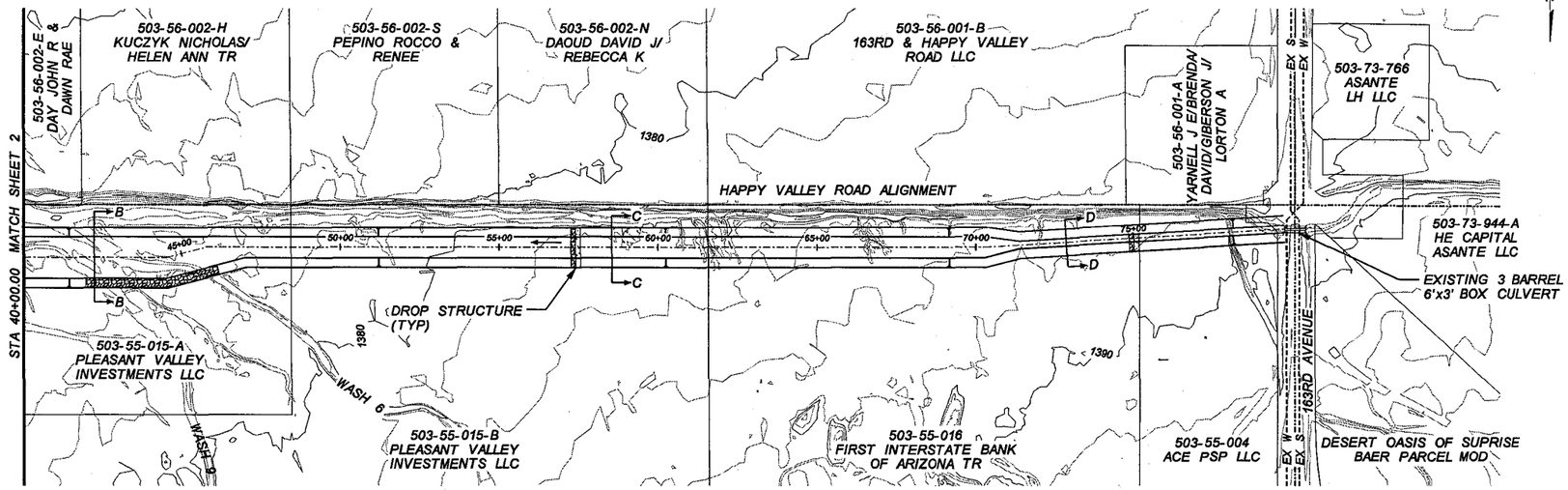
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

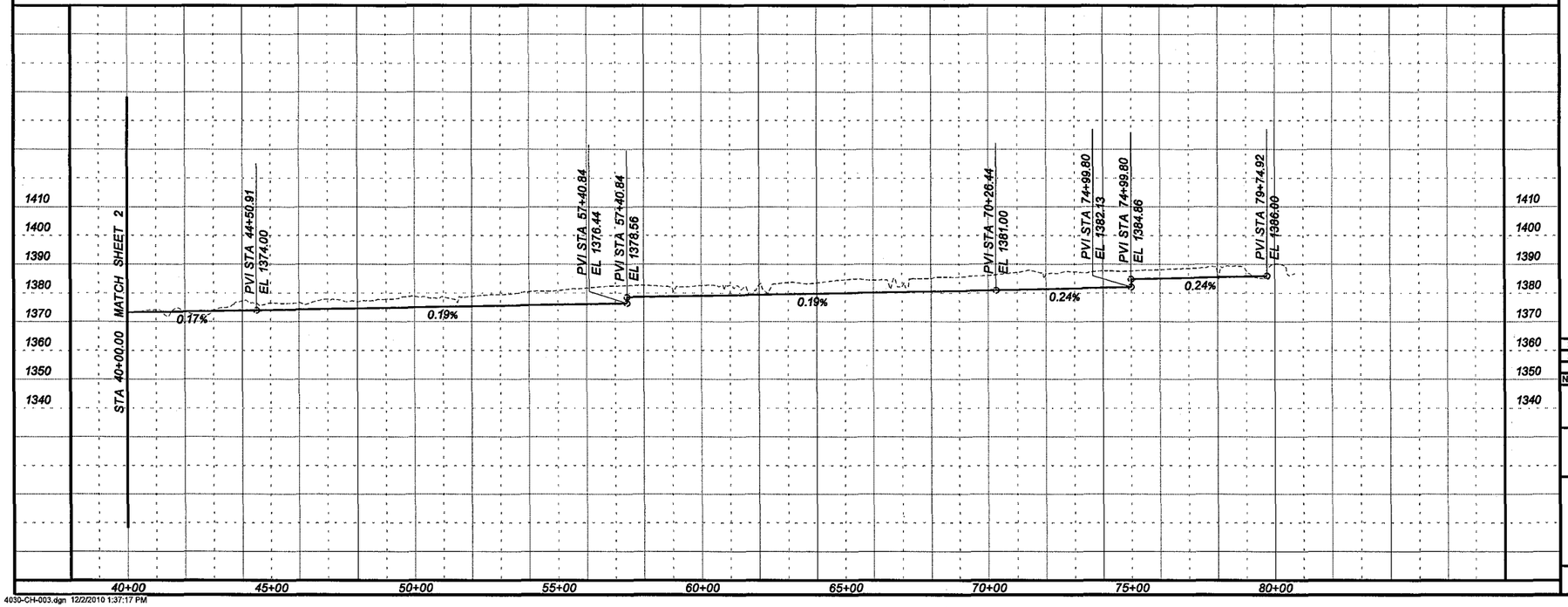
HAPPY VALLEY DCR
PROJECT NUMBER 344.02.20
CONTRACT NUMBER 2008C012

CONCEPTUAL
15% PLANS
NOT FOR
CONSTRUCTION

	BY	DATE
DESIGNED	NEF	DEC/2010
DRAWN	DLP	DEC/2010
CHECKED	DJP	DEC/2010

DRAWING NO. | PLAN AND PROFILE | SHEET 2 OF 6





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☐ REMOVE ☐

◯ CONSTRUCT ◯

DESIGN PARAMETERS

SECTION B
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V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

SECTION C
Q100=1,400 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

SECTION D
Q100=750 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

GENERAL NOTES

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3. THIS PLAN WAS PREPARED USING 2 FT CONTOUR DATA PROVIDED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY FROM AERIAL PHOTOGRAPHS FLOWN IN APRIL 2002 BY LANDATA AIRBORNE SYSTEMS, INC.
COORDINATES
HORIZONTAL: NAD83 ARIZONA STATE PLANE-CENTRAL ZONE
VERTICAL: NAVD 88

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263-1100
BLUE STAKE

NO.	REVISION	BY	DATE
3			
2			
1			

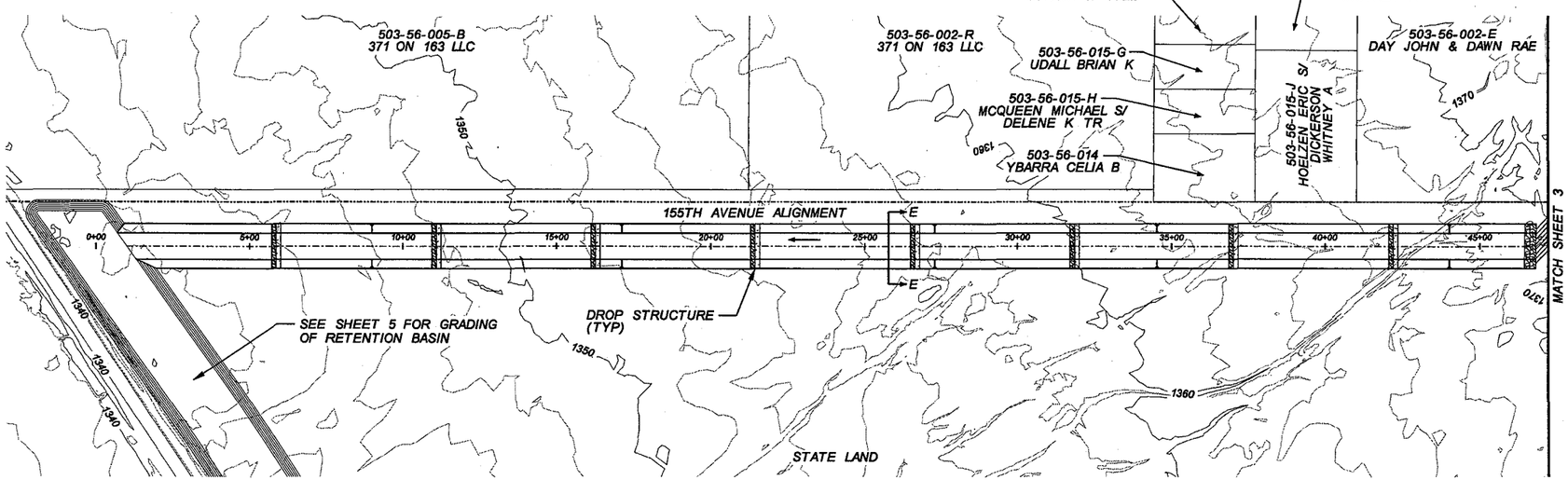
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

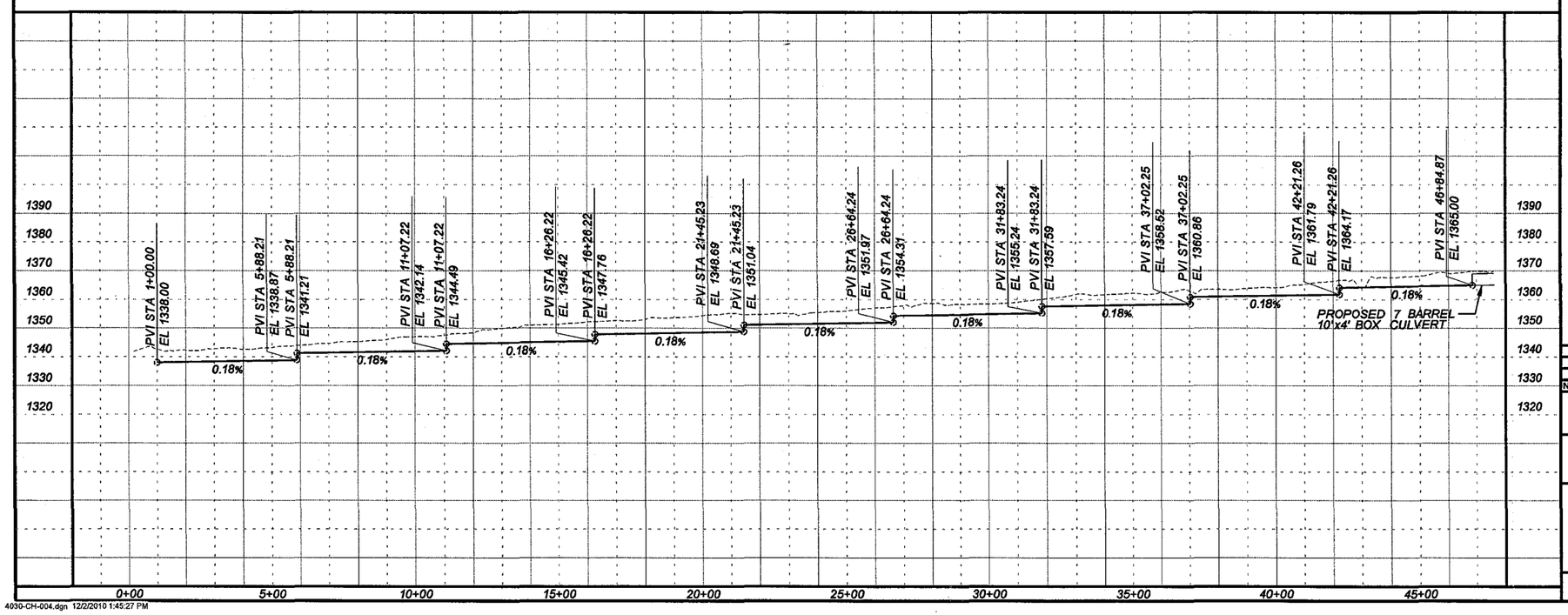
HAPPY VALLEY DCR
PROJECT NUMBER 344.02.20
CONTRACT NUMBER 2008C012

CONCEPTUAL
15% PLANS
NOT FOR
CONSTRUCTION

	BY	DATE
DESIGNED	NEF	DEC/2010
DRAWN	DLP	DEC/2010
CHECKED	DJP	DEC/2010

DRAWING NO. | PLAN AND PROFILE | SHEET 3 OF 6





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☐ REMOVE ☐

○ CONSTRUCT ○

DESIGN PARAMETERS

SECTION E
Q100=1,730 CFS
V=4 FT/S
n=0.035
FLOW DEPTH=4 FT
FREEBOARD=1 FT

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FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

HAPPY VALLEY DCR
PROJECT NUMBER 344.02.20
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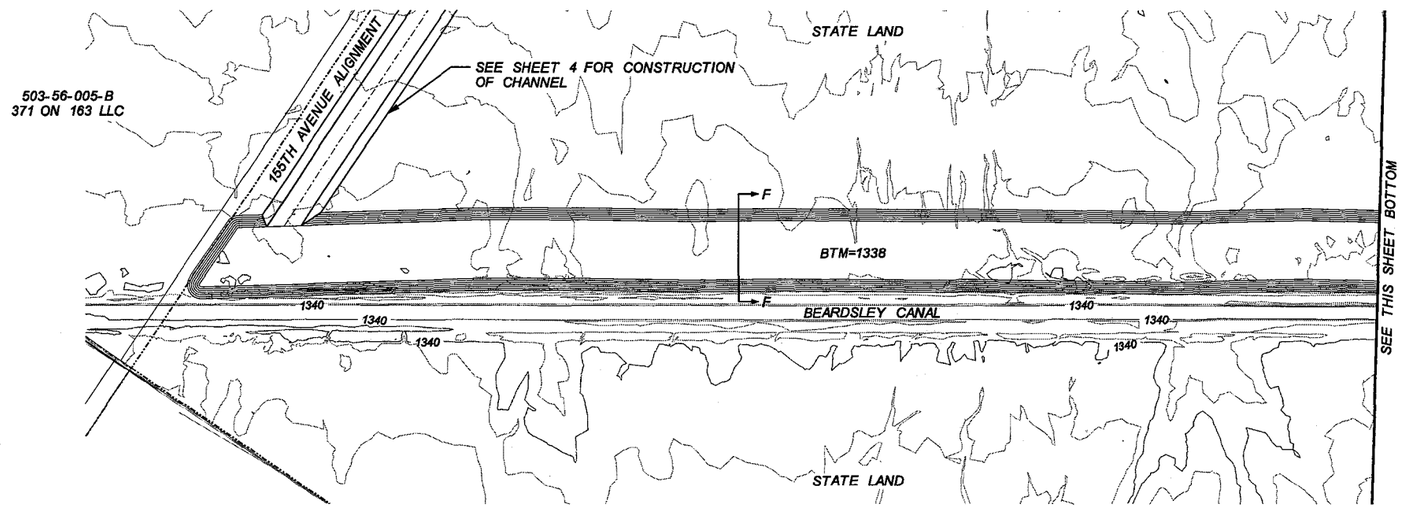
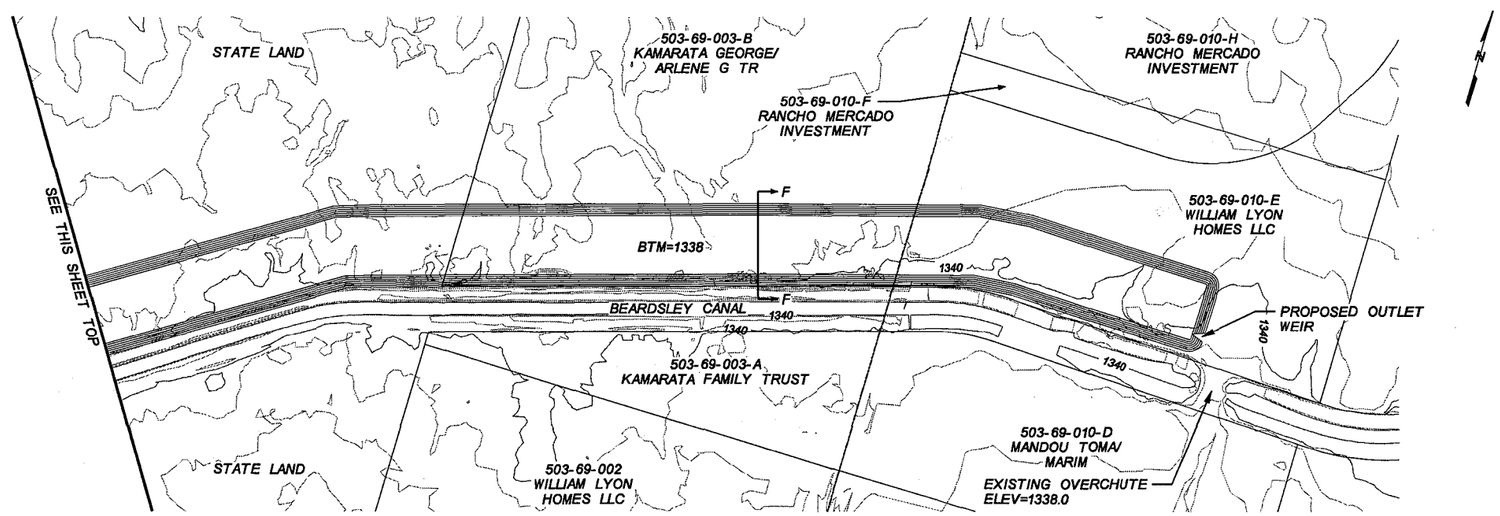
	BY	DATE
DESIGNED	NEF	DEC/2010
DRAWN	DLP	DEC/2010
CHECKED	DJP	DEC/2010

DRAWING NO. | PLAN AND PROFILE | SHEET 4 OF 6





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NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

HAPPY VALLEY DCR
PROJECT NUMBER 344.02.20
CONTRACT NUMBER 2008C012

CONCEPTUAL 15% PLANS NOT FOR CONSTRUCTION

	BY	DATE
DESIGNED	NEF	DEC/2010
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DRAWING NO. | PLAN AND PROFILE | SHEET 5 OF 6

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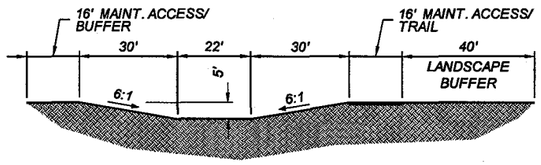
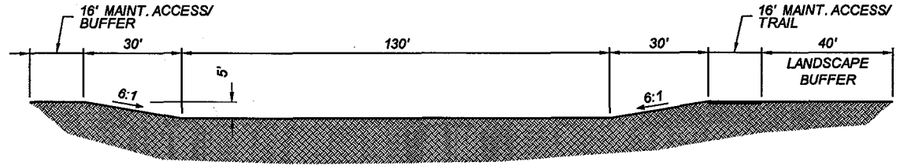
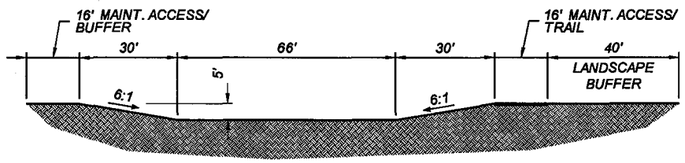


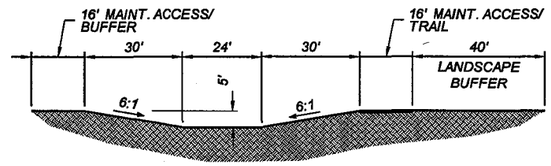
SECTION A-A
HAPPY VALLEY ROAD CHANNEL
STA 1+00.00 TO STA 33+92.36
TOTAL LENGTH=3292.36'



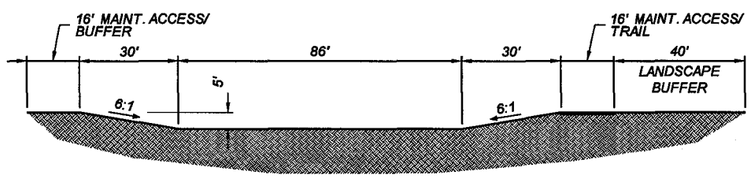
SECTION B-B
HAPPY VALLEY ROAD CHANNEL
STA 36+01.44 TO STA 44+50.91
TOTAL LENGTH=849.47'



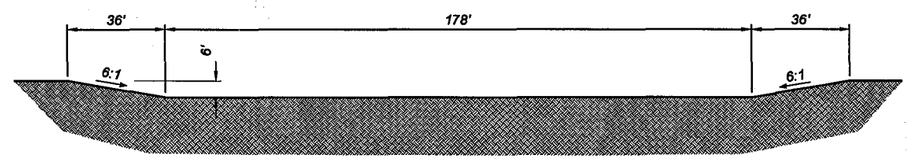
SECTION C-C
HAPPY VALLEY ROAD CHANNEL
STA 47+02.85 TO STA 70+28.46
TOTAL LENGTH=2325.61



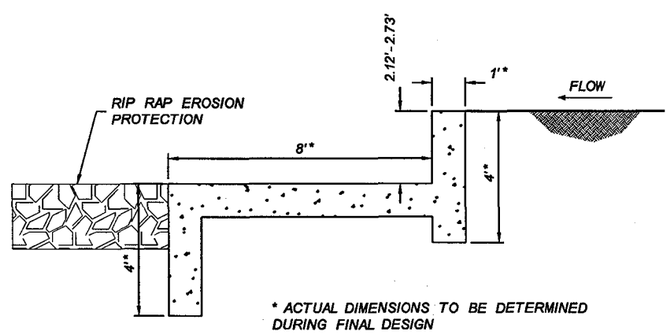
SECTION D-D
HAPPY VALLEY ROAD CHANNEL
STA 71+33.71 TO STA 79+74.92
TOTAL LENGTH=841.21'



SECTION E-E
155TH AVENUE CHANNEL
STA 1+00.00 TO STA 46+84.87
TOTAL LENGTH=4584.87'



SECTION F-F
BASIN



* ACTUAL DIMENSIONS TO BE DETERMINED DURING FINAL DESIGN

DROP STRUCTURE DETAIL
NTS

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COORDINATES
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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

HAPPY VALLEY DCR
PROJECT NUMBER 344.02.20
CONTRACT NUMBER 2008C012

CONCEPTUAL 15% PLANS NOT FOR CONSTRUCTION

	BY	DATE
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DRAWING NO. | PLAN AND PROFILE | SHEET 6 OF 6

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APPENDIX A HYDROLOGIC ANALYSIS SUPPORTING DOCUMENTATION

A.1 Soil Parameter Tables

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6451,"Antho sandy loams",0.41,0.00,100
6452,"Antho gravelly sandy loams",0.41,0.00,100
6453,"Antho-Carrizo-Maripo complex",0.58,0.00,100
6454,"Antho-Carrizo-Maripo complex, low precipitation",0.58,0.00,100
6455,"Anthony sandy loam",0.43,0.00,100
6456,"Anthony-Arizo complex",0.62,0.00,100
6457,"Anthony-Arizo complex, low precipitation",0.62,0.00,100
6458,"Arizo cobbly sandy loam",0.96,0.00,100
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6532,"Agualt and Ripley soils, saline-sodic",0.00,0.00,100
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6536,"Carrizo-Momoli complex, 0 to 3 percent slopes",1.20,0.00,100
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6538,"Cherioni-Coolidge complex, 1 to 15 percent slopes",0.00,0.00,100
6539,"Cipriano-Hyder-Rock outcrop complex, 15 to 65 percent slopes",0.59,15.00,100
6581,"Brios gravelly loamy sand,3 to 5 percent slopes",0.00,0.00,100
6582,"Brios very fine sandy loam,0 to 2 percent slopes",0.00,0.00,100
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6584,"Carrizo-Pinamt complex, 1 to 5 percent slopes",0.00,0.00,100
6585,"Carrizo very gravelly coarse sand, 0 to 1 percent slopes",0.00,0.00,100
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6587,"Casa Grande complex, 0 to 5 percent slopes",0.00,0.00,100
6588,"Casa Grande fine sandy loam, 0 to 3 percent slopes",0.00,0.00,100
6589,"Cavelt-Carrizo-Gunsight complex, 1 to 10 percent slopes",0.00,0.00,100
7031,"Ajo-pinamt, deep, complex, 3 to 15 percent slopes",0.00,0.00,100
7032,"Anklam-cellar-rock outcrop complex, 15 to 55 percent slopes",0.00,0.00,100
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64515,"Carrizo-Gunsight complex, 1 to 5 percent slopes",0.54,0.00,100
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64531,"Dixaleta-Rock outcrop complex, 25 to 65 percent slopes",0.33,35.00,100
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64535,"Eba very gravelly loam, low precipitation, 8 to 20 percent slopes",0.23,0.00,100
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64542,"Eba-Pinaleno complex, low precipitation, 3 to 20 percent slopes",0.17,0.00,100
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64593,"Nickel-Cave complex, 8 to 30 percent slopes",0.33,0.00,100
64594,"Nickel-Cave complex, low precipitation, 8 to 30 percent slopes",0.33,0.00,100
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65342,"Indio silt loam, saline-sodic",0.00,0.00,100
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65362,"Vaiva-Quilotosa extremely stony sandy loams, 25 to 55 percent slopes",0.00,0.00,100
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65811,"Cristobal-Gunsight complex, 3 to 15 percent slopes",0.00,0.00,100
65812,"Dateland-Cuerda complex, saline-sodic, 0 to 3 percent slopes",0.00,0.00,100
65813,"Denure-Pahaka complex, 1 to 3 percent slopes",0.00,0.00,100
65814,"Denure-Pahaka complex, 3 to 5 percent slopes",0.00,0.00,100
65815,"Gadsden, Glenbar and Vint soils, saline-sodic, 0 to 2 percent slopes",0.00,0.00,100
65816,"Gadsden silty clay loam, saline-sodic, 0 to 2 percent slopes",0.00,0.00,100
65817,"Glenbar silt loam, saline-sodic, 0 to 2 percent slopes",0.00,0.00,100
65818,"Indio silt loam, saline-sodic, 0 to 2 percent slopes",0.00,0.00,100
65819,"Indio-Vint complex, saline-sodic, 0 to 3 percent slopes",0.00,0.00,100
65820,"Kamato complex, 0 to 5 percent slopes",0.00,0.00,100
65821,"Kamato loam, 0 to 2 percent slopes",0.00,0.00,100
65822,"Lagunita silt loam,  0 to 2 percent slopes",0.00,0.00,100
65823,"Laveen fine sandy loam, saline-sodic, 0 to 2 percent slopes",0.00,0.00,100
65824,"Momoli cobbly sandy loam, 5 to 15 percent slopes",0.00,0.00,100
65825,"Pompeii-Lomitas-Rock outcrop complex, 15 to 65 percent slopes",0.00,0.00,100
65826,"Quilotosa-Momoli-Vaiva complex, 1 to 15 percent slopes",0.00,0.00,100
65827,"Quilotosa-Rock outcrop-Vaiva complex, 20 to 65 percent slopes",0.00,0.00,100
65828,"Redun-Shontik complex, 1 to 3 percent slopes",0.00,0.00,100
65829,"Rillito-Gunsight complex, 3 to 15 percent slopes",0.00,0.00,100
65830,"Rositas-Casa Grande-Slickspots complex, 1 to 15 percent slopes",0.00,0.00,100
65831,"Rositas loamy fine sand, sodic, 0 to 3 percent slopes",0.00,0.00,100
65832,"Shontik-Redun complex, 0 to 3 percent slopes",0.00,0.00,100
65833,"Talai silt loam, 0 to 2 percent slopes",0.00,0.00,100
65834,"Trix loam, saline-sodic, 0 to 1 percent slopes",0.00,0.00,100
65835,"Vint-Yahana complex, saline-sodic, 0 to 10 percent slopes",0.00,0.00,100
65836,"Why-Brios complex, 0 to 2 percent slopes",0.00,0.00,100
65837,"Yahana-Indio complex, saline-sodic, 0 to 3 percent slopes",0.00,0.00,100
65838,"Yahana silty clay loam, 0 to 2 percent slopes",0.00,0.00,100
70313,"Chutum loam, 1 to 3 percent slopes",0.00,0.00,100
70315,"Dateland-denure association, 1 to 3 percent slopes",0.00,0.00,100
70316,"Delnorte-stagecoach complex, 1 to 20 percent slopes",0.00,0.00,100
70318,"Delthorny-garzona-rock outcrop complex, 15 to 60 percent slopes",0.00,0.00,100
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70319,"Denure-momoli complex, 1 to 5 percent slopes",0.00,0.00,100
70323,"Gachado-lomitas-rock outcrop complex, 15 to 45 percent slopes",0.00,0.00,100
70324,"Gadsden silty clay loam, 0 to 1 percent slopes",0.00,0.00,100
70325,"Gilman very fine sandy loam, 0 to 1 percent slopes",0.00,0.00,100
70327,"Glenbar loam, 0 to 1 percent slopes",0.00,0.00,100
70328,"Glendale clay loam, 0 to 2 percent slopes, flooded",0.00,0.00,100
70329,"Glendale silt loam, 1 to 3 percent slopes",0.00,0.00,100
70330,"Glendale-pajarito complex, 1 to 3 percent slopes",0.00,0.00,100
70331,"Grabe-vado complex, 1 to 5 percent slopes",0.00,0.00,100
70332,"Granolite-rock outcrop complex, 15 to 65 percent slopes",0.00,0.00,100
70334,"Hantz clay loam, 0 to 1 percent slopes",0.00,0.00,100
70336,"Hickiwan-gunsight-momoli complex, 3 to 15 percent slopes",0.00,0.00,100
70340,"Lajitas-bosa-rock outcrop complex, 15 to 50 percent slopes",0.00,0.00,100
70343,"Mohall-pahaka complex, 1 to 3 percent slopes",0.00,0.00,100
70344,"Mohall-trix complex, 0 to 1 percent slopes",0.00,0.00,100
70345,"Nahda-stagecoach complex, 1 to 15 percent slopes",0.00,0.00,100
70347,"Pajarito-sahuarita complex, 1 to 3 percent slopes",0.00,0.00,100
70348,"Pantano-granolite complex, 5 to 25 percent slopes",0.00,0.00,100
70349,"Pinamt-momoli complex, 1 to 10 percent slopes",0.00,0.00,100
70355,"Sasco loam, 0 to 1 percent slopes",0.00,0.00,100
70360,"Vado-agustin complex, 1 to 8 percent slopes",0.00,0.00,100
70362,"Wintersburg loam, 0 to 1 percent slopes",0.00,0.00,100
70363,"Water",0.00,0.00,100
100103,"Sandy Clay Loam",0.12,0.00,100
100121,"Sandy Clay Loam",0.12,0.00,100
100126,"Sandy Loam",0.40,15.00,100
100301,"Sandy Loam",0.40,0.00,100
100303,"Sandy Loam",0.40,15.00,100
200239,"Sandy Loam",0.40,30.00,100
200292,"Sandy Loam",0.40,30.00,100
200300,"Sandy Clay Loam",0.06,0.00,100
200301,"Sandy Clay Loam",0.06,0.00,100
200352,"Sandy Loam",0.40,10.00,100
200381,"Sandy Loam",0.40,0.00,100
200382,"Sandy Loam",0.40,15.00,100
200390,"Sandy Clay Loam",0.06,0.00,100
200391,"Sandy Clay Loam",0.06,0.00,100
200400,"Sandy Clay Loam",0.06,0.00,100
200401,"Sandy Clay Loam",0.06,0.00,100
200402,"Sandy Loam",0.40,10.00,100
200415,"Sandy Loam",0.40,0.00,100
200416,"Sandy Clay Loam",0.06,0.00,100
200417,"Loam",0.25,20.00,100
200418,"Sandy Loam",0.40,0.00,100
200451,"Loam",0.25,0.00,100
200452,"Loam",0.25,20.00,100
300337,"Saucedo volcanics - includes rhyolite, latite, and andesite",0.00,0.00,100
645100,"Quilotosa-Vaiva-Rock outcrop complex, 20 to 65 percent slopes",0.40,20.00,100
645101,"Rillito loam, 0 to 3 percent slopes",0.28,0.00,100
645102,"Rillito gravelly loam, 1 to 8 percent slopes",0.40,0.00,100
645103,"Rock outcrop-Gachado complex, 5 to 55 percent slopes",0.10,65.00,100
645104,"Rock outcrop-Lehmans complex, 15 to 65 percent slopes",0.14,60.00,100
645105,"Rock outcrop-Lehmans complex, low precipitation, 15 to 65 percent       slopes",0.14,60.00,100
645106,"Sal-Cipriano complex, 1 to 10 percent slopes",0.18,0.00,100
645107,"Sal-Cipriano complex, low precipitation, 1 to 10 percent slopes",0.18,0.00,100
645108,"Schenco-Rock outcrop complex, 3 to 25 percent slopes",0.31,30.00,100
645109,"Schenco-Rock outcrop complex, 25 to 60 percent slopes",0.35,35.00,100
645110,"Suncity-Cipriano complex, 1 to 7 percent slopes",0.13,0.00,100
645111,"Torriorthents, 15 to 40 percent slopes",0.40,0.00,100
645112,"Tremant gravelly sandy loams",0.39,0.00,100
645113,"Tremant gravelly loams",0.39,0.00,100
645114,"Tremant gravelly loams, low precipitation",0.39,0.00,100
645115,"Tremant-Antho complex, 1 to 5 percent slopes",0.39,0.00,100
645116,"Tremant-Gunsight-Rillito complex, 1 to 5 percent slopes",0.23,0.00,100
645117,"Tremant-Gunsight-Rillito complex, low precipitation, 1 to 5 percent slopes",0.23,0.00,100
645118,"Tremant-Rillito complex",0.42,0.00,100
645119,"Tremant-Suncity complex, 1 to 8 percent slopes",0.14,0.00,100
645120,"Tres Hermanos gravelly sandy loams",0.06,0.00,100
645121,"Tres Hermanos-Anthony complex, 1 to 5 percent slopes",0.12,0.00,100
645122,"Vado gravelly sandy loam, 1 to 5 percent slopes",0.33,0.00,100
645123,"Vaiva very gravelly loam, 1 to 20 percent slopes",0.37,0.00,100
645124,"Valencia sandy loams",0.39,0.00,100
645125,"Vint loamy fine sand",0.43,0.00,100
645999,"Blank/Unknown/Uncertain",0.00,0.00,100
651999,"Blank/Unknown/Uncertain",0.00,0.00,100
655999,"Blank/Unknown/Uncertain",0.00,0.00,100
999999,"Blank/Unknown/Uncertain",0.00,0.00,100
6374229,"Lehmans gravelly clay loam, 8 to 45 percent slopes",0.14,60.00,100
6374235,"Lehmans extremely rocky clay loam, 8 to 60 percent slopes",0.09,30.00,100
6375455,"Rockland",0.14,60.00,100
6512021,"Agualt loam",0.26,0.00,100
6512025,"Antho sandy loam, saline-alkali",0.39,0.00,100
6512029,"Antho-Brios sandy loams",0.39,0.00,100
6512042,"Antho association",0.40,0.00,100
6512044,"Antho-Valencia association",0.39,0.00,100
6512047,"Avonda clay loam",0.05,0.00,100
6512049,"Avondale clay loam",0.04,0.00,100
6512051,"Avondale clay loam, saline-alkali",0.04,0.00,100
6512228,"Beardsley loam",0.24,0.00,100
6512255,"Brios loamy sand",1.05,0.00,100
6512257,"Brios sandy loam",0.39,0.00,100
6512259,"Brios loam",0.25,0.00,100
6512423,"Carrizo gravelly sandy loam",0.40,0.00,100
6512430,"Carrizo and Brios soils",0.50,0.00,100
6512433,"Casa Grande Sandy loam",0.24,0.00,100
6512435,"Casa Grande loam",0.24,0.00,100
6512441,"Casa Grande complex",0.30,0.00,100
6512445,"Casa Grande-Leveen complex, alkali",0.26,0.00,100
6512447,"Cashion clay, saline-alkali",0.01,0.00,100
6512448,"Cheriono-Rock outcrop complex",0.29,20.00,100
6512451,"Coolidge sandy loam",0.40,0.00,100
6512457,"Coolidge-Tremant complex",0.19,0.00,100
6512462,"Coolidge-Laveen association",0.39,0.00,100
6512647,"Dune land",1.20,0.00,100
6512857,"Estrella loam",0.25,0.00,100
6512859,"Estrella loam, saline-alkali",0.25,0.00,100
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6513220,"Gachado-Rock outcrop complex",0.10,40.00,100
6513223,"Gadsden clay loam",0.04,0.00,100
6513225,"Gadsden clay",0.01,0.00,100
6513227,"Gadsden clay, saline-alkali",0.01,0.00,100
6513229,"Gilman fine sandy loam",0.26,0.00,100
6513231,"Gilman fine sandy loam, saline-alkali",0.24,0.00,100
6513235,"Gilman loam, saline-alkali",0.24,0.00,100
6513242,"Gilman complex, saline-alkali",0.25,0.00,100
6513244,"Gilman-Antho association",0.29,0.00,100
6513246,"Gilman-Laveen association",0.25,0.00,100
6513251,"Gilman loam, clayey subsoil variant, moderately saline",0.24,0.00,100
6513255,"Glenbar loam",0.23,0.00,100
6513257,"Glenbar loam, saline-alkali",0.23,0.00,100
6513259,"Glenbar clay loam",0.04,0.00,100
6513261,"Glenbar clay loam, saline-alkali",0.04,0.00,100
6513263,"Glenbar clay",0.01,0.00,100
6513444,"Harqua-Laveen complex",0.15,0.00,100
6514221,"La Palma very fine sandy loam",0.26,0.00,100
6514223,"Laveen sandy loam",0.40,0.00,100
6514227,"Laveen loam, saline-alkali",0.25,0.00,100
6514229,"Laveen clay loam",0.04,0.00,100
6514231,"Laveen-Antho complex, saline-alkali",0.33,0.00,100
6514421,"Maripo sandy loam",0.40,0.00,100
6514449,"Mohall sandy loam",0.39,0.00,100
6514451,"Mohall loam",0.25,0.00,100
6514455,"Mohall clay loam",0.05,0.00,100
6514457,"Mohall clay",0.01,0.00,100
6514462,"Mohall-Laveen association",0.15,0.00,100
6515021,"Perryville sandy loam",0.40,0.00,100
6515023,"Perryville loam, saline-alkali",0.38,0.00,100
6515058,"Pinal gravelly loam",0.40,0.00,100
6515456," Rock outcrop-Cherioni complex",0.40,65.00,100
6515821,"Toltec loam",0.25,0.00,100
6515822,"Torrifluvents",0.40,0.00,100
6515825,"Torriorthents",0.40,0.00,100
6515826,"Torripsamments and Torrifluvents, frequently flooded",1.20,0.00,100
6515829,"Tremant loam",0.25,0.00,100
6515833,"Tremant clay loam",0.04,0.00,100
6515835,"Tremant gravelly clay loam",0.04,0.00,100
6515859,"Trix clay loam",0.04,0.00,100
6515861,"Tucson loam",0.25,0.00,100
6515865,"Tucson clay loam",0.05,0.00,100
6516221,"Valencia sandy loam",0.39,0.00,100
6516223,"Valencia sandy loam, saline-alkali",0.39,0.00,100
6516225,"Valencia gravelly sandy loam",0.39,0.00,100
6516229,"Vecont loam",0.25,0.00,100
6516231,"Vecont clay",0.01,0.00,100
6516233,"Vint loamy fine sand",0.91,0.00,100
6516235,"Vint fine sandy loam",0.27,0.00,100
6516241,"Vint loam",0.26,0.00,100
6516247,"Vint clay loam",0.04,0.00,100
6516255,"Vint-Carrizo complex",0.63,0.00,100
6516433,"Wintersburg complex",0.03,0.00,100
6552031,"Agualt fine sandy loam",0.25,0.00,100
6552033,"Agualt loam",0.25,0.00,100
6552045,"Alluvial land",1.20,0.00,100
6552063,"Avondale clay loam",0.04,0.00,100
6552421,"Carrizo gravelly loamy sand",1.20,0.00,100
6552423,"Carrizo fine sandy loam",0.25,0.00,100
6552425,"Cashion clay",0.01,0.00,100
6552449,"Contine clay loam",0.04,0.00,100
6552857,"Estrella loam",0.25,0.00,100
6553231,"Gilman fine sandy loam",0.25,0.00,100
6553245,"Gilman loam",0.25,0.00,100
6553247,"Glenbar clay loam",0.04,0.00,100
6553255,"Gravelly alluvial land",1.20,0.00,100
6554449,"Mohall sandy loam",0.40,0.00,100
6554463,"Mohall loam",0.25,0.00,100
6555045,"Pimer clay loam",0.04,0.00,100
6555049,"Pinal loam, moderately deep variant",0.25,0.00,100
6555449,"Rock land",0.25,65.00,100
6555461,"Rough broken land",0.40,20.00,100
6555867,"Trix clay loam",0.04,0.00,100
6556221,"Valencia sandy loam",0.40,0.00,100
6556229,"Vecont clay",0.01,0.00,100
6556231,"Vint loamy fine sand",1.20,0.00,100
65124202,"Calciorthids and Torriorthents, eroded",0.38,0.00,100
65132493,"Gilman,Antho and Glenbar soils, severely eroded",0.19,0.00,100
637244526,"Cellar very gravelly sandy loam, 8 to 30 percent slopes",0.14,25.00,100
637244730,"Cellar very rocky sandy loam, 15 to 60 percent slopes",0.44,15.00,100
637444130,"Moano very rocky loam, 15 to 60 percent slopes",0.29,20.00,100
651202320,"Anthosandy loam, 0 to 1 percent slopes",0.38,0.00,100
651202322,"Antho sandy loam, 1 to 3 percent slopes",0.39,0.00,100
651202720,"Antho gravelly sandy loam, 0 to 1 percent slopes",0.40,0.00,100
651202722,"Antho gravelly sandy loam, 1 to 3 percent slopes",0.40,0.00,100
651203120,"Antho-Carrizo complex, 0 to 1 percent slopes",0.38,0.00,100
651203122,"Antho-Carrizo complex, 1 to 3 percent slopes",0.40,0.00,100
651203222,"Antho-Carrizo complex, 0 to 3 percent slopes",0.40,0.00,100
651203424,"Antho-Tremant complex, 1 to 5 percent slopes",0.38,0.00,100
651204122,"Antho-Tremant-Mohall complex, 1 to 5 percent slopes",0.27,0.00,100
651225036,"Borrow pit",0.00,0.00,100
651242926,"Carrizo-Ebon complex, 3 to 12 percent slopes",0.19,0.00,100
651245522,"Coolidge gravelly sandy loam, 1 to 3 percent slopes",0.40,0.00,100
651282326,"Ebon gravelly loam, 0 to 8 percent slopes",0.10,0.00,100
651285026,"Ebon-Pinamt complex, 0 to 10 percent slopes",0.12,0.00,100
651323320,"Gilman loan, 0 to 1 percent slopes",0.25,0.00,100
651323322,"Gilman loam, 1 to 3 percent slopes",0.26,0.00,100
651325036,"Gravel pit",0.00,0.00,100
651326426,"Gunsight-Pinal complex, 1 to 10 percent slopes",0.35,0.00,100
651326720,"Gunsight-Rillito complex, 0 to 1 percent slopes",0.23,0.00,100
651326722,"Gunsight-Rillito complex, 1 to 3 percent slopes",0.24,0.00,100
651326826,"Gunsight-Rillito complex, 0 to 10 percent slopes",0.26,0.00,100
651342022,"Harqua complex, 0 to 3 percent slopes",0.07,0.00,100
651342024,"Harqua complex, 3 to 8 percent slopes",0.05,0.00,100
651344224,"Harqua-Gunsight complex, 0 to 5 percent slopes",0.14,0.00,100
651345522,"Harqua-Rillito complex, 1 to 3 percent slopes",0.12,0.00,100
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651422520,"Laveen loam, 0 to 1 percent slopes",0.25,0.00,100
651422522,"Laveen loam, 1 to 3 percent slopes",0.25,0.00,100
651422862,"Man-made levee",0.00,0.00,100
651441064,"Waste stabilization pond",0.00,0.00,100
651445822,"Mohall-Tremant complex, 0 to 3 percent slopes",0.15,0.00,100
651502920,"Perryville gravelly loam, 0 to 1 percent slopes",0.37,0.00,100
651502922,"Perryville gravelly loam, 1 to 3 percent slopes",0.38,0.00,100
651505422,"Perryville-Rillito complex, 0 to 3 percent slopes",0.28,0.00,100
651505720,"Pinal loam, 0 to 1 percent slopes",0.25,0.00,100
651505722,"Pinal loam, 1 to 3 percent slopes",0.26,0.00,100
651506322,"Pinal-La Palma loams, 1 to 3 percent slopes",0.25,0.00,100
651506422,"Pinal-Suncity complex, 0 to 3 percent slopes",0.38,0.00,100
651506826,"Pinamt-Tremant complex, 1 to 10 percent slopes",0.20,0.00,100
651542120,"Rillito sandy loam, 0 to 1 percent slopes",0.39,0.00,100
651542122,"Rillito sandy loam, 1 to 3 percent slopes",0.39,0.00,100
651542320,"Rillito loam, 0 to 1 percent slopes",0.26,0.00,100
651542322,"Rillito loam, 1 to 3 percent slopes",0.25,0.00,100
651543522,"Rillito-Harqua complex, 1 to 3 percent slopes",0.23,0.00,100
651545128,"Rillito-Perryville complex, 5 to 20 percent slopes",0.29,0.00,100
651583120,"Tremant gravelly loam, 0 to 1 percent slopes",0.37,0.00,100
651583122,"Tremant gravelly loam 1 to 3 percent slopes",0.36,0.00,100
651585022,"Tremant complex, 0 to 3 percent slopes",0.12,0.00,100
651585520,"Tremant-Rillito complex, 0 to 1 percent slopes",0.11,0.00,100
651585522,"Tremant-Rillito complex, 1 to 3 percent slopes",0.13,0.00,100
651585624,"Tremant-Rillito complex, 0 to 5 percent slopes",0.14,0.00,100
653422862,"Man-made levee",0.00,0.00,100
655204720,"Antho sandy loam, 0 to 1 percent slopes",0.40,0.00,100
655204722,"Antho sandy loam, 1 to 3 percent slopes",0.40,0.00,100
655204922,"Antho gravelly sandy loam, 1 to 3 percent slopes",0.40,0.00,100
655242924,"Cavelt gravelly loam, 1 to 5 percent slopes",0.40,0.00,100
655325462,"Gravel pit",0.00,0.00,100
655422120,"Laveen loam, 0 to 1 percent slopes",0.25,0.00,100
655422122,"Laveen loam, 1 to 3 percent slopes",0.25,0.00,100
655422920,"Laveen clay loam, 0 to 1 percent slopes",0.04,0.00,100
655504720,"Pinal gravelly loam, 0 to 1 percent slopes",0.40,0.00,100
655504724,"Pinal gravelly loam, 1 to 3 percent slopes",0.40,0.00,100
655506320,"Pinamt very gravelly loam, 0 to 1 percent slopes",0.40,0.00,100
655506324,"Pinamt very gravelly loam, 3 to 5 percent slopes",0.40,0.00,100
655543720," Rillito gravelly loam, 0 to 1 percent slopes",0.40,0.00,100
655543722,"Rillito gravelly loam, 1 to 3 percent slopes",0.40,0.00,100
655585522,"Tremant gravelly loam, 1 to 3 percent slopes",0.10,0.00,100
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A.2 Land Use Parameter Tables

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110,"Rural Residential (<= 1/5 du per acre)",0.30,5,30,"dry"
120,"Estate Residential (1/5 du per acre to 1 du per acre)",0.30,10,30,"normal"
130,"Large Lot Residential - Single Family (1 du per acre to 2 du per acre)",0.30,15,50,"normal"
140,"Medium Lot Residential - Single Family (2-4 du per acre)",0.25,30,50,"normal"
150,"Small Lot Residential - Single Family (4-6 du per acre)",0.25,35,50,"normal"
160,"Very Small Lot Residential - Single Family (>6 du per acre-includes mobile home",0.25,40,50,"normal"
170,"Medium Density Residential - Muli Family (5-10 du per acre)",0.25,45,50,"normal"
180,"High Density Residential - Multi Family (10-15 du per acre)",0.25,65,50,"normal"
190,"Very High Density Residential - Multi Family (> 15 du per acre)",0.25,85,50,"normal"
200,"General Commercial (Commercial where no detail available)",0.10,80,60,"normal"
210,"Specialty Commercial (<=50,000 sq. ft.)",0.10,80,65,"normal"
220,"Neighborhood Commercial (50,000 to 100,000 sq. ft.)",0.10,80,65,"normal"
230,"Community Commercial (100,000 to 500,000 sq. ft.)",0.10,80,75,"normal"
240,"Regional Commercial (500,000 to 1,000,000 sq. ft.)",0.10,80,65,"normal"
250,"Super-Regional Commercial (>= 1,000,000 sq. ft.)",0.10,80,70,"normal"
300,"General Industrial (Industrial where no detail available)",0.15,55,60,"normal"
310,"Warehouse/Distribution Centers",0.15,80,75,"normal"
320,"Industrial",0.15,55,60,"normal"
400,"Office General (Office where no detail available)",0.10,80,75,"normal"
410,"Office Low Rise (1-4 stories)",0.10,80,75,"normal"
420,"Office Mid Rise (5-12 stories)",0.10,80,75,"normal"
430,"Office High Rise (13 stories or more)",0.10,80,75,"normal"
510,"Tourist and Visitor Accommodations (Hotels, motels and resorts)",0.10,80,75,"normal"
520,"Educational (Public schools, private schools and universities)",0.25,45,80,"normal"
530,"Institutional (Includes hospitals and churches)",0.10,80,75,"normal"
540,"Cemeteries",0.20,5,90,"normal"
550,"Public Facilities (Includes community centers, power sub-stations, libraries, ci",0.10,80,75,"normal"
560,"Special Events (Includes stadiums, sports complexes and fairgrounds)",0.10,80,75,"normal"
570,"Other Employment - low (Proving grounds and land fills)",0.15,80,25,"dry"
580,"Other Employment - medium",0.15,80,75,"normal"
590,"Other Employment - high",0.15,80,75,"normal"
600,"General Transportation (Transportation where no detail available)",0.30,20,30,"normal"
610,"Transportation (Includes railroads, railyards, transit centers and freeways)",0.10,80,30,"normal"
620,"Airports (Includes public use airports)",0.15,55,60,"normal"
700,"General Open Space (Open space where no detail available)",0.35,5,30,"normal"
710,"Active Open Space (Includes parks)",0.20,5,50,"normal"
720,"Golf courses",0.20,5,75,"normal"
730,"Passive Open Space (Includes mountain preserves and washes)",0.35,0,30,"dry"
740,"Water",0.00,0,0,"wet"
750,"Agriculture",0.50,0,85,"normal"
760,"Graded Land",0.25,0,0,"dry"
810,"Business Park (Includes enclosed industrial, office or retail in a planned envir",0.10,80,75,"normal"
820,"Mixed Use",0.10,80,60,"normal"
900,"Vacant (Existing Landuse Database only)",0.35,0,25,"dry"
```

A.3 HEC-1 Model Results

Existing Conditions 100-Year 24-Hour Storm HEC-1 Model With Berm

DRAINAGE ID	HAPPY VALLEY CHANNEL WITH BERM 100-YR 24-HR Q (cfs)
CPI618	629
CPI615	701
CPI612	1406
CP624D	217
CP624E	259
CP624G	405
CP624H	405
CP621A	1409
CP621B	1399
CPI609	2466
CPI606	2098
C606A	363
CPI604	321
CPI603	3452
C600A	930
CPI621 (PI621C)	830
CP624C	346
CWI525	1614
CPI628	750
C624A	1500
C639A	1550
C524A	1768
C2.8	1776
C2.6	1759
CWI524	1766
CPI639	353
CWI506	3353
CWI500	23515
CPI635	3017
C1.14B	204
C1.15B	217
C1.17B	236
C636	233
C624	549
CPI624	989
CPI633	3016
CPI600	4146

1500 0 1500 3000 4500

SCALE: 1"=3000'

HAPPY VALLEY CHANNEL DCR
HEC 1 RESULTS W/ BERM

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
602.467.2200 • FAX 602.467.2201 • www.RBF.com

LAYOUT	DRAFTED	CHECKED
NEF	DLP	NEF

DRAWING SCALE(S): 1"=3000'

PLAN DATE: DEC/2010

PROJECT NUMBER: 45104030

SHEET NO. 1 OF 1 SHEETS

H:\PDATA\45104030\CADD\STORMWATER\EXHIBITS\4030-SW-HECTBERM-091109.DWG NFORD 12/8/10 11:06 am

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   19NOV10  TIME  11:04:07  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                    HEC-1 INPUT                                                    PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID   HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
             2          ID   100-YEAR 24-HOUR STORM - HAPPY VALLEY CHANNEL WITH BERM
             3          ID   EXISTING CONDITIONS
             4          ID   ******************************************************************************
             5          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
             6          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
             7          ID   ******************************************************************************
             8          ID   **                                                                          **
             9          ID   **  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY    **
            10          ID   **                                                                          **
            11          ID   ******************************************************************************
            12          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            13          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            14          ID   ******************************************************************************
            15          ID   **                                                                          **
            16          ID   ** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS    **
            17          ID   ** DATED OCTOBER 2004:                                                      **
            18          ID   **                                                                          **
            19          ID   **     -Diversion added after CTW480                                        **
            20          ID   **          -Main flow (5%) to CTW478                                       **
            21          ID   **          -Diverted flow (95%) to CWI584                                  **
            22          ID   **          -Added concentration point CWI584 combining RD480 and WI584     **
            23          ID   **          -Hard coding was added to CTW478                                **
            24          ID   **          -Route added after D480 (Diversion Recovery)                    **
            25          ID   **          -Route RWI584 was adjusted                                      **
            26          ID   **          -Storage Route SCP050 was adjusted                              **
            27          ID   **          -Route R508* was adjusted                                       **
            28          ID   **          -Hard coding for CWI510 was adjusted                            **
            29          ID   **                                                                          **
            30          ID   **     -Diversion D618 was moved from after CPI618 to before RDCP12         **
            31          ID   **          -Updated route RD618 information                                **
            32          ID   **          -Hard coding on CPI618 was adjusted                             **
            33          ID   **          -Hard coding on CPI615 was adjusted                             **
            34          ID   **                                                                          **
            35          ID   **     -Route RPI639 changed from following US60 to CPI636 to route         **
            36          ID   **      through US60/RR structures and combine with CWI506                  **
            37          ID   **          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
            38          ID   **           following R624A to follow RWI524                               **
            39          ID   **          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
            40          ID   **          -RPI639 information was changed to reflect new route            **
            41          ID   **          -CWI506 changed from combining 3 to combine 4:                  **
            42          ID   **           RWI525, RWI524, RPI639 & WI506                                 **
            43          ID   **          -Hard coding on CWI506 was adjusted                             **
            44          ID   **          -Hard Coding on CWI500 was adjusted                             **
            45          ID   **                                                                          **
            46          ID   ******************************************************************************
            47          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            48          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            49          ID   ******************************************************************************
            50          ID
            51          ID
            52          ID
            53          ID   ******************************************************************************
            54          ID   ******************************************************************************
            55          ID   **                                                                          **
1                                    HEC-1 INPUT                                                    PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            56          ID   **    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004       **
            57          ID   **                                                                          **
            58          ID   ******************************************************************************
            59          ID   ******************************************************************************
            60          ID
            61          ID   PROJECT:                Wittmann ADMS Update
            62          ID   CLIENT:                 Flood Control District of Maricopa County
            63          ID   PREPARED BY:            Entellus, Inc.
            64          ID   PROJECT No:             FCD 2002C029              Entellus 310.032
```

```
ID   FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
ID                                          MODIFIED DATE: MAY 04, 2005
ID
ID   STORM:
ID                        100-year 24-hour Storm
ID
ID   DEVELOPMENT CONDITIONS:
ID                        Existing Conditions
ID
ID   MODELING ASSUMPTIONS:
ID                        It was assumed that the US60 did not have adequate
ID                        storage to cause any significant attenuation.
ID
ID                        The assumption was made that the CAP Canal embankment
ID                        would not be breached under a large flood event.
ID
ID                        The assumption was made that the Beardsley Canal would
ID                        not fail under a large storm event (Per District
ID                        Instruction).  In addition, the berm north of the
ID                        Beardsley canal and east of US60 was assumed to fail
ID                        (per district Instruction).
ID
ID                        For both the CAP and Beardsley Canals, once the berm
ID                        elevation was reached weir flow was assumed.  It was
ID                        also assumed that any weir flow over the canal that
ID                        might enter the canal and be diverted out of the study
ID                        area was insignificant, and thus was ignored.  In other
ID                        words all weir flow over the canal embankment reaches
ID                        the downstream concentration point.
ID
ID                        Typical X-sects were developed, and it was assumed
ID                        that a typical x-sect could adequately represent
ID                        various reaches.
ID
ID                        Time-Area Relations were used base on the District's
ID                        Hydrology Manual criteria.  Two Time-Area Relation
ID                        Curves were utilized:
ID                                -Urban
ID                                -Natural
ID                        The Time-Area Relation Curves were taken directly
ID                        from the manual
ID
ID   MODELING METHODS:
ID                        This model utilizes QI cards to input the Padelford
ID                        hydrographs from the 100-year 6-hour existing
ID                        conditions model developed by A-N West Inc. for the
```



```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

ID                        Padelford Wash Floodplain Delineation Study.  The
ID                        hydrograph was altered from its original form
ID                        (2-minute interval to 5-minute interval) through
ID                        simple interpolation.
ID
ID                        Clark Unit Hydrographs were used for all subbasins
ID                        except the two subbasins directly upstream of the
ID                        Bonita Dam (PD726B and PD740 use S-graphs).  The UC
ID                        parameters were calculated using the WMS7.0 software.
ID
ID                        For Basins PD726B and PD740 S-Graphs were utilized per
ID                        the request of the FCDMC.  Limited details regarding
ID                        the calculations of the S-graphs can be found in the
ID                        model by the basin KK card.  For full details of the
ID                        S-graph calculations refer to the Appendix.
ID
ID                        Normal Depth routing was used for all routing reaches.
ID
ID                        Hard coding was used to account for the percentage of
ID                        area associated with a diversion.  Because of the use
ID                        of JD cards and aereal reduction, hard coding  was
ID                        necessary to properly account for area.  For a given
ID                        diversion a percentage of the flow is routed to two
ID                        different locations.  The same percentage of area
ID                        follows that diverted flow.  In addition the area
ID                        downstream of the main path is reduced or increased and
ID                        is hard coded to account for the loss or gain of area.
ID                        Hard coding was performed based on the 24-hour existing
ID                        conditions model.
ID
ID                        Stage-storage was developed for all the structures
ID                        along the CAP Canal, as well as along the Beardsley
ID                        Canal.  In addition several stage-storage locations
ID                        were developed for areas with significant storage
ID                        along the SR74.  No storage was modeled along the US60
ID                        and railroad, but the culverts were analyzed for
ID                        diversion potential.  Diversions were placed in the
ID                        model where deemed appropriate.  See appendix for
ID                        details.
ID
ID                        FLO-2D was utilized to calculate the split flows at
ID                        concentration points CIW351. CIW357, CIW363 and CWI576.
ID                        See appendix for modeling details.
ID
ID   ******************************************************************************
ID   ******************************************************************************
ID
*DIAGRAM
IT       5                0    1500
IO       5
IN      15                0
JD    4.18     0.01
* 24-hour distribution
PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 164          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 165          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 166          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 167          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 168          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 169          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 170          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 171          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 172          JD   3.929    10.0
 173          JD   3.856    20.0
 174          JD   3.725    40.0
 175          JD   3.599    80.0
 176          JD   3.532   120.0
 177          JD   3.444   200.0
 178          JD   3.385   300.0
 179          JD   3.289   500.0
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP110

 180          KK  DCAP11
 181          BI  DCAP11      22
              *
              *
              * ROUTE UPDATED 4/14/4

 182          KK  RDCP11
 183          RS       5    FLOW     0.0     0.0
 184          RC   0.043   0.035   0.043    6377  0.0094
              * PITS10_2
 185          RX       0      89     103     136     185     206     261     280
 186          RY    1612  1610.5    1610  1608.5    1610    1611  1611.8    1612
              *
              * CAP Diversion Recovery: Outflow from structure CAP120

 187          KK  DCAP12
 188          BI  DCAP12      22
              *
              *
              * Diversion Out: Flow split FS11
              * Flow Split Diversion: Main path to CPI618, Diversion to CPI615
              * 53% of flow is diverted to CPI615

 189          KK    D618
 190          DT   DO618     0.0     0.0
 191          DI       0   10000
 192          DQ       0    5300
              *
              *
              * ROUTE UPDATED 4/14/4
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 193          KK  RDCP12
 194          RS       2    FLOW     0.0     0.0
 195          RC   0.043   0.035   0.043    6159  0.0094
              * PITS30
 196          RX       0      49     199     206     222     231     299     375
 197          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *

 198          KK   PI618
 199          BA  0.2886
 200          LG   0.281   0.235   4.623   0.332    9.32
 201          UC   0.500   0.407
              * Natural Time-Area Relation
 202          UA       0       3       5       8      12      20      43      75      90      96
 203          UA     100
              *
              *
              * Combines PI618, RDCP12 and RDCP11

 204          KK  CPI618
              * Hard Coded
 205          HC       3    5.48
              *
              *
              * ROUTE UPDATED 4/14/04

 206          KK  RPI618
 207          RS       5    FLOW     0.0     0.0
 208          RC   0.043   0.035   0.043   10443  0.0075
              * PITS20
 209          RX       0      50      84      87     123     125     156     285
 210          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP130

 211          KK  DCAP13
 212          BI  DCAP13      22
              *
              *
              * ROUTE UPDATED 4/14/4

 213          KK  RDCP13
 214          RS       6    FLOW     0.0     0.0
 215          RC   0.043   0.035   0.043   11034  0.0089
              * PITS30
 216          RX       0      49     199     206     222     231     299     375
```

```
 217          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                          HEC-1 INPUT                                                    PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 218          KK   PI615
 219          BA  0.8419
 220          LG   0.299   0.243   4.318   0.409   8.997
 221          UC   0.771   0.57
              * Urban Time-Area Relation
 222          UA       0       5      16      30      65      77      84      90      94      97
 223          UA     100
              *
              *
              * Diversion Recovery: Flow split FS11

 224          KK    D618
 225          DR   DO618
              *
              *
              * ROUTE UPDATED 05/04/2005

 226          KK   RD618
 227          RS       5    FLOW     0.0     0.0
 228          RC   0.043   0.035   0.043    9630  0.0091
              * PITS20
 229          RX       0      50      84      87     123     125     156     285
 230          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * Combines RD618, PI615 and RDCP13

 231          KK  CPI615
              * Hard Coded
 232          HC       3    6.21
              *
              *
              * ROUTE UPDATED 4/14/04

 233          KK  RPI615
 234          RS       2    FLOW     0.0     0.0
 235          RC   0.043   0.035   0.043    5109  0.0079
              * PITS20
 236          RX       0      50      84      87     123     125     156     285
 237          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 238          KK   PI612
 239          BA  0.7377
 240          LG   0.337    0.25   4.365     0.4   6.284
 241          UC   0.883   0.770
              * Natural Time-Area Relation
 242          UA       0       3       5       8      12      20      43      75      90      96
 243          UA     100
              *
              *
1                                          HEC-1 INPUT                                                    PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 244          KK  PI624B
 245          KM   OFFSITE SUBBASIN PI624B (North of Jomax Road, upstream of 36" culvert)
 246          BA   0.098
 247          LG   0.433   0.250   4.300   0.531   2.226
 248          UC   0.558   0.644
              * Natural Time-Area Relation
 249          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 250          UA     100
              *
              * Diversion to RX624B - Max Flow in 36" culvert w/4' depth = 47cfs (From DEI)
              *

 251          KK  DO624B
 252          KM   36" CONC CULVERT
 253          DT   D624B
 254          DI       0      47      87     200
 255          DQ       0      47      47      47
              *
              * ROUTE REMAINDER TO CP624D (From DEI)
              *

 256          KK  RX624B
 257          RS       3    FLOW     0.0     0.0
 258          RC   0.043   0.035   0.043    2000   0.006
 259          RX       0       4       8      12      20      24      28      32
 260          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 261          KK  PI624D
 262          KM   OFFSITE SUBBASIN PI624D (North of Jomax Road, upstream of 3-8x4 Box Culvert)
 263          BA   0.323
 264          LG   0.362   0.261   4.449   0.404   4.520
 265          UC   0.783   0.763
              * Natural Time-Area Relation
 266          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 267          UA     100
              * Hard Coded

 268          KK  CP624D
```

```
 269          HC       2    0.35
              *
              * MAIN FLOW NORTH RESTRICTION @ DESERT OASIS 3-10x4 BC CAPACITY TO DITCH
              * DIVERSION IS TO WASH 5 EAST

 270          KK   D624D
 271          DT  DO624D
 272          DI       0     380     400
 273          DQ       0     380     380
              *
              * ROUTING FROM DEI
1                                        HEC-1 INPUT                                          PAGE  8

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 274          KK  RX624D
 275          RS       3    FLOW     0.0     0.0
 276          RC   0.043   0.035   0.043    3854   0.006
 277          RX       0       4       8      12      20      24      28      32
 278          RY    1454    1453    1452    1450    1450    1452    1452    1454
              * COMBINES PI612, RPI618, RPI615, and FLOW FROM NORTH RESTRICTION @ DESERT OASIS

 279          KK  CPI612
              * Hard Coded
 280          HC       4   12.43
              *
              *
              * Diversion Out: Flow split FS12
              * Flow Split Diversion: Main path to CPI609, Diversion to PI621

 281          KK    D612
 282          DT   DO612     0.0     0.0
 283          DI       0   10000
 284          DQ       0    7500
              *
              *
              * ROUTE UPDATED 4/14/04

 285          KK  RPI612
 286          RS       3    FLOW     0.0     0.0
 287          RC   0.043   0.035   0.043    5754   0.006
              * PITS20
 288          RX       0      50      84      87     123     125     156     285
 289          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP140

 290          KK  DCAP14
 291          BI  DCAP14      22
              *
              *
              * ROUTE UPDATED 4/14/4

 292          KK  RDCP14
 293          RS      12    FLOW     0.0     0.0
 294          RC   0.043   0.035   0.043   20386  0.0086
              * PITS30
 295          RX       0      49     199     206     222     231     299     375
 296          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                        HEC-1 INPUT                                          PAGE  9

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 297          KK   PI609
 298          BA  1.9353
 299          LG   0.321   0.247   4.529   0.368   8.386
 300          UC   1.146   0.915
              * Urban Time-Area Relation
 301          UA       0       5      16      30      65      77      84      90      94      97
 302          UA     100
              *
              * Diversion Recovery: WASH 5 EAST IN DESERT OASIS

 303          KK   D624D
 304          DR  DO624D

 305          KK  RD624D
 306          RS       2    FLOW     0.0     0.0
 307          RC   0.043   0.035   0.043    3140   0.008
 308          RX       0       4       8      12      27      31      35      39
 309          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              * ******************************************************************************
              * DESERT OASIS DEVELOPMENT ******************************************************
              * ******************************************************************************
              *

 310          KK  PI624E
 311          KM   OFFSITE SUBBASIN PI624E
 312          BA   0.257
 313          LG    0.25    0.25    4.55   0.419      35
 314          UC   0.250   0.121
              * Urban Time-Area Relation
 315          UA       0       5      16      30      65      77      84      90      94      97
 316          UA     100
              *
              * RETENTION DIVERSION 80% OF REQUIRED 164 acres * 2.85/12 * 0.60 = 23.4 AcreFt
              * USE=18.75 AcreFt

 317          KK  624ERT
```

```
318          DT  RET624   18.75
319          DI   10000
320          DQ   10000
             * Hard Coded

321          KK  CP624E
322          HC       2   0.609

323          KK  RD624E
324          RS       3    FLOW     0.0     0.0
325          RC   0.043   0.035   0.043    2793   0.007
326          RX       0       4       8      12      27      31      35      39
327          RY    1454    1453    1452    1450    1450    1452    1452    1454
1                                         HEC-1 INPUT                                                          PAGE 10

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

328          KK  PI624G
329          KM   OFFSITE SUBBASIN PI624G (Undeveloped Desert Oasis Parcel)
330          BA   0.074
331          LG   0.350   0.250   4.550   0.354   5.000
332          UC   0.417   0.375
             * Natural Time-Area Relation
333          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
334          UA     100
             *

335          KK  PI624F
336          KM   OFFSITE SUBBASIN PI624F (Undeveloped Asante)
337          BA   0.060
338          LG   0.350   0.250   4.550   0.354   5.000
339          UC   0.492   0.603
             * Natural Time-Area Relation
340          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
341          UA     100
             *
             * CONCENTRATION POINT @ 163RD Ave Culvert (Wash 5 East)
             *
             * Diversion Recovery: Flow Split D624B (36" Culvert)

342          KK   D624B
343          DR   D624B

344          KK  RD624B
345          RS       8    FLOW     0.0     0.0
346          RC   0.043   0.035   0.043    6800   0.007
347          RX       0     170     195     198     201     204     241     414
348          RY    1434    1432    1430    1428    1428    1430    1432    1434
             *

349          KK  PI624C
350          BA   0.372
351          LG   0.350   0.250   4.692   0.320   5.000
352          UC   0.675   0.515
             * Natural Time-Area Relation
353          UA       0       3       5       8      12      20      43      75      90      96
354          UA     100
             *

355          KK  CP624C
             * Hard Coded
356          HC       2    0.44

357          KK  DO624C
358          KM   Asante Berm Breach
359          DT   D624C
360          DI       0     346
361          DQ       0     235
1                                         HEC-1 INPUT                                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

362          KK  RD624C
363          RS       3    FLOW     0.0     0.0
364          RC   0.043   0.035   0.043    1585  0.0032
365          RX       0    15.8    46.6    52.8    58.5    65.5    67.3    74.1
366          RY  1390.3    1390  1388.6    1388  1386.9    1387    1388    1390
             * Hard Coded

367          KK  CP624G
368          HC       4    0.88

369          KK  DO624G
370          KM   163rd Ave Culvert Flow Split
371          DT   D624G
372          DI       0     409
373          DQ       0      61
             * n value changed to match DEI's HEC-RAS n value

374          KK  RD624G
375          RS       1    FLOW     0.0     0.0
376          RC   0.056   0.025   0.056     442  0.0068
377          RX       0      91      97     103     116     126     139     165
378          RY    1390    1388    1386    1384    1386    1388    1390    1392

379          KK  PI624H
380          KM   OFFSITE SUBBASIN PI624H (Undeveloped Desert Oasis Parcel)
381          BA   0.075
382          LG   0.350   0.250   4.550   0.354   5.000
383          UC   0.521   0.663
             * Natural Time-Area Relation
384          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
385          UA     100
             * Hard Coded
```

```
386          KK  CP624H
387          HC       2    0.83
             * n value changed to match DEI's HEC-RAS n value

388          KK  RD624H
389          RS       3    FLOW     0.0     0.0
390          RC   0.056   0.025   0.056    1534  0.0026
391          RX       0     117     121     126     128     131     134     137
392          RY    1388    1386    1384    1382    1382    1384    1386    1388
             * Diversion Recovery: Flow split FS12

393          KK    D612
394          DR   DO612
             *
             *
             * ROUTE UPDATED 4/14/4
             * Length and Slope Updated
1                                          HEC-1 INPUT                                                    PAGE 12

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

395          KK   RD612
396          RS       4    FLOW     0.0     0.0
397          RC   0.043   0.035   0.043    4537  0.0066
             * PITS20
398          RX       0      50      84      87     123     125     156     285
399          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *

400          KK  PI621A
401          KM   OFFSITE SUBBASIN PI621A
402          BA   0.167
403          LG   0.350   0.250   4.550   0.354   5.000
404          UC   0.608   0.603
             * Natural Time-Area Relation
405          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
406          UA     100
             *
             * Hard Coded

407          KK  CP621A
408          HC       3   10.32
             * n value changed to match DEI's HEC-RAS n value

409          KK  RD621A
410          RS       1    FLOW     0.0     0.0
411          RC   0.056   0.025   0.056    1587  0.0038
412          RX       0     213     228     242     256     265     267     269
413          RY    1384    1382    1380    1378    1378    1380    1382    1384

414          KK  PI621B
415          KM   OFFSITE SUBBASIN PI621B
416          BA   0.035
417          LG   0.350   0.250   4.550   0.354   5.000
418          UC   0.362   0.427
             * Natural Time-Area Relation
419          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
420          UA     100
             *

421          KK  CP621B
422          HC       2
             * n value changed to match DEI's HEC-RAS n value

423          KK  RD621B
424          RS       1    FLOW     0.0     0.0
425          RC   0.056   0.025   0.056     342  0.0038
426          RX       0     213     228     242     256     265     267     269
427          RY    1384    1382    1380    1378    1378    1380    1382    1384
             * Combines RPI612, RDCP14, PI609, RD621B
1                                          HEC-1 INPUT                                                    PAGE 13

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

428          KK  CPI609
             * Hard Coded
429          HC       4   18.46
             *
             *
             * ROUTE UPDATED 4/14/04
             * Length, Slope, and Cross Section Updated
             * n value changed to match DEI's HEC-RAS n value

430          KK  R609-1
431          RS       1    FLOW     0.0     0.0
432          RC   0.056   0.025   0.056    1523  0.0038
433          RX       0      44      72      85     129     139     145     152
434          RY    1374    1372    1370    1368    1368    1370    1372    1374
             *
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A

435          KK   DHVC1
436          DT  DOHVC1     0.0     0.0
437          DI       0    2466
438          DQ       0     291
             *
             * ROUTE UPDATED 4/14/04
             * Length, Slope, and Cross Section Updated
             * n value changed to match DEI's HEC-RAS n value

439          KK  R609-2
440          RS       1    FLOW     0.0     0.0
```

```
441          RC   0.056   0.025   0.056    1300  0.0038
442          RX       0      44      72      85     129     139     145     152
443          RY    1374    1372    1370    1368    1368    1370    1372    1374
             *
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A

444          KK   DHVC2
445          DT  DOHVC2     0.0     0.0
446          DI       0    2175
447          DQ       0     554
             *
             * ROUTE UPDATED 4/14/04
             * Length, Slope, and Cross Section Updated
             * n value changed to match DEI's HEC-RAS n value

448          KK  R609-3
449          RS       3    FLOW     0.0     0.0
450          RC   0.056   0.025   0.056    2449  0.0038
451          RX       0      44      72      85     129     139     145     152
452          RY    1374    1372    1370    1368    1368    1370    1372    1374
             *
1                                          HEC-1 INPUT                                                    PAGE 14

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

453          KK  DCAP15
454          BI  RDCP15      22
             * ROUTE UPDATED 4/14/4

455          KK  RDCP15
456          RS       6    FLOW     0.0     0.0
457          RC   0.043   0.035   0.043    9602  0.0106
             * PITS30
458          RX       0      49     199     206     222     231     299     375
459          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *

460          KK  PI606A
461          BA  0.4572
462          LG   0.308   0.245   4.449   0.378  10.151
463          UC   0.667   0.586
             * Natural Time-Area Relation
464          UA       0       3       5       8      12      20      43      75      90      96
465          UA     100
             *
             *
             * COMBINES BASIN PI606A, RDCP15

466          KK   C606A
             * Hard Coded
467          HC       2    4.08
             *
             *
             * Diversion Out: Flow split FS14
             * Flow Split Diversion: Main path to CPI606, Diversion to CPI604
             * 41% of flow is diverted to CPI604

468          KK   D606A
469          DT  DO606A     0.0     0.0
470          DI       0   10000
471          DQ       0    4100
             *
             *
             * ROUTE UPDATED 4/14/4

472          KK   R606A
473          RS       7    FLOW     0.0     0.0
474          RC   0.043   0.035   0.043   12583  0.0081
             * PDTS30
475          RX       0      47     318     322     356     364     463     604
476          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *
1                                          HEC-1 INPUT                                                    PAGE 15

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

477          KK   PI606
478          BA  1.0765
479          LG   0.324    0.25   4.383   0.419  10.725
480          UC   0.879   0.635
             * Urban Time-Area Relation
481          UA       0       5      16      30      65      77      84      90      94      97
482          UA     100
             *
             *
             * COMBINES BASIN PI606, R606A, AND RPI609

483          KK  CPI606
             * Hard Coded
484          HC       3   15.61
             *
             *
             * ROUTE UPDATED 4/14/04

485          KK  RPI606
486          RS       3    FLOW     0.0     0.0
487          RC   0.043   0.035   0.043    2654  0.0055
             * TSR606
488          RX       0     241     598     949    1098    1381    2002    2039
489          RY    1354    1354    1350    1348    1348    1350    1352    1354
             *
```

```
                 *
490              KK   PI604
491              BA  0.3628
492              LG   0.307    0.25    4.97   0.285  22.848
493              UC   0.688   0.579
                 * Urban Time-Area Relation
494              UA       0       5      16      30      65      77      84      90      94      97
495              UA     100
                 *
                 *
                 * Diversion Recovery: Flow split FS14

496              KK   D606A
497              DR  DO606A
                 *
                 *
                 * ROUTE UDPATED 4/14/4

498              KK  RD606A
499              RS       6    FLOW     0.0     0.0
500              RC   0.043   0.035   0.043    7507  0.0087
                 * PITS30
501              RX       0      49     199     206     222     231     299     375
502              RY    1532    1532    1530    1528    1528    1530    1532    1532
                 *
                 *
                 * Combines RD606A and PI604
1                                                HEC-1 INPUT                                                    PAGE 16
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

503              KK  CPI604
                 * Hard Coded
504              HC       2    2.03
                 *
                 *
                 * ROUTE UPDATED 4/14/04

505              KK  RPI604
506              RS       4    FLOW     0.0     0.0
507              RC   0.043   0.035   0.043    7442   0.007
                 * PDTS30
508              RX       0      47     318     322     356     364     463     604
509              RY    1416    1414    1410    1408    1408    1410    1412    1414
                 *
                 *

510              KK   PD744
511              BA  0.7975
512              LG   0.342   0.249   4.427   0.357   5.989
513              UC   0.908   0.725
                 * Natural Time-Area Relation
514              UA       0       3       5       8      12      20      43      75      90      96
515              UA     100
                 *
                 *Diversion Recovery

516              KK  DHVC1
517              DR  DOHVC1

518              KK  RDHVC1
519              RS       3    FLOW     0.0     0.0
520              RC   0.043   0.035   0.043    3750  0.0069
                 * PITS40
521              RX       0       7      14      27      61      79      97     113
522              RY    1370    1368    1366    1364    1364    1366    1368    1370
                 *
                 *Diversion Recovery

523              KK  DHVC2
524              DR  DOHVC2

525              KK  RDHVC2
526              RS       3    FLOW     0.0     0.0
527              RC   0.043   0.035   0.043    3091  0.0065
                 * PITS40
528              RX       0       7      14      27      61      79      97     113
529              RY    1370    1368    1366    1364    1364    1366    1368    1370
                 *
1                                                HEC-1 INPUT                                                    PAGE 17
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

530              KK  PI600A
531              BA  0.5202
532              LG   0.345   0.246   5.184   0.252   4.929
533              UC    0.45   0.205
                 * Natural Time-Area Relation
534              UA       0       3       5       8      12      20      43      75      90      96
535              UA     100
                 * Hard Coded

536              KK   C600A
537              HC       3    6.86
                 * ROUTE UPDATED 4/14/4

538              KK  RD600A
539              RS       2    FLOW     0.0     0.0
540              RC   0.043   0.035   0.043    4775  0.0013
                 * TSBEAR
541              RX       0      25      30      35      60     110     460     600
542              RY    1344    1344    1342    1340    1340    1342    1344    1345
                 *
```

```
                *
543             KK   PI603
544             BA  0.5190
545             LG   0.344    0.25    4.66   0.316   7.957
546             UC   0.738   0.615
                * Natural Time-Area Relation
547             UA       0       3       5       8      12      20      43      75      90      96
548             UA     100
                *
                *
                * COMBINES RD600A, RPI606, RPI604, PD744 AND PI603

549             KK  CPI603
550             HC       5
                *
                *
                *
                * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
                * *** This storage includes the storage at basins PI603, PI600A and PD744
                * *** The Discharge represents the Discharge through the Beardsley Canal
                * *** structure as well as the weir flow across PI603, PI600A and PD744,
                * *** so the SQ card can be calculated by adding the flows for basins PI603
                * *** and PD744 as found in the appendix.
                * *** The weir flow across PD744 is diverted out on the next KK card.
                * *** The weir flow for Basin PI600A is not diverted, because both
                * *** flows (from PI600A and PI603) go to CPI600.

551             KK  SPI603
552             RS       1    STOR       0
553             SQ       0     309     874    1605    2471    3453    4539   14797   33095   56636
554             SQ   84417
555             SE    1338    1339    1340    1341    1342    1343    1344  1344.5    1345  1345.5
556             SE    1346
                *
1                                                HEC-1 INPUT                                                PAGE 18

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

557             SA       0    0.48    5.26   27.16  105.96  105.98     106
558             SE    1336    1338    1340    1342    1344    1345    1346
                *
                *
                * This diversion is only weir flow across the boundary of Basin PD744
                * over the Beardsley Canal to CPD720.  This Diversion is being combined
                * with CPD726 and they are routed together.
                *
                * For overtopping of the berm, the Weir equation was used.
                * Q=C*L*H^1.5
                * C was assumed to be 2.7
                * L, the length of the weir was the basin boundary along the canal = 3652 ft
                * Berm Elevation was 1344
                * *** The remaing flow goes to CPI600 ***

559             KK    D744
560             DT   DO744     0.0     0.0
561             DI       0     309     874    1605    2471    3453    4539   14797   33095   56636
562             DI   84417
563             DQ       0       0       0       0       0       0       0    3486    9860   18115
564             DQ   27889
                *
                * ROUTE UPDATED 4/14/04

565             KK  RPI603
566             RS       1    FLOW     0.0     0.0
567             RC   0.043   0.035   0.043    3427  0.0044
                * PDTS40_1
568             RX       0      86     158     492     543     560     776    1208
569             RY    1330  1326.5    1326    1324    1320    1326    1328    1330
                *
                *

570             KK  CWI504
571             BI  CWI504      22
                * ROUTE UPDATED 4/14/04

572             KK  RWI504
573             RS       1    FLOW     0.0     0.0
574             RC   0.045   0.035   0.045    1494   0.001
                * McMicken Dam Channel
575             RX       0      46     101     121     171     181    1421    3621
576             RY      25      14       4       0       0       4      14      25
                *

577             KK  CWI508
578             BI  CWI508      22
                *
                * Diversion Out: Flow split FS10
                * Flow Split Diversion: Main path to CWI510, Diversion to CWI500
                * 19% of flow is diverted to CWI500
1                                                HEC-1 INPUT                                                PAGE 19

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

579             KK    D508
580             DT   DO508     0.0     0.0
581             DI       0   10000
582             DQ       0    1900
                *
                *

583             KK  WI510A
584             BA  1.1293
585             LG   0.337    0.26   4.622   0.338   5.191
586             UC   0.813   0.521
```

```
                 * Natural Time-Area Relation
587              UA        0        3        5        8       12       20       43       75       90       96
588              UA      100
                 *
                 *
                 * ROUTE UPDATED 4/14/4

589              KK    R510A
590              RS        8     FLOW      0.0      0.0
591              RC     0.04     0.04     0.04    17257   0.0051
                 * WITS70
592              RX        0      450      700     1284     1435     1499     1745     2500
593              RY   1401.5   1399.5     1396   1395.5     1390     1396     1399     1400
                 *
                 *

594              KK    WI510
595              BA   1.2273
596              LG    0.339    0.274    5.732    0.204    5.364
597              UC    1.313    1.287
                 * Natural Time-Area Relation
598              UA        0        3        5        8       12       20       43       75       90       96
599              UA      100
                 *
                 *
                 * COMBINES CWI508, WI510 AND R510A

600              KK   CWI510
                 * Hard Coded
601              HC        3    35.84
                 *
                 *
                 * ROUTE UPDATED 4/14/04

602              KK   RWI510
603              RS        2     FLOW      0.0      0.0
604              RC     0.04     0.04     0.04     6492   0.0048
                 * WITS70
605              RX        0      450      700     1284     1435     1499     1745     2500
606              RY   1401.5   1399.5     1396   1395.5     1390     1396     1399     1400
                 *
                 *
```



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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

607              KK    WI502
608              BA   1.2082
609              LG    0.344    0.251    5.448    0.229    6.516
610              UC    1.179    1.004
                 * Natural Time-Area Relation
611              UA        0        3        5        8       12       20       43       75       90       96
612              UA      100
                 *
                 *
                 * COMBINES WI502, RWI510 AND RWI504

613              KK   CWI502
614              HC        3
                 *
                 *
                 * ROUTE UPDATED 4/14/04

615              KK   RWI502
616              RS        1     FLOW      0.0      0.0
617              RC    0.045    0.035    0.045     1679   0.0026
                 * McMicken Dam Channel
618              RX        0       46      101      121      171      181     1421     3621
619              RY       25       14        4        0        0        4       14       25
                 *

620              KK   CWI525
621              BI   CWI525       22
                 *
                 * Railroad Diversion: Main path to CWI506, Diversion to CWI524
                 * From Structure RR630 and RR640, See Appendix D.5 for analysis

622              KK     D525
623              DT    DO525      0.0      0.0
624              DI        0      269      463      699      969
625              DQ        0        0        9       26       48
                 *
                 *
                 * ROUTE UPDATED 4/14/04

626              KK   RWI525
627              RS        6     FLOW      0.0      0.0
628              RC    0.043    0.035    0.043    11015   0.0064
                 * WITS130
629              RX        0      400      456      575      620      650      660      682
630              RY   1396.5     1394   1393.5     1393     1392     1394     1395   1396.5
                 *
                 * CAP Diversion Recovery: Outflow from structure CAP100

631              KK   DCAP10
632              BI   DCAP10       22
                 *
                 *
                 * ROUTE UPDATED 4/14/4
```



```
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

633              KK   RDCP10
```

```
634          RS       4    FLOW     0.0     0.0
635          RC   0.043   0.035   0.043    6701  0.0081
             * WITS120
636          RX       0     100     292     409     492     567     718     886
637          RY    1511    1510  1509.5  1507.5    1506    1509  1510.5    1511
             *
             *

638          KK   PI628
639          BA  0.5695
640          LG   0.285    0.25    4.56   0.349   8.902
641          UC   0.538   0.316
             * Natural Time-Area Relation
642          UA       0       3       5       8      12      20      43      75      90      96
643          UA     100
             *
             *
             * Combines PI628 and RDCP10

644          KK  CPI628
             * Hard Coded
645          HC       2    4.11
             *
             *
             * ROUTE UPDATED 10/25/10

646          KK  RPI628
647          RS       6    FLOW     0.0     0.0
648          RC   0.043   0.035   0.043    7825  0.0077
             * PITS20
649          RX       0      50      84      87     123     125     156     285
650          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             *

651          KK  PI624A
652          BA   1.306
653          LG    0.34    0.34    4.55    0.35       3
654          UC   0.861   0.562
             * Natural Time-Area Relation
655          UA       0       3       5       8      12      20      43      75      90      96
656          UA     100
             *
             *
             * COMBINES RPI628 AND PI624A

657          KK   C624A
658          HC       2
             *
             *
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

659          KK   R624A
660          RS       1    FLOW     0.0     0.0
661          RC   0.035   0.035   0.035     680  0.0050
662          RX       0       4      50      62     122     134     180     184
663          RY       4       3       3       0       0       3       3       4
             *

664          KK  PI639A
665          BA   0.095
666          LG    0.35    0.35    4.50    0.35       0
667          UC   0.554   0.527
             * Natural Time-Area Relation
668          UA       0       3       5       8      12      20      43      75      90      96
669          UA     100
             *
             * COMBINES R624A AND PI639A

670          KK   C639A
671          HC       2
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)

672          KK   R639A
673          RS       2    FLOW     0.0     0.0
674          RC   0.043   0.035   0.043    3360  0.0050
675          RX       0       4      50      62     122     134     180     184
676          RY       4       3       3       0       0       3       3       4
             *

677          KK  WI524A
678          BA   0.599
679          LG    0.35    0.35    4.40    0.37       0
680          UC   0.758   0.517
             * Natural Time-Area Relation
681          UA       0       3       5       8      12      20      43      75      90      96
682          UA     100
             *
             *
             * Railroad Diversion Recovery: Outflow from structure RR630

683          KK    D525
684          DR   DO525
             *
             *
             * ROUTE UPDATED 4/14/4

685          KK   RD525
686          RS       6    FLOW     0.0     0.0
687          RC   0.043   0.035   0.043    6496  0.0065
```

```
                 * WITS130
688              RX       0     400     456     575     620     650     660     682
689              RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
                 *
                 *
                 * Combines RD525, WI524, AND R639A
1                                          HEC-1 INPUT                                                    PAGE 23

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


690              KK   C524A
                 * Hard Coded
691              HC       3    6.67
                 *
                 * Asante Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

692              KK   R524A
693              RS       1    FLOW     0.0     0.0
694              RC   0.035   0.035   0.035    1025  0.0050
695              RX       0      12      18      24     117     123     129     141
696              RY       4       2       1       0       0       1       2       4
                 *
                 * ASANTE DATA OBTAINED FROM DEI DRAINAGE REPORT

697              KK     2.8
698              BA  0.0792
699              LG    0.25    0.25    5.70    0.24      35
700              UC   0.280   0.180
                 * Urban Time-Area Relation
701              UA       0       5      16      30      65      77      84      90      94      97
702              UA     100

703              KK    C2.8
704              HC       2
                 * Asante Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

705              KK    R2.8
706              RS       1    FLOW     0.0     0.0
707              RC   0.035   0.035   0.035    1810  0.0050
708              RX       0      12      18      24     117     123     129     141
709              RY       4       2       1       0       0       1       2       4
                 * UNDEVELOPED ASANTE PHASE 3

710              KK      3A
711              BA   0.046
712              LG    0.35    0.35    4.60    0.33       0
713              UC   0.387   0.285
                 * Natural Time-Area Relation
714              UA       0       3       5       8      12      20      43      75      90      96
715              UA     100
                 *
                 * Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

716              KK    R3A
717              RS       1    FLOW     0.0     0.0
718              RC   0.035   0.035   0.035     995  0.0050
719              RX       0       4       8      12      32      36      40      44
720              RY       3       2       1       0       0       1       2       3
                 *
1                                          HEC-1 INPUT                                                    PAGE 24

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


721              KK    2.11
722              BA  0.0350
723              LG    0.25    0.25    4.65    0.38      35
724              UC   0.212   0.124
                 * Urban Time-Area Relation
725              UA       0       5      16      30      65      77      84      90      94      97
726              UA     100
                 * COMBINES UNDEVELOPED PARCEL 3 AND 2.11

727              KK   C2.11
728              HC       2
                 * Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

729              KK   R2.11
730              RS       1    FLOW     0.0     0.0
731              RC   0.035   0.035   0.035    1000  0.0070
732              RX       0       4       8      12      32      36      40      44
733              RY       3       2       1       0       0       1       2       3
                 *

734              KK    2.10
735              BA  0.0675
736              LG    0.25    0.25    5.00    0.32      35
737              UC   0.309   0.254
                 * Urban Time-Area Relation
738              UA       0       5      16      30      65      77      84      90      94      97
739              UA     100
                 * FROM DEI

740              KK   S2.10
741              RS       1    STOR       0
742              SQ       0       0       0    14.2    92.8
743              SE       0       1     1.6       2       3
744              SV       0    1.36    3.28    5.83
745              SE       0       1       2       3
                 *
```

```
746          KK     2.7
747          BA  0.1104
748          LG    0.25    0.25    5.30    0.28      35
749          UC   0.224   0.094
             * Urban Time-Area Relation
750          UA       0       5      16      30      65      77      84      90      94      97
751          UA     100
             *

752          KK     2.4
753          BA  0.0659
754          LG    0.25    0.25    4.55    0.41      35
755          UC   0.327   0.270
             * Urban Time-Area Relation
756          UA       0       5      16      30      65      77      84      90      94      97
757          UA     100
             * FROM DEI
1                                          HEC-1 INPUT                                                PAGE 25

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

758          KK    S2.4
759          RS       1    STOR       0
760          SQ       0    6.85   23.26   40.68   51.06   392.0
761          SE       0       1       2       3       4       5
762          SV       0    0.36    0.82    1.37    1.40    1.40
763          SE       0       1       2       3       4       5
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

764          KK    R2.4
765          RS       1    FLOW     0.0     0.0
766          RC   0.035   0.035   0.035     400  0.0080
767          RX       0       4       8      12      22      26      30      34
768          RY       3       2       1       0       0       1       2       3
             * COMBINES R2.4, 2.7, S2.10, AND R2.11

769          KK    C2.7
770          HC       4
             *

771          KK    S2.7
772          RS       1    STOR       0
773          SQ       0       1       1       1
774          SE       0       1     2.5       3
775          SV       0    8.63   18.42   29.32
776          SE       0       1       2       3
             * COMBINES S2.7 AND R2.8

777          KK    C2.6
778          HC       2
             * ASANTE CHANNEL FROM DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

779          KK    R2.6
780          RS       1    FLOW     0.0     0.0
781          RC   0.035   0.035   0.035    1700  0.0050
782          RX       0      12      18      24     117     123     129     141
783          RY       4       2       1       0       0       1       2       4
             *

784          KK     2.5
785          BA  0.0933
786          LG    0.25    0.25    5.10    0.31      35
787          UC   0.313   0.241
             * Urban Time-Area Relation
788          UA       0       5      16      30      65      77      84      90      94      97
789          UA     100
             * COMBINES 2.5 AND C2.6
1                                          HEC-1 INPUT                                                PAGE 26

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

790          KK  CWI524
791          HC       2
             *
             * Railroad Diversion: Main path to CWI506, Diversion to CPI639
             * From Structure RR650, See Appendix D.5 for analysis

792          KK    D524
793          DT   DO524     0.0     0.0
794          DI       0     595     906    1295    1748
795          DQ       0       0      38     119     230
             * ROUTE UPDATED 4/14/04

796          KK  RWI524
797          RS       2    FLOW     0.0     0.0
798          RC   0.043   0.035   0.043    4526  0.0062
             * WITS130
799          RX       0     400     456     575     620     650     660     682
800          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             * UNDEVELOPED PORTION OF PHASE 4

801          KK      4A
802          BA   0.185
803          LG    0.35    0.35    4.55    0.34       0
804          UC   0.621   0.486
             * Natural Time-Area Relation
805          UA       0       3       5       8      12      20      43      75      90      96
806          UA     100
             *
             * CHANNEL FROM DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)
```

```
807          KK     R4A
808          RS       2    FLOW     0.0     0.0
809          RC   0.035   0.035   0.035    2160  0.0055
810          RX       0       4       8      12      32      36      40      44
811          RY       3       2       1       0       0       1       2       3
             *

812          KK     2.1
813          BA  0.1365
814          LG    0.25    0.25    4.55    0.41      35
815          UC   0.352   0.259
             * Urban Time-Area Relation
816          UA       0       5      16      30      65      77      84      90      94      97
817          UA     100
             * COMBINES UNDEVELOPED 4A AND 2.1

818          KK    C2.1
819          HC       2
             *
1                                          HEC-1 INPUT                                          PAGE 27

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

820          KK    S2.1
821          RS       1    STOR       0
822          SQ       0    98.9   279.5   513.3   592.2
823          SE       0       1       2       3     3.3
824          SV       0    0.33    0.66    1.00    1.10
825          SE       0       1       2       3     3.3
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 40 ft)

826          KK    R2.1
827          RS       2    FLOW     0.0     0.0
828          RC   0.035   0.035   0.035    2310  0.0035
829          RX       0       4       8      12      52      56      60      64
830          RY       3       2       1       0       0       1       2       3
             *

831          KK    1.11
832          BA  0.1290
833          LG    0.25    0.25    4.90    0.34      35
834          UC   0.369   0.244
             * Urban Time-Area Relation
835          UA       0       5      16      30      65      77      84      90      94      97
836          UA     100
             *

837          KK    D524
838          DR   DO524
             * ASANTE Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

839          KK   RD524
840          RS       1    FLOW     0.0     0.0
841          RC   0.035   0.035   0.035    2040  0.0050
842          RX       0      12      18      24     117     123     129     141
843          RY       4       2       1       0       0       1       2       4
             * COMBINES RD524, 1.11, AND R2.1

844          KK  CPI639
845          HC       3    1.34
             *
             * ROUTE UPDATED 05/04/2005

846          KK  RPI639
847          RS       2    FLOW     0.0     0.0
848          RC   0.043   0.035   0.043    2635  0.0061
             * WITS130
849          RX       0     400     456     575     620     650     660     682
850          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *
1                                          HEC-1 INPUT                                          PAGE 28

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

851          KK   WI506
852          BA  1.5757
853          LG   0.326    0.25   5.331   0.254  10.467
854          UC   1.083   0.781
             * Urban Time-Area Relation
855          UA       0       5      16      30      65      77      84      90      94      97
856          UA     100
             *

857          KK  CWI506
858          HC       4   17.54
             *
             * Diversion Recovery: Flow split FS10

859          KK    D508
860          DR   DO508
             *
             *
             * ROUTE UPDATED 4/14/4

861          KK   RD508
862          RS       2    FLOW     0.0     0.0
863          RC    0.04    0.04    0.04    5200  0.0065
             * WITS70
864          RX       0     450     700    1284    1435    1499    1745    2500
865          RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
```

```
                 *
                 *

866              KK   WI500
867              BA  1.0487
868              LG   0.349    0.25   5.521   0.224   5.124
869              UC   0.979   0.695
                 * Natural Time-Area Relation
870              UA       0       3       5       8      12      20      43      75      90      96
871              UA     100
                 *
                 *
                 * COMBINES WI500, RD508, RWI506 AND RWI502

872              KK  CWI500
                 * Hard Coded
873              HC       4  227.89
                 *
                 *
                 * STORAGE AT MCMICKEN DAM SPILLWAY
                 *
                 *
1                                          HEC-1 INPUT                                                PAGE 29

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

874              KK  SSPILL
875              KM   MCMICKEN DAM OUTLET AND SPILLWAY RATING CURVES USED HERE
876              RS       1    STOR       0       0
877              SV       0    1370    5505   17501   20816   25623   30850   36661   38754   39849
878              SQ       0     675     810    4080    4325   21150   47400   81650   93160   99300
879              SE    1335    1340    1345  1352.5 1353.65 1355.65 1357.65 1359.65 1360.35  1360.7
880              ST  1360.7   12775    3.05     1.5
                 *
                 *
                 * ROUTE UPDATED 4/14/04

881              KK  RWI500
882              RS       3    FLOW     0.0     0.0
883              RC   0.045   0.035   0.045    5659   0.001
                 * McMicken Dam Channel
884              RX       0      46     101     121     171     181    1421    3621
885              RY      25      14       4       0       0       4      14      25
                 *

886              KK   PI635
887              BA  0.6106
888              LG    0.29    0.27   5.391   0.237  15.959
889              UC   0.683   0.465
                 * Natural Time-Area Relation
890              UA       0       3       5       8      12      20      43      75      90      96
891              UA     100
                 *
                 *
                 * COMBINES PI635 AND RWI500

892              KK  CPI635
893              HC       2
                 *
                 * ROUTE UPDATED 4/14/04

894              KK  RPI635
895              RS       6    FLOW     0.0     0.0
896              RC   0.045   0.035   0.045    7557   0.001
                 * McMicken Dam Channel
897              RX       0      46     101     121     171     181    1421    3621
898              RY      25      14       4       0       0       4      14      25
                 *
                 *

899              KK  PI621C
900              BA   0.701
901              LG   0.345   0.248   4.650   0.332   5.378
902              UC   0.621   0.305
                 * Natural Time-Area Relation
903              UA       0       3       5       8      12      20      43      75      90      96
904              UA     100
                 *
                 *
                 * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
                 * Berm Elevation = 1342
                 * The storage behind this basin is contained, and does not flow to a siphon
                 * For overtopping of the berm, the Weir equation was used.
                 * Q=C*L*H^1.5
                 * C was assumed to be 2.7
                 * L, the length of the weir was the basin boundary along the canal = 3107 ft
1                                          HEC-1 INPUT                                                PAGE 30

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

905              KK  SPI621
906              RS       1    STOR       0
907              SQ       0       0       0       0    2966    8389   15411   23727
908              SA       0    0.10    1.69   21.17   21.18   21.19   21.20   12.21
909              SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
                 *
                 *
                 * ROUTE UPDATED 4/14/04

910              KK  RPI621
911              RS       1    FLOW     0.0     0.0
912              RC   0.043   0.035   0.043    2775  0.0079
                 * TSR621
913              RX       0      20      32      79     118     139     374     400
```

```
914          RY    1344    1343    1342    1342    1340    1342    1344    1344
             *

915          KK   PI633
916          BA  0.3359
917          LG   0.329   0.235   5.231   0.248   4.696
918          UC   0.708   0.635
             * Natural Time-Area Relation
919          UA       0       3       5       8      12      20      43      75      90      96
920          UA     100
             *
             *
             *

921          KK     1.8
922          BA  0.0176
923          LG    0.25    0.25    4.55    0.41      35
924          UC   0.178   0.136
             * Urban Time-Area Relation
925          UA       0       5      16      30      65      77      84      90      94      97
926          UA     100
             *

927          KK    S1.8
928          RS       1    STOR       0
929          SQ       0       0       0    47.8
930          SE  1369.0  1370.0  1371.1  1372.0
931          SV       0    0.20    0.50    0.93
932          SE  1369.0  1370.0  1371.0  1372.0
             *

933          KK     1.7
934          BA  0.0677
935          LG    0.25    0.25    5.20    0.29      35
936          UC   0.306   0.198
             * Urban Time-Area Relation
937          UA       0       5      16      30      65      77      84      90      94      97
938          UA     100
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

939          KK    1.5A
940          BA  0.0138
941          LG    0.25    0.25    5.00    0.32      35
942          UC   0.211   0.182
             * Urban Time-Area Relation
943          UA       0       5      16      30      65      77      84      90      94      97
944          UA     100
             * COMBINES 1.7, 1.5A, AND S1.8

945          KK    C1.7
946          HC       3
             *

947          KK    S1.7
948          RS       1    STOR       0
949          SQ       0       0    61.6   174.2
950          SE  1366.0  1367.0  1368.0  1369.0
951          SV       0    1.81    3.78    6.09
952          SE  1366.0  1367.0  1368.0  1369.0
             *

953          KK     1.9
954          BA  0.0723
955          LG    0.25    0.25    4.55    0.41      35
956          UC   0.330   0.251
             * Urban Time-Area Relation
957          UA       0       5      16      30      65      77      84      90      94      97
958          UA     100
             *

959          KK     1.6
960          BA  0.0450
961          LG    0.25    0.25    4.55    0.41      35
962          UC   0.279   0.173
             * Urban Time-Area Relation
963          UA       0       5      16      30      65      77      84      90      94      97
964          UA     100
             * COMBINES 1.9, 1.6, AND S1.7

965          KK    C1.6
966          HC       3
             *

967          KK    S1.6
968          RS       1    STOR       0
969          SQ       0    65.9   186.4   342.2   431.3
970          SE  1366.0  1367.0  1368.0  1369.0  1369.5
971          SV       0    1.27    2.73    4.41    4.41
972          SE  1366.0  1367.0  1368.0  1369.0  1369.5
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

973          KK    1.10
974          BA  0.0224
975          LG    0.25    0.25    4.55    0.41      35
976          UC   0.161   0.113
             * Urban Time-Area Relation
977          UA       0       5      16      30      65      77      84      90      94      97
978          UA     100
```

```
                 * STREET SECTION

979              KK   R1.10
980              RS       2    FLOW     0.0     0.0
981              RC   0.015   0.015   0.015    1700  0.0053
982              RX       0    0.10   38.94   39.04   64.20   64.30  103.24  103.34
983              RY       2       0    0.78    1.28    1.28    0.78       0       2
                 *

984              KK   1.13A
985              BA  0.0279
986              LG    0.25    0.25    4.55    0.41      35
987              UC   0.213   0.152
                 * Urban Time-Area Relation
988              UA       0       5      16      30      65      77      84      90      94      97
989              UA     100
                 *

990              KK   1.14A
991              BA  0.0381
992              LG    0.25    0.25    4.50    0.42      35
993              UC   0.306   0.244
                 * Urban Time-Area Relation
994              UA       0       5      16      30      65      77      84      90      94      97
995              UA     100
                 * COMBINES 1.14A, 1.13A, R1.10, AND S4.11

996              KK  C1.14A
997              HC       4
                 *

998              KK  S1.14A
999              RS       1    STOR       0
1000             SQ       0       0       0   316.8
1001             SE       0     1.0     2.5     3.0
1002             SV       0    6.64   13.49   20.53
1003             SE       0     1.0     2.5     3.0
                 *

1004             KK   1.13B
1005             BA  0.0252
1006             LG    0.25    0.25    5.10    0.31      35
1007             UC   0.308   0.329
                 * Urban Time-Area Relation
1008             UA       0       5      16      30      65      77      84      90      94      97
1009             UA     100
                 * ASANTE Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)
```



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LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1010             KK  R1.13B
1011             RS       2    FLOW     0.0     0.0
1012             RC   0.035   0.035   0.035    1200  0.0050
1013             RX       0       6      12      18     111     117     123     129
1014             RY       3       2       1       0       0       1       2       3
                 *

1015             KK   1.14B
1016             BA  0.0315
1017             LG    0.25    0.23    6.20    0.20      35
1018             UC   0.274   0.239
                 * Urban Time-Area Relation
1019             UA       0       5      16      30      65      77      84      90      94      97
1020             UA     100
                 * COMBINES 1.14B, R1.13B, AND S1.14A

1021             KK  C1.14B
1022             HC       3
                 * ASANTE Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1023             KK  R1.14B
1024             RS       1    FLOW     0.0     0.0
1025             RC   0.035   0.035   0.035     820  0.0050
1026             RX       0       6      12      18     111     117     123     129
1027             RY       3       2       1       0       0       1       2       3
                 *

1028             KK   1.16A
1029             BA  0.0265
1030             LG    0.25    0.25    4.50    0.42      35
1031             UC   0.181   0.120
                 * Urban Time-Area Relation
1032             UA       0       5      16      30      65      77      84      90      94      97
1033             UA     100
                 *

1034             KK  S1.16A
1035             RS       1    STOR       0
1036             SQ       0       0       0    17.2
1037             SE       0     1.0     2.0     3.0
1038             SV       0    0.92    1.91    2.98
1039             SE       0     1.0     2.0     3.0
                 * Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1040             KK  R1.16A
1041             RS       2    FLOW     0.0     0.0
1042             RC   0.035   0.035   0.035     590  0.0014
1043             RX       0       4       8      12      22      26      30      34
1044             RY       3       2       1       0       0       1       2       3
                 *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1045          KK   1.15A
1046          BA  0.0243
1047          LG    0.25    0.25    4.40    0.45      35
1048          UC   0.195   0.161
              * Urban Time-Area Relation
1049          UA       0       5      16      30      65      77      84      90      94      97
1050          UA     100
              *

1051          KK  S1.15A
1052          RS       1    STOR       0
1053          SQ       0       0       0    56.0
1054          SE       0     1.0     2.0     3.0
1055          SV       0    0.70    1.46    2.28
1056          SE       0     1.0     2.0     3.0
              *

1057          KK   1.15B
1058          BA  0.0156
1059          LG    0.25    0.15    7.30    0.13      35
1060          UC   0.207   0.157
              * Urban Time-Area Relation
1061          UA       0       5      16      30      65      77      84      90      94      97
1062          UA     100
              * COMBINES 1.15B, S1.15A, R1.16A, AND R1.14B

1063          KK  C1.15B
1064          HC       4
              *
              * ASANTE Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1065          KK  R1.15B
1066          RS       2    FLOW     0.0     0.0
1067          RC   0.035   0.035   0.035    1760  0.0050
1068          RX       0       6      12      18     111     117     123     129
1069          RY       3       2       1       0       0       1       2       3
              *

1070          KK   1.16B
1071          BA  0.0268
1072          LG    0.25    0.25    4.55    0.41      35
1073          UC   0.137   0.077
              * Urban Time-Area Relation
1074          UA       0       5      16      30      65      77      84      90      94      97
1075          UA     100
              *

1076          KK  S1.16B
1077          RS       1    STOR       0
1078          SQ       0       0       0    17.2
1079          SE       0     1.0     2.0     3.0
1080          SV       0    0.93    1.93    3.01
1081          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1082          KK  R1.16B
1083          RS       4    FLOW     0.0     0.0
1084          RC   0.035   0.035   0.035    1630  0.0012
1085          RX       0       4       8      12      22      26      30      34
1086          RY       3       2       1       0       0       1       2       3
              *

1087          KK   1.17A
1088          BA  0.0521
1089          LG    0.25    0.25    4.20    0.50      35
1090          UC   0.282   0.197
              * Urban Time-Area Relation
1091          UA       0       5      16      30      65      77      84      90      94      97
1092          UA     100
              *

1093          KK  S1.17A
1094          RS       1    STOR       0
1095          SQ       0       0       0    56.0
1096          SE       0     1.0     2.0     3.0
1097          SV       0    1.84    3.78    5.84
1098          SE       0     1.0     2.0     3.0
              *

1099          KK   1.17B
1100          BA  0.0332
1101          LG    0.25    0.25    4.20    0.50      35
1102          UC   0.299   0.279
              * Urban Time-Area Relation
1103          UA       0       5      16      30      65      77      84      90      94      97
1104          UA     100
              * COMBINES 1.17B, S1.17A, R1.16B, AND R1.15B

1105          KK  C1.17B
1106          HC       4
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 40 ft)

1107          KK  R1.17B
1108          RS       1    FLOW     0.0     0.0
1109          RC   0.035   0.035   0.035     990  0.0050
```

```
1110    RX       0       6      12      18      58      64      70      76
1111    RY       3       2       1       0       0       1       2       3
        *

1112    KK     1.3
1113    BA  0.0285
1114    LG    0.25    0.25    4.55    0.41      35
1115    UC   0.204   0.152
        * Urban Time-Area Relation
1116    UA       0       5      16      30      65      77      84      90      94      97
1117    UA     100
        *
```



```
LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1118    KK    S1.3
1119    RS       1    STOR       0
1120    SQ       0       0       0    17.2
1121    SE       0     1.0     2.0     3.0
1122    SV       0    1.27    2.62    4.07
1123    SE       0     1.0     2.0     3.0
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1124    KK    R1.3
1125    RS       4    FLOW     0.0     0.0
1126    RC   0.035   0.035   0.035    2450  0.0050
1127    RX       0       4       8      12      22      26      30      34
1128    RY       3       2       1       0       0       1       2       3
        *

1129    KK     1.2
1130    BA  0.1074
1131    LG    0.25    0.25    4.50    0.42      35
1132    UC   0.358   0.195
        * Urban Time-Area Relation
1133    UA       0       5      16      30      65      77      84      90      94      97
1134    UA     100
        *

1135    KK    S1.2
1136    RS       1    STOR       0
1137    SQ       0       0       0    56.0
1138    SE       0     1.0     2.0     3.0
1139    SV       0    4.92   10.01   15.28
1140    SE       0     1.0     2.0     3.0
        * COMBINES S1.2, R1.3, AND R1.17B

1141    KK    C636
1142    HC       3
        *
        * ROUTE UPDATED 4/14/04

1143    KK  RPI636
1144    RS       1    FLOW     0.0     0.0
1145    RC   0.043   0.035   0.043     730  0.0137
        * WITS130
1146    RX       0     400     456     575     620     650     660     682
1147    RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
        *
        * Diversion Recovery: ASANTE Berm Breach

1148    KK   D624C
1149    DR   D624C
```



```
LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1150    KK  RD624C
1151    RS       3    FLOW     0.0     0.0
1152    RC   0.043   0.035   0.043    3480  0.0057
        * PDTS40_1
1153    RX       0      86     158     492     543     560     776    1208
1154    RY    1330  1326.5    1326    1324    1320    1326    1328    1330
        *
        * Diversion Recovery: 163rd Ave Culvert Flow Split

1155    KK   D624G
1156    DR   D624G

1157    KK  RD624G
1158    RS       3    FLOW     0.0     0.0
1159    RC   0.043   0.035   0.043    3000  0.0063
        * PDTS40_1
1160    RX       0      86     158     492     543     560     776    1208
1161    RY    1330  1326.5    1326    1324    1320    1326    1328    1330
        *
        * UNDEVELOPED PORTION OF PHASE 4

1162    KK      4B
1163    BA   0.375
1164    LG    0.35    0.36    5.00    0.27       0
1165    UC   0.626   0.360
        * Natural Time-Area Relation
1166    UA       0       3       5       8      12      20      43      75      90      96
1167    UA     100
        *

1168    KK     C4B
1169    HC       3    0.81
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)
```

```
1170          KK     R4B
1171          RS       2    FLOW     0.0     0.0
1172          RC   0.035   0.035   0.035    1410  0.0050
1173          RX       0       4       8      12      22      26      30      34
1174          RY       3       2       1       0       0       1       2       3
              *

1175          KK    1.5B
1176          BA  0.0167
1177          LG    0.25    0.25    5.70    0.24      35
1178          UC   0.206   0.173
              * Urban Time-Area Relation
1179          UA       0       5      16      30      65      77      84      90      94      97
1180          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1181          KK   S1.5B
1182          RS       1    STOR       0
1183          SQ       0       0       0    14.2
1184          SE       0     1.0     2.6     3.0
1185          SV       0    0.57    1.19    1.88
1186          SE       0     1.0     2.0     3.0
              * COMBINES S1.5B AND UNDEVELOPED PARCEL 4

1187          KK   C1.5B
1188          HC       2
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1189          KK   R1.5B
1190          RS       1    FLOW     0.0     0.0
1191          RC   0.035   0.035   0.035     800  0.0050
1192          RX       0       4       8      12      22      26      30      34
1193          RY       3       2       1       0       0       1       2       3
              *

1194          KK    1.5C
1195          BA  0.0133
1196          LG    0.25    0.25    5.20    0.29      35
1197          UC   0.133   0.080
              * Urban Time-Area Relation
1198          UA       0       5      16      30      65      77      84      90      94      97
1199          UA     100
              *

1200          KK   S1.5C
1201          RS       1    STOR       0
1202          SQ       0       0       0    14.2
1203          SE       0     1.0     2.6     3.0
1204          SV       0    0.45    0.95    1.51
1205          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1206          KK   R1.5C
1207          RS       2    FLOW     0.0     0.0
1208          RC   0.035   0.035   0.035     845  0.0050
1209          RX       0       4       8      12      22      26      30      34
1210          RY       3       2       1       0       0       1       2       3
              *

1211          KK     1.4
1212          BA  0.0284
1213          LG    0.25    0.25    5.70    0.24      35
1214          UC   0.204   0.155
              * Urban Time-Area Relation
1215          UA       0       5      16      30      65      77      84      90      94      97
1216          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1217          KK    S1.4
1218          RS       1    STOR       0
1219          SQ       0       0       0    14.2
1220          SE       0     1.0     2.6     3.0
1221          SV       0    1.26    2.60    4.04
1222          SE       0     1.0     2.0     3.0
              * COMBINES S1.4, R1.5C, AND R1.5B

1223          KK    C624
1224          HC       3
              *

1225          KK   PI624
1226          BA   0.452
1227          LG    0.35    0.35    4.80    0.29       0
1228          UC   0.915   0.764
              * Natural Time-Area Relation
1229          UA       0       3       5       8      12      20      43      75      90      96
1230          UA     100
              *

1231          KK  CPI624
1232          HC       3
              *
              * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
              * It was assumed that this basin is isolated, and can only overtop the canal.
              * Berm Elevation = 1342
              * For Overtopping of the berm, the Weir equation was used.
```

```
                    * Q=C*B*H^1.5
                    * C was assumed to be 2.7
                    * B, the length of the weir was the basin boundary along the canal = 4305 ft

1233                KK  SPI624
1234                RS       1    STOR       0
1235                SQ       0       0       0       0    4110   11624   21354   32876
1236                SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
1237                SA       0    0.19    5.86   36.95   36.96   36.97
1238                SE    1336    1338    1340    1342    1343    1344
                    *
                    *
                    * ROUTE UPDATED 4/14/04

1239                KK  RPI624
1240                RS       3    FLOW     0.0     0.0
1241                RC   0.043   0.035   0.043    5060  0.0043
                    * TSR621-modified X-sect
1242                RX       0      40      52      99     138     159     394   511.5
1243                RY    1345    1343    1342    1342    1340    1342    1344    1345
                    *
                    *
                    * Combines RPI635, D600A, RPI621, RPI624 and PI633
1                                                HEC-1 INPUT                                                    PAGE 40

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1244                KK  CPI633
1245                HC       4
                    *
                    * ROUTE UPDATED 4/14/04

1246                KK  RPI633
1247                RS       4    FLOW     0.0     0.0
1248                RC   0.045   0.035   0.045    5834   0.001
                    * McMicken Dam Channel
1249                RX       0      46     101     121     171     181    1421    3621
1250                RY      25      14       4       0       0       4      14      25
                    *
                    *

1251                KK   PI600
1252                BA  0.6050
1253                LG   0.342   0.244   5.047   0.268   4.887
1254                UC   0.542   0.341
                    * Natural Time-Area Relation
1255                UA       0       3       5       8      12      20      43      75      90      96
1256                UA     100
                    *
                    *
                    * COMBINES BASIN RPI633, RPI603 and  PI600

1257                KK  CPI600
1258                HC       3
                    *
                    * ROUTE UPDATED 4/14/04

1259                KK  RPI600
1260                RS       2    FLOW     0.0     0.0
1261                RC   0.045   0.035   0.045    4937   0.001
                    * McMicken Dam Channel
1262                RX       0      46     101     121     171     181    1421    3621
1263                RY      25      14       4       0       0       4      14      25
                    *
                    *
1264                ZZ
1
          SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  180      DCAP11
                V
                V
  182      RDCP11
                .
                .
  187           .      DCAP12
                .          .
                .          .
  190           .          .-------->   DO618
  189           .       D618
                .          V
                .          V
  193           .      RDCP12
                .          .
                .          .
  198           .          .       PI618
                .          .           .
                .          .           .
  204      CPI618.......................
                V
                V
  206      RPI618
                .
                .
  211           .      DCAP13
                .          V
                .          V
  213           .      RDCP13
                .          .
                .          .
  218           .          .       PI615
```

```
                                                  .<-------   DO618
225                                          D618
224                                              V
                                                 V
226                                          RD618
                                                 .
                                                 .
231                 CPI615......................
                        V
                        V
233                 RPI615
                        .
                        .
238                     .       PI612
                        .           .
                        .           .
244                     .           .     PI624B
                        .           .         .
                        .           .         .
253                     .           .         .------->   D624B
251                     .           .     DO624B
                        .           .         V
                        .           .         V
256                     .           .     RX624B
                        .           .         .
                        .           .         .
261                     .           .         .      PI624D
                        .           .         .          .
                        .           .         .          .
268                     .           .     CP624D............
                        .           .         .
                        .           .         .
271                     .           .         .------->  DO624D
270                     .           .      D624D
                        .           .         V
                        .           .         V
274                     .           .     RX624D
                        .           .         .
                        .           .         .
279             CPI612.....................................
                        .
                        .
282                     .------->   DO612
281                 D612
                        V
                        V
285             RPI612
                        .
                        .
290                 .   DCAP14
                        V
                        V
292                 .   RDCP14
                        .
                        .
297                     .       PI609
                        .           .
                        .           .
304                     .           .         .<-------  DO624D
303                     .           .      D624D
                        .           .         V
                        .           .         V
305                     .           .     RD624D
                        .           .         .
                        .           .         .
310                     .           .         .      PI624E
                        .           .         .          .
                        .           .         .          .
318                     .           .         .          .------->  RET624
317                     .           .         .      624ERT
                        .           .         .          .
                        .           .         .          .
321                     .           .     CP624E............
                        .           .         V
                        .           .         V
323                     .           .     RD624E
                        .           .         .
                        .           .         .
328                     .           .         .      PI624G
                        .           .         .          .
                        .           .         .          .
335                     .           .         .          .      PI624F
                        .           .         .          .          .
                        .           .         .          .          .
343                     .           .         .          .          .<-------   D624B
342                     .           .         .          .          .      D624B
                        .           .         .          .          .          V
                        .           .         .          .          .          V
344                     .           .         .          .          .      RD624B
                        .           .         .          .          .          .
                        .           .         .          .          .          .
349                     .           .         .          .          .          .      PI624C
                        .           .         .          .          .          .          .
                        .           .         .          .          .          .          .
355                     .           .         .          .          .      CP624C............
                        .           .         .          .          .          .
                        .           .         .          .          .          .
359                     .           .         .          .          .          .------->   D624C
357                     .           .         .          .          .      DO624C
                        .           .         .          .          .          V
                        .           .         .          .          .          V
362                     .           .         .          .          .      RD624C
                        .           .         .          .          .          .
                        .           .         .          .          .          .
```

```
367          .          .          .     CP624G.................................
             .          .          .          .
             .          .          .          .
371          .          .          .          .-------->   D624G
369          .          .          .     DO624G
             .          .          .          V
             .          .          .          V
374          .          .          .     RD624G
             .          .          .          .
             .          .          .          .
379          .          .          .          .      PI624H
             .          .          .          .          .
             .          .          .          .          .
386          .          .          .     CP624H............
             .          .          .          V
             .          .          .          V
388          .          .          .     RD624H
             .          .          .          .
             .          .          .          .
394          .          .          .          .          .<-------   DO612
393          .          .          .          .        D612
             .          .          .          .          V
             .          .          .          .          V
395          .          .          .          .      RD612
             .          .          .          .          .
             .          .          .          .          .
400          .          .          .          .          .      PI621A
             .          .          .          .          .          .
             .          .          .          .          .          .
407          .          .          .     CP621A........................
             .          .          .          V
             .          .          .          V
409          .          .          .     RD621A
             .          .          .          .
             .          .          .          .
414          .          .          .          .      PI621B
             .          .          .          .          .
             .          .          .          .          .
421          .          .          .     CP621B............
             .          .          .          V
             .          .          .          V
423          .          .          .     RD621B
             .          .          .          .
             .          .          .          .
428     CPI609..................................
             V
             V
430     R609-1
             .
             .
436          .-------> DOHVC1
435      DHVC1
             V
             V
439     R609-2
             .
             .
445          .-------> DOHVC2
444      DHVC2
             V
             V
448     R609-3
             .
             .
453          .      DCAP15
             .          V
             .          V
455          .      RDCP15
             .          .
             .          .
460          .          .      PI606A
             .          .          .
             .          .          .
466          .       C606A............
             .          .
             .          .
469          .          .-------> DO606A
468          .       D606A
             .          V
             .          V
472          .       R606A
             .          .
             .          .
477          .          .       PI606
             .          .          .
             .          .          .
483     CPI606........................
             V
             V
485     RPI606
             .
             .
490          .       PI604
             .          .
             .          .
497          .          .          .<-------  DO606A
496          .          .       D606A
             .          .          V
             .          .          V
498          .          .      RD606A
             .          .          .
             .          .          .
503          .      CPI604............
             .          V
             .          V
505          .      RPI604
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                .         .
                .         .
510             .         .      PD744
                .         .         .
                .         .         .
517             .         .         ..<-------  DOHVC1
516             .         .         .     DHVC1
                .         .         .         V
                .         .         .         V
518             .         .         .     RDHVC1
                .         .         .         .
                .         .         .         .
524             .         .         .         ..<-------  DOHVC2
523             .         .         .         .     DHVC2
                .         .         .         .         V
                .         .         .         .         V
525             .         .         .         .     RDHVC2
                .         .         .         .         .
                .         .         .         .         .
530             .         .         .         .         .     PI600A
                .         .         .         .         .        .
                .         .         .         .         .        .
536             .         .         .      C600A.......................
                .         .         .         V
                .         .         .         V
538             .         .         .     RD600A
                .         .         .         .
                .         .         .         .
543             .         .         .         .       PI603
                .         .         .         .         .
                .         .         .         .         .
549     CPI603.............................................
            V
            V
551     SPI603
            .
            .
560         .------->   DO744
559       D744
            V
            V
565     RPI603
            .
            .
570         .     CWI504
                      V
                      V
572         .     RWI504
                .         .
                .         .
577             .         .     CWI508
                .         .         .
                .         .         .
580             .         .         .------->   DO508
579             .         .       D508
                .         .         .
                .         .         .
583             .         .         .     WI510A
                .         .         .         V
                .         .         .         V
589             .         .         .      R510A
                .         .         .         .
                .         .         .         .
594             .         .         .         .       WI510
                .         .         .         .         .
                .         .         .         .         .
600             .         .     CWI510......................
                .         .         V
                .         .         V
602             .         .     RWI510
                .         .         .
                .         .         .
607             .         .         .      WI502
                .         .         .         .
                .         .         .         .
613             .     CWI502......................
                .         V
                .         V
615             .     RWI502
                .         .
                .         .
620             .         .     CWI525
                .         .         .
                .         .         .
623             .         .         .------->   DO525
622             .         .       D525
                .         .         V
                .         .         V
626             .         .     RWI525
                .         .         .
                .         .         .
631             .         .         .     DCAP10
                .         .         .         V
                .         .         .         V
633             .         .         .     RDCP10
                .         .         .         .
                .         .         .         .
638             .         .         .         .       PI628
                .         .         .         .         .
                .         .         .         .         .
644             .         .         .     CPI628............
                .         .         .         V
                .         .         .         V
646             .         .         .     RPI628
                .         .         .         .
                .         .         .         .
```

```
651                                  PI624A
                                       .
657                              C624A............
                                     V
                                     V
659                              R624A
                                       .
664                                  PI639A
                                       .
670                              C639A............
                                     V
                                     V
672                              R639A
                                       .
677                                  WI524A
                                       .
                                       .
684                                    .<-------   DO525
683                                    .       D525
                                       .          V
                                       .          V
685                                    .      RD525
                                       .          .
                                       .          .
690                              C524A.......................
                                     V
                                     V
692                              R524A
                                       .
                                       .
697                                  2.8
                                       .
                                       .
703                               C2.8............
                                     V
                                     V
705                               R2.8
                                       .
                                       .
710                                   3A
                                       V
                                       V
716                                  R3A
                                       .
                                       .
721                                    .       2.11
                                       .          .
                                       .          .
727                                 C2.11...........
                                       V
                                       V
729                                 R2.11
                                       .
                                       .
734                                    .       2.10
                                       .          V
                                       .          V
740                                    .      S2.10
                                       .          .
                                       .          .
746                                    .          .        2.7
                                       .          .          .
                                       .          .          .
752                                    .          .          .        2.4
                                       .          .          .          V
                                       .          .          .          V
758                                    .          .          .       S2.4
                                       .          .          .          V
                                       .          .          .          V
764                                    .          .          .       R2.4
                                       .          .          .          .
                                       .          .          .          .
769                                 C2.7.................................
                                       V
                                       V
771                                 S2.7
                                       .
                                       .
777                               C2.6............
                                     V
                                     V
779                               R2.6
                                       .
                                       .
784                                  2.5
                                       .
                                       .
790                             CWI524............
                                       .
                                       .
793                                    .------->   DO524
792                               D524
                                     V
                                     V
796                             RWI524
                                       .
                                       .
801                                   4A
                                       V
                                       V
807                                  R4A
                                       .
```

```
                                                HVC_EX_WBERM.OH1
812                                                    2.1
818                                            C2.1............
                                                  V
                                                  V
820                                            S2.1
                                                  V
                                                  V
826                                            R2.1
831                                                    1.11
838                                                                .<-------   DO524
837                                                            D524
                                                                  V
                                                                  V
839                                                           RD524
844                                        CPI639......................
                                                  V
                                                  V
846                                        RPI639
851                                                   WI506
857                                CWI506...................................
860                                            .<-------   DO508
859                                        D508
                                                  V
                                                  V
861                                        RD508
866                                            WI500
872                        CWI500...................................
                                V
                                V
874                        SSPILL
                                V
                                V
881                        RWI500
886                                PI635
892                        CPI635............
                                V
                                V
894                        RPI635
899                                PI621C
                                        V
                                        V
905                                SPI621
                                        V
                                        V
910                                RPI621
915                                            PI633
921                                                1.8
                                                  V
                                                  V
927                                            S1.8
933                                                    1.7
939                                                            1.5A
945                                            C1.7......................
                                                  V
                                                  V
947                                            S1.7
953                                                    1.9
959                                                            1.6
965                                            C1.6......................
                                                  V
                                                  V
967                                            S1.6
973                                                    1.10
```

```
                                   HVC_EX_WBERM.OH1
                                          V
                                          V
979                                     R1.10
                                          .
                                          .
984                                       .       1.13A
                                          .         .
                                          .         .
990                                       .         .       1.14A
                                          .         .         .
                                          .         .         .
996                                C1.14A.....................................
                                       V
                                       V
998                                S1.14A
                                          .
                                          .
1004                                    1.13B
                                          V
                                          V
1010                                  R1.13B
                                          .
                                          .
1015                                      .       1.14B
                                          .         .
                                          .         .
1021                               C1.14B.......................
                                       V
                                       V
1023                               R1.14B
                                          .
                                          .
1028                                    1.16A
                                          V
                                          V
1034                                  S1.16A
                                          V
                                          V
1040                                  R1.16A
                                          .
                                          .
1045                                      .       1.15A
                                          .         V
                                          .         V
1051                                      .      S1.15A
                                          .         .
                                          .         .
1057                                      .         .       1.15B
                                          .         .         .
                                          .         .         .
1063                               C1.15B.....................................
                                       V
                                       V
1065                               R1.15B
                                          .
                                          .
1070                                    1.16B
                                          V
                                          V
1076                                  S1.16B
                                          V
                                          V
1082                                  R1.16B
                                          .
                                          .
1087                                      .       1.17A
                                          .         V
                                          .         V
1093                                      .      S1.17A
                                          .         .
                                          .         .
1099                                      .         .       1.17B
                                          .         .         .
                                          .         .         .
1105                               C1.17B.....................................
                                       V
                                       V
1107                               R1.17B
                                          .
                                          .
1112                                      1.3
                                          V
                                          V
1118                                     S1.3
                                          V
                                          V
1124                                     R1.3
                                          .
                                          .
1129                                      .         1.2
                                          .          V
                                          .          V
1135                                      .        S1.2
                                          .         .
                                          .         .
1141                                 C636........................
                                       V
                                       V
1143                               RPI636
                                          .
                                          .
1149                                      .<-------   D624C
1148                                    D624C
                                          V
                                          V
1150                                   RD624C
```

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                                                  HVC_EX_WBERM.OH1
                 .          .          .          .          .          .
1156             .          .          .          .          .          .<-------   D624G
1155             .          .          .          .          .       D624G
                 .          .          .          .          .          V
                 .          .          .          .          .          V
1157             .          .          .          .          .      RD624G
                 .          .          .          .          .          .
                 .          .          .          .          .          .
1162             .          .          .          .          .          .          4B
                 .          .          .          .          .          .          .
                 .          .          .          .          .          .          .
1168             .          .          .          .          .       C4B.......................
                 .          .          .          .          .         V
                 .          .          .          .          .         V
1170             .          .          .          .          .       R4B
                 .          .          .          .          .         .
                 .          .          .          .          .         .
1175             .          .          .          .          .         .       1.5B
                 .          .          .          .          .         .          V
                 .          .          .          .          .         .          V
1181             .          .          .          .          .         .      S1.5B
                 .          .          .          .          .         .          .
                 .          .          .          .          .         .          .
1187             .          .          .          .          .     C1.5B............
                 .          .          .          .          .         V
                 .          .          .          .          .         V
1189             .          .          .          .          .     R1.5B
                 .          .          .          .          .         .
                 .          .          .          .          .         .
1194             .          .          .          .          .         .       1.5C
                 .          .          .          .          .         .          V
                 .          .          .          .          .         .          V
1200             .          .          .          .          .         .      S1.5C
                 .          .          .          .          .         .          V
                 .          .          .          .          .         .          V
1206             .          .          .          .          .         .      R1.5C
                 .          .          .          .          .         .          .
                 .          .          .          .          .         .          .
1211             .          .          .          .          .         .          .        1.4
                 .          .          .          .          .         .          .          V
                 .          .          .          .          .         .          .          V
1217             .          .          .          .          .         .          .       S1.4
                 .          .          .          .          .         .          .          .
                 .          .          .          .          .         .          .          .
1223             .          .          .          .          .       C624.......................
                 .          .          .          .          .         .
                 .          .          .          .          .         .
1225             .          .          .          .          .         .      PI624
                 .          .          .          .          .         .          .
                 .          .          .          .          .         .          .
1231             .          .          .          .     CPI624.......................
                 .          .          .          .          V
                 .          .          .          .          V
1233             .          .          .          .     SPI624
                 .          .          .          .          V
                 .          .          .          .          V
1239             .          .          .          .     RPI624
                 .          .          .          .          .
                 .          .          .          .          .
1244             .      CPI633.....................................
                 .          V
                 .          V
1246             .      RPI633
                 .          .
                 .          .
1251             .          .       PI600
                 .          .          .
                 .          .          .
1257       CPI600........................
                V
                V
1259       RPI600
```

```
(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN  1998               *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   19NOV10  TIME  11:04:07  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

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HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
100-YEAR 24-HOUR STORM - HAPPY VALLEY CHANNEL WITH BERM
EXISTING CONDITIONS
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
**  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY   **
**                                                                         **
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS   **
** DATED OCTOBER 2004:                                                     **
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**                                                                      **
**     -Diversion added after CTW480                                    **
**          -Main flow (5%) to CTW478                                   **
**          -Diverted flow (95%) to CWI584                              **
**          -Added concentration point CWI584 combining RD480 and WI584 **
**          -Hard coding was added to CTW478                            **
**          -Route added after D480 (Diversion Recovery)                **
**          -Route RWI584 was adjusted                                  **
**          -Storage Route SCP050 was adjusted                          **
**          -Route R508* was adjusted                                   **
**          -Hard coding for CWI510 was adjusted                        **
**                                                                      **
**     -Diversion D618 was moved from after CPI618 to before RDCP12     **
**          -Updated route RD618 information                            **
**          -Hard coding on CPI618 was adjusted                         **
**          -Hard coding on CPI615 was adjusted                         **
**                                                                      **
**     -Route RPI639 changed from following US60 to CPI636 to route     **
**      through US60/RR structures and combine with CWI506              **
**          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
**           following R624A to follow RWI524                           **
**          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
**          -RPI639 information was changed to reflect new route        **
**          -CWI506 changed from combining 3 to combine 4:              **
**           RWI525, RWI524, RPI639 & WI506                             **
**          -Hard coding on CWI506 was adjusted                         **
**          -Hard Coding on CWI500 was adjusted                         **
**                                                                      **
**************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
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**                                                                      **
**    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004   **
**                                                                      **
**************************************************************************
**************************************************************************

PROJECT:                Wittmann ADMS Update
CLIENT:                 Flood Control District of Maricopa County
PREPARED BY:            Entellus, Inc.
PROJECT NO:             FCD 2002C029              Entellus 310.032
FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
                                       MODIFIED DATE: MAY 04, 2005

STORM:
                    100-year 24-hour Storm

DEVELOPMENT CONDITIONS:
                    Existing Conditions

MODELING ASSUMPTIONS:
                    It was assumed that the US60 did not have adequate
                    storage to cause any significant attenuation.

                    The assumption was made that the CAP Canal embankment
                    would not be breached under a large flood event.

                    The assumption was made that the Beardsley Canal would
                    not fail under a large storm event (Per District
                    Instruction).  In addition, the berm north of the
                    Beardsley canal and east of US60 was assumed to fail
                    (per district Instruction).

                    For both the CAP and Beardsley Canals, once the berm
                    elevation was reached weir flow was assumed.  It was
                    also assumed that any weir flow over the canal that
                    might enter the canal and be diverted out of the study
                    area was insignificant, and thus was ignored.  In other
                    words all weir flow over the canal embankment reaches
                    the downstream concentration point.

                    Typical X-sects were developed, and it was assumed
                    that a typical x-sect could adequately represent
                    various reaches.

                    Time-Area Relations were used base on the District's
                    Hydrology Manual criteria.  Two Time-Area Relation
                    Curves were utilized:
                            -Urban
                            -Natural
                    The Time-Area Relation Curves were taken directly
                    from the manual

MODELING METHODS:
                    This model utilizes QI cards to input the Padelford
                    hydrographs from the 100-year 6-hour existing
                    conditions model developed by A-N West Inc. for the
                    Padelford Wash Floodplain Delineation Study.  The
                    hydrograph was altered from its original form
                    (2-minute interval to 5-minute interval) through
                    simple interpolation.

                    Clark Unit Hydrographs were used for all subbasins
                    except the two subbasins directly upstream of the
                    Bonita Dam (PD726B and PD740 use S-graphs).  The UC
                    parameters were calculated using the WMS7.0 software.

                    For Basins PD726B and PD740 S-Graphs were utilized per
                    the request of the FCDMC.  Limited details regarding
                    the calculations of the S-graphs can be found in the
```

model by the basin KK card. For full details of the S-graph calculations refer to the Appendix.

Normal Depth routing was used for all routing reaches.

Hard coding was used to account for the percentage of area associated with a diversion. Because of the use of JD cards and aereal reduction, hard coding was necessary to properly account for area. For a given diversion a percentage of the flow is routed to two different locations. The same percentage of area follows that diverted flow. In addition the area downstream of the main path is reduced or increased and is hard coded to account for the loss or gain of area. Hard coding was performed based on the 24-hour existing conditions model.

Stage-storage was developed for all the structures along the CAP Canal, as well as along the Beardsley Canal. In addition several stage-storage locations were developed for areas with significant storage along the SR74. No storage was modeled along the US60 and railroad, but the culverts were analyzed for diversion potential. Diversions were placed in the model where deemed appropriate. See appendix for details.

FLO-2D was utilized to calculate the split flows at concentration points CIW351. CIW357, CIW363 and CWI576. See appendix for modeling details.

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```
159 IO        OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ       1500  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      6   0  ENDING DATE
                   NDTIME       0455  ENDING TIME
                    ICENT         19  CENTURY MARK

              COMPUTATION INTERVAL    0.08 HOURS
                   TOTAL TIME BASE  124.92 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

161 JD        INDEX STORM NO. 1
                    STRM       4.18  PRECIPITATION DEPTH
                    TRDA       0.01  TRANSPOSITION DRAINAGE AREA

162 PI          PRECIPITATION PATTERN
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                  0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                  0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                  0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

172 JD        INDEX STORM NO. 2
                    STRM       3.93  PRECIPITATION DEPTH
                    TRDA      10.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                  0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

173 JD        INDEX STORM NO. 3
                STRM        3.86  PRECIPITATION DEPTH
                TRDA       20.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

174 JD        INDEX STORM NO. 4
                STRM        3.72  PRECIPITATION DEPTH
                TRDA       40.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

175 JD        INDEX STORM NO. 5
                STRM        3.60  PRECIPITATION DEPTH
                TRDA       80.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

176 JD        INDEX STORM NO. 6
                STRM        3.53  PRECIPITATION DEPTH
                TRDA      120.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

177 JD        INDEX STORM NO. 7
                STRM        3.44  PRECIPITATION DEPTH
                TRDA      200.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

178 JD        INDEX STORM NO. 8
                STRM        3.38  PRECIPITATION DEPTH
                TRDA      300.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
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179 JD        INDEX STORM NO. 9
                  STRM        3.29  PRECIPITATION DEPTH
                  TRDA      500.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
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181 BI        READ STATION   DCAP11 HYDROGRAPH FROM UNIT 22

188 BI        READ STATION   DCAP12 HYDROGRAPH FROM UNIT 22

212 BI        READ STATION   DCAP13 HYDROGRAPH FROM UNIT 22

291 BI        READ STATION   DCAP14 HYDROGRAPH FROM UNIT 22

454 BI        READ STATION   RDCP15 HYDROGRAPH FROM UNIT 22
      WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

571 BI        READ STATION   CWI504 HYDROGRAPH FROM UNIT 22

578 BI        READ STATION   CWI508 HYDROGRAPH FROM UNIT 22

621 BI        READ STATION   CWI525 HYDROGRAPH FROM UNIT 22

632 BI        READ STATION   DCAP10 HYDROGRAPH FROM UNIT 22
      WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

WARNING --- ROUTED OUTFLOW (    444.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

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WARNING --- ROUTED OUTFLOW (    449.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    473.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    464.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    438.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
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HVC_EX_WBERM.OH1
RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	DCAP11	424.	16.08	411.	256.	88.	53.75		
+	ROUTED TO	RDCP11	424.	16.33	410.	256.	88.	53.75		
+	HYDROGRAPH AT	DCAP12	410.	16.08	394.	243.	84.	53.75		
+	DIVERSION TO	DO618	218.	16.08	209.	129.	45.	53.75		
+	HYDROGRAPH AT	D618	193.	16.08	185.	114.	40.	53.75		
+	ROUTED TO	RDCP12	193.	16.33	185.	114.	40.	53.75		
+	HYDROGRAPH AT	PI618	323.	12.33	43.	12.	4.	0.29		
+	3 COMBINED AT	CPI618	629.	16.17	605.	390.	135.	5.48		
+	ROUTED TO	RPI618	628.	16.75	604.	390.	135.	5.48		
+	HYDROGRAPH AT	DCAP13	420.	16.08	404.	248.	88.	53.75		
+	ROUTED TO	RDCP13	420.	16.67	403.	248.	88.	53.75		
+	HYDROGRAPH AT	PI615	625.	12.33	115.	31.	10.	0.84		
+	HYDROGRAPH AT	D618	218.	16.08	209.	129.	45.	53.75		
+	ROUTED TO	RD618	217.	16.42	209.	129.	45.	53.75		
+	3 COMBINED AT	CPI615	701.	12.33	626.	416.	146.	6.21		
+	ROUTED TO	RPI615	653.	16.75	626.	416.	146.	6.21		
+	HYDROGRAPH AT	PI612	458.	12.67	96.	26.	9.	0.74		
+	HYDROGRAPH AT	PI624B	67.	12.42	11.	3.	1.	0.10		
+	DIVERSION TO	D624B	47.	12.25	10.	3.	1.	0.10		
+	HYDROGRAPH AT	DO624B	20.	12.42	1.	0.	0.	0.10		
+	ROUTED TO	RX624B	15.	12.58	1.	0.	0.	0.10		
+	HYDROGRAPH AT	PI624D	204.	12.58	41.	11.	4.	0.32		
+	2 COMBINED AT	CP624D	217.	12.58	42.	11.	4.	0.35		
+	DIVERSION TO	DO624D	217.	12.58	42.	11.	4.	0.35		
+	HYDROGRAPH AT	D624D	0.	0.00	0.	0.	0.	0.35		
+	ROUTED TO	RX624D	0.	0.00	0.	0.	0.	0.35		
+	4 COMBINED AT	CPI612	1406.	12.67	1232.	826.	288.	12.43		
+	DIVERSION TO	DO612	1055.	12.67	924.	620.	216.	12.43		
+	HYDROGRAPH AT	D612	352.	12.67	308.	207.	72.	12.43		
+	ROUTED TO	RPI612	335.	12.92	308.	207.	72.	12.43		
+	HYDROGRAPH AT	DCAP14	362.	16.08	347.	185.	62.	53.75		
+	ROUTED TO	RDCP14	362.	17.25	346.	185.	62.	53.75		
+	HYDROGRAPH AT	PI609	960.	12.50	262.	71.	24.	1.94		

+	HYDROGRAPH AT	D624D	217.	12.58	42.	11.	4.	0.35
+	ROUTED TO	RD624D	205.	12.67	42.	11.	4.	0.35
+	HYDROGRAPH AT	PI624E	512.	12.08	48.	15.	5.	0.26
+	DIVERSION TO	RET624	512.	12.08	35.	9.	3.	0.26
+	HYDROGRAPH AT	624ERT	229.	12.17	18.	5.	2.	0.26
+	2 COMBINED AT	CP624E	259.	12.25	59.	16.	5.	0.61
+	ROUTED TO	RD624E	226.	12.75	59.	16.	5.	0.61
+	HYDROGRAPH AT	PI624G	86.	12.25	10.	3.	1.	0.07
+	HYDROGRAPH AT	PI624F	51.	12.33	8.	2.	1.	0.06
+	HYDROGRAPH AT	D624B	47.	12.25	10.	3.	1.	0.10
+	ROUTED TO	RD624B	46.	12.83	10.	3.	1.	0.10
+	HYDROGRAPH AT	PI624C	331.	12.50	51.	13.	4.	0.37
+	2 COMBINED AT	CP624C	346.	12.50	61.	16.	5.	0.44
+	DIVERSION TO	D624C	235.	12.50	41.	11.	4.	0.44
+	HYDROGRAPH AT	DO624C	111.	12.50	20.	5.	2.	0.44
+	ROUTED TO	RD624C	107.	12.67	20.	5.	2.	0.44
+	4 COMBINED AT	CP624G	405.	12.42	95.	26.	9.	0.88
+	DIVERSION TO	D624G	60.	12.42	14.	4.	1.	0.88
+	HYDROGRAPH AT	DO624G	345.	12.42	81.	22.	7.	0.88
+	ROUTED TO	RD624G	348.	12.42	81.	22.	7.	0.88
+	HYDROGRAPH AT	PI624H	59.	12.33	10.	3.	1.	0.08
+	2 COMBINED AT	CP624H	405.	12.42	91.	24.	8.	0.83
+	ROUTED TO	RD624H	377.	12.67	91.	24.	8.	0.83
+	HYDROGRAPH AT	D612	1055.	12.67	924.	620.	216.	12.43
+	ROUTED TO	RD612	1004.	13.00	924.	620.	216.	12.43
+	HYDROGRAPH AT	PI621A	137.	12.42	23.	6.	2.	0.17
+	3 COMBINED AT	CP621A	1409.	12.92	982.	649.	226.	10.32
+	ROUTED TO	RD621A	1392.	13.00	981.	649.	226.	10.32
+	HYDROGRAPH AT	PI621B	39.	12.25	5.	1.	0.	0.04
+	2 COMBINED AT	CP621B	1399.	13.00	983.	650.	227.	10.35
+	ROUTED TO	RD621B	1399.	13.00	983.	650.	227.	10.35
+	4 COMBINED AT	CPI609	2466.	12.92	1726.	1105.	382.	18.46
+	ROUTED TO	R609-1	2457.	12.92	1726.	1105.	382.	18.46
+	DIVERSION TO	DOHVC1	290.	12.92	204.	130.	45.	18.46
+	HYDROGRAPH AT	DHVC1	2167.	12.92	1522.	975.	337.	18.46

+	ROUTED TO	R609-2	2166.	13.00	1522.	975.	337.	18.46
+	DIVERSION TO	DOHVC2	552.	13.00	388.	248.	86.	18.46
+	HYDROGRAPH AT	DHVC2	1614.	13.00	1134.	726.	251.	18.46
+	ROUTED TO	R609-3	1610.	13.08	1134.	726.	251.	18.46
+	HYDROGRAPH AT	DCAP15	248.	14.42	216.	66.	22.	39.36
+	ROUTED TO	RDCP15	246.	14.75	215.	66.	22.	39.36
+	HYDROGRAPH AT	PI606A	374.	12.50	65.	18.	6.	0.46
+	2 COMBINED AT	C606A	363.	12.50	253.	97.	32.	4.08
+	DIVERSION TO	DO606A	149.	12.50	104.	40.	13.	4.08
+	HYDROGRAPH AT	D606A	214.	12.50	149.	57.	19.	4.08
+	ROUTED TO	R606A	166.	18.25	148.	57.	19.	4.08
+	HYDROGRAPH AT	PI606	708.	12.42	147.	40.	13.	1.08
+	3 COMBINED AT	CPI606	2098.	13.00	1356.	818.	283.	15.61
+	ROUTED TO	RPI606	2077.	13.17	1352.	818.	283.	15.61
+	HYDROGRAPH AT	PI604	312.	12.33	63.	18.	6.	0.36
+	HYDROGRAPH AT	D606A	149.	12.50	104.	40.	13.	4.08
+	ROUTED TO	RD606A	131.	12.83	104.	40.	13.	4.08
+	2 COMBINED AT	CPI604	321.	12.67	144.	58.	19.	2.03
+	ROUTED TO	RPI604	312.	12.92	141.	58.	19.	2.03
+	HYDROGRAPH AT	PD744	531.	12.67	107.	28.	9.	0.80
+	HYDROGRAPH AT	DHVC1	290.	12.92	204.	130.	45.	18.46
+	ROUTED TO	RDHVC1	286.	13.17	203.	130.	45.	18.46
+	HYDROGRAPH AT	DHVC2	552.	13.00	388.	248.	86.	18.46
+	ROUTED TO	RDHVC2	548.	13.08	387.	248.	86.	18.46
+	HYDROGRAPH AT	PI600A	822.	12.25	76.	20.	7.	0.52
+	3 COMBINED AT	C600A	930.	12.25	632.	401.	139.	6.86
+	ROUTED TO	RD600A	812.	13.50	615.	401.	139.	6.86
+	HYDROGRAPH AT	PI603	418.	12.50	74.	20.	7.	0.52
+	5 COMBINED AT	CPI603	3452.	13.08	2187.	1293.	447.	25.82
+	ROUTED TO	SPI603	3109.	13.42	2172.	1293.	447.	25.82
+	DIVERSION TO	DO744	0.	0.00	0.	0.	0.	25.82
+	HYDROGRAPH AT	D744	3109.	13.42	2172.	1293.	447.	25.82
+	ROUTED TO	RPI603	3064.	13.67	2157.	1293.	447.	25.82
+	HYDROGRAPH AT	CWI504	17196.	16.08	15524.	5927.	2016.	164.40
+	ROUTED TO	RWI504	17161.	16.17	15515.	5927.	2016.	164.40
	HYDROGRAPH AT							

+		CWI508	7401.	16.33	4749.	1821.	616.	41.34
+	DIVERSION TO	DO508	1406.	16.33	902.	346.	117.	41.34
+	HYDROGRAPH AT	D508	5995.	16.33	3847.	1475.	499.	41.34
+	HYDROGRAPH AT	WI510A	937.	12.58	151.	39.	13.	1.13
+	ROUTED TO	R510A	553.	13.75	149.	39.	13.	1.13
+	HYDROGRAPH AT	WI510	563.	13.00	179.	47.	16.	1.23
+	3 COMBINED AT	CWI510	6176.	16.25	4065.	1565.	529.	35.84
+	ROUTED TO	RWI510	6035.	16.67	3938.	1565.	529.	35.84
+	HYDROGRAPH AT	WI502	669.	12.83	179.	47.	16.	1.21
+	3 COMBINED AT	CWI502	21379.	16.58	18774.	7288.	2477.	201.44
+	ROUTED TO	RWI502	21344.	16.67	18768.	7288.	2477.	201.44
+	HYDROGRAPH AT	CWI525	1614.	12.58	834.	557.	190.	8.92
+	DIVERSION TO	DO525	101.	12.58	37.	20.	7.	8.92
+	HYDROGRAPH AT	D525	1514.	12.58	797.	538.	183.	8.92
+	ROUTED TO	RWI525	1184.	13.33	781.	537.	183.	8.92
+	HYDROGRAPH AT	DCAP10	420.	16.08	404.	253.	86.	53.75
+	ROUTED TO	RDCP10	420.	16.50	404.	252.	86.	53.75
+	HYDROGRAPH AT	PI628	695.	12.33	81.	22.	7.	0.57
+	2 COMBINED AT	CPI628	750.	12.33	413.	280.	96.	4.11
+	ROUTED TO	RPI628	616.	12.75	412.	280.	96.	4.11
+	HYDROGRAPH AT	PI624A	960.	12.58	158.	41.	14.	1.31
+	2 COMBINED AT	C624A	1500.	12.67	545.	319.	109.	5.42
+	ROUTED TO	R624A	1500.	12.67	545.	319.	109.	5.42
+	HYDROGRAPH AT	PI639A	79.	12.42	11.	3.	1.	0.09
+	2 COMBINED AT	C639A	1550.	12.67	554.	321.	110.	5.51
+	ROUTED TO	R639A	1471.	12.83	552.	321.	110.	5.51
+	HYDROGRAPH AT	WI524A	463.	12.50	68.	17.	6.	0.60
+	HYDROGRAPH AT	D525	101.	12.58	37.	20.	7.	8.92
+	ROUTED TO	RD525	63.	13.58	36.	20.	7.	8.92
+	3 COMBINED AT	C524A	1768.	12.75	641.	357.	122.	6.67
+	ROUTED TO	R524A	1766.	12.83	640.	357.	122.	6.67
+	HYDROGRAPH AT	2.8	151.	12.08	16.	5.	2.	0.08
+	2 COMBINED AT	C2.8	1776.	12.83	646.	361.	124.	6.75
+	ROUTED TO	R2.8	1759.	12.83	645.	361.	124.	6.75
+	HYDROGRAPH AT	3A	59.	12.25	6.	1.	0.	0.05
+	ROUTED TO	R3A	54.	12.33	6.	1.	0.	0.05

+	HYDROGRAPH AT	2.11	73.	12.00	7.	2.	1.	0.04
+	2 COMBINED AT	C2.11	91.	12.08	12.	3.	1.	0.08
+	ROUTED TO	R2.11	88.	12.17	12.	3.	1.	0.08
+	HYDROGRAPH AT	2.10	107.	12.08	13.	4.	1.	0.07
+	ROUTED TO	S2.10	50.	12.42	10.	3.	1.	0.07
+	HYDROGRAPH AT	2.7	250.	12.00	22.	7.	2.	0.11
+	HYDROGRAPH AT	2.4	98.	12.08	12.	4.	1.	0.07
+	ROUTED TO	S2.4	96.	12.17	12.	4.	1.	0.07
+	ROUTED TO	R2.4	91.	12.25	12.	4.	1.	0.07
+	4 COMBINED AT	C2.7	357.	12.08	55.	16.	6.	0.32
+	ROUTED TO	S2.7	1.	12.08	1.	1.	1.	0.32
+	2 COMBINED AT	C2.6	1759.	12.83	645.	362.	125.	7.07
+	ROUTED TO	R2.6	1752.	12.92	644.	362.	124.	7.07
+	HYDROGRAPH AT	2.5	152.	12.08	18.	6.	2.	0.09
+	2 COMBINED AT	CWI524	1766.	12.92	650.	367.	126.	7.17
+	DIVERSION TO	DO524	234.	12.92	27.	7.	2.	7.17
+	HYDROGRAPH AT	D524	1532.	12.92	622.	360.	124.	7.17
+	ROUTED TO	RWI524	1418.	13.17	618.	360.	124.	7.17
+	HYDROGRAPH AT	4A	162.	12.42	22.	6.	2.	0.19
+	ROUTED TO	R4A	151.	12.50	22.	6.	2.	0.19
+	HYDROGRAPH AT	2.1	201.	12.08	26.	8.	3.	0.14
+	2 COMBINED AT	C2.1	230.	12.42	47.	13.	4.	0.32
+	ROUTED TO	S2.1	229.	12.50	47.	13.	4.	0.32
+	ROUTED TO	R2.1	224.	12.58	47.	13.	4.	0.32
+	HYDROGRAPH AT	1.11	198.	12.08	25.	8.	3.	0.13
+	HYDROGRAPH AT	D524	234.	12.92	27.	7.	2.	7.17
+	ROUTED TO	RD524	206.	13.08	27.	7.	2.	7.17
+	3 COMBINED AT	CPI639	353.	13.00	99.	28.	9.	1.34
+	ROUTED TO	RPI639	340.	13.17	99.	28.	9.	1.34
+	HYDROGRAPH AT	WI506	961.	12.50	239.	65.	22.	1.58
+	4 COMBINED AT	CWI506	3353.	13.17	1591.	971.	334.	17.54
+	HYDROGRAPH AT	D508	1406.	16.33	902.	346.	117.	41.34
+	ROUTED TO	RD508	1389.	16.58	902.	346.	117.	41.34
+	HYDROGRAPH AT	WI500	765.	12.67	154.	40.	13.	1.05
+	4 COMBINED AT	CWI500	23515.	16.75	20602.	8472.	2882.	227.89

+	ROUTED TO	SSPILL	3018.	27.08	2999.	2754.	1896.	227.89
+	ROUTED TO	RWI500	3017.	27.67	2999.	2753.	1896.	227.89
+	HYDROGRAPH AT	PI635	622.	12.50	100.	28.	9.	0.61
+	2 COMBINED AT	CPI635	3017.	27.67	2999.	2753.	1896.	228.50
+	ROUTED TO	RPI635	3016.	28.42	2998.	2752.	1896.	228.50
+	HYDROGRAPH AT	PI621C	830.	12.42	96.	25.	8.	0.70
+	ROUTED TO	SPI621	770.	12.50	57.	15.	5.	0.70
+	ROUTED TO	RPI621	455.	12.75	57.	15.	5.	0.70
+	HYDROGRAPH AT	PI633	280.	12.50	50.	13.	4.	0.34
+	HYDROGRAPH AT	1.8	37.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.8	31.	12.08	3.	1.	0.	0.02
+	HYDROGRAPH AT	1.7	122.	12.08	13.	4.	1.	0.07
+	HYDROGRAPH AT	1.5A	26.	12.08	3.	1.	0.	0.01
+	3 COMBINED AT	C1.7	177.	12.08	19.	6.	2.	0.10
+	ROUTED TO	S1.7	111.	12.25	18.	5.	2.	0.10
+	HYDROGRAPH AT	1.9	111.	12.08	14.	4.	1.	0.07
+	HYDROGRAPH AT	1.6	83.	12.08	9.	3.	1.	0.05
+	3 COMBINED AT	C1.6	275.	12.17	39.	11.	4.	0.22
+	ROUTED TO	S1.6	234.	12.25	39.	11.	4.	0.22
+	HYDROGRAPH AT	1.10	50.	12.00	4.	1.	0.	0.02
+	ROUTED TO	R1.10	41.	12.08	4.	1.	0.	0.02
+	HYDROGRAPH AT	1.13A	54.	12.00	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14A	60.	12.08	7.	2.	1.	0.04
+	4 COMBINED AT	C1.14A	341.	12.17	55.	17.	6.	0.30
+	ROUTED TO	S1.14A	171.	12.58	35.	10.	3.	0.30
+	HYDROGRAPH AT	1.13B	36.	12.08	5.	2.	1.	0.03
+	ROUTED TO	R1.13B	30.	12.33	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14B	55.	12.08	7.	2.	1.	0.03
+	3 COMBINED AT	C1.14B	204.	12.58	45.	13.	4.	0.36
+	ROUTED TO	R1.14B	200.	12.67	45.	13.	4.	0.36
+	HYDROGRAPH AT	1.16A	57.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16A	7.	12.42	2.	1.	0.	0.03
+	ROUTED TO	R1.16A	7.	12.58	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.15A	46.	12.00	5.	1.	0.	0.02
+	ROUTED TO	S1.15A	21.	12.25	2.	1.	0.	0.02
	HYDROGRAPH AT							

+		1.15B	33.	12.00	4.	1.	0.	0.02
+	4 COMBINED AT	C1.15B	217.	12.58	52.	15.	5.	0.43
+	ROUTED TO	R1.15B	210.	12.75	52.	15.	5.	0.43
+	HYDROGRAPH AT	1.16B	66.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16B	7.	12.33	2.	1.	0.	0.03
+	ROUTED TO	R1.16B	6.	12.83	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.17A	89.	12.08	10.	3.	1.	0.05
+	ROUTED TO	S1.17A	15.	12.58	4.	1.	0.	0.05
+	HYDROGRAPH AT	1.17B	48.	12.08	6.	2.	1.	0.03
+	4 COMBINED AT	C1.17B	236.	12.75	62.	19.	6.	0.54
+	ROUTED TO	R1.17B	233.	12.83	62.	19.	6.	0.54
+	HYDROGRAPH AT	1.3	55.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.3	2.	13.33	1.	0.	0.	0.03
+	ROUTED TO	R1.3	2.	13.92	1.	0.	0.	0.03
+	HYDROGRAPH AT	1.2	180.	12.08	20.	6.	2.	0.11
+	ROUTED TO	S1.2	5.	13.92	3.	1.	0.	0.11
+	3 COMBINED AT	C636	233.	12.83	65.	20.	7.	0.68
+	ROUTED TO	RPI636	229.	12.83	65.	20.	7.	0.68
+	HYDROGRAPH AT	D624C	235.	12.50	41.	11.	4.	0.44
+	ROUTED TO	RD624C	217.	12.75	41.	11.	4.	0.44
+	HYDROGRAPH AT	D624G	60.	12.42	14.	4.	1.	0.88
+	ROUTED TO	RD624G	56.	12.83	14.	4.	1.	0.88
+	HYDROGRAPH AT	4B	401.	12.42	47.	12.	4.	0.38
+	3 COMBINED AT	C4B	555.	12.50	102.	26.	9.	0.81
+	ROUTED TO	R4B	551.	12.58	101.	26.	9.	0.81
+	HYDROGRAPH AT	1.5B	33.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.5B	3.	12.67	1.	0.	0.	0.02
+	2 COMBINED AT	C1.5B	552.	12.58	102.	26.	9.	0.83
+	ROUTED TO	R1.5B	549.	12.58	102.	26.	9.	0.83
+	HYDROGRAPH AT	1.5C	34.	12.00	3.	1.	0.	0.01
+	ROUTED TO	S1.5C	2.	12.42	1.	0.	0.	0.01
+	ROUTED TO	R1.5C	1.	12.75	1.	0.	0.	0.01
+	HYDROGRAPH AT	1.4	58.	12.00	6.	2.	1.	0.03
+	ROUTED TO	S1.4	0.	23.50	0.	0.	0.	0.03
+	3 COMBINED AT	C624	549.	12.58	102.	26.	9.	0.87
+	HYDROGRAPH AT	PI624	281.	12.67	56.	14.	5.	0.45

+	3 COMBINED AT CPI624	989.	12.67	218.	59.	20.	2.00
+	ROUTED TO SPI624	815.	13.00	138.	38.	13.	2.00
+	ROUTED TO RPI624	563.	13.50	136.	38.	13.	2.00
+	4 COMBINED AT CPI633	3016.	28.33	2998.	2753.	1896.	231.53
+	ROUTED TO RPI633	3014.	28.92	2996.	2750.	1895.	231.53
+	HYDROGRAPH AT PI600	731.	12.33	87.	23.	8.	0.61
+	3 COMBINED AT CPI600	4146.	24.50	4051.	3344.	2265.	257.96
+	ROUTED TO RPI600	4141.	25.00	4047.	3344.	2264.	257.96

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SSPILL
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.56	0.00	17661.	4092.	0.00	25.92	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.75	0.00	16294.	3751.	0.00	26.25	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.50	0.00	15899.	3643.	0.00	26.33	0.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.06	0.00	15198.	3452.	0.00	26.58	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.64	0.00	14526.	3269.	0.00	26.75	0.00

PLAN 6 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.42	0.00	14170.	3172.	0.00	26.92	0.00

PLAN 7 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.13	0.00	13704.	3045.	0.00	27.08	0.00

PLAN 8 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.93	0.00	13394.	2960.	0.00	27.17	0.00

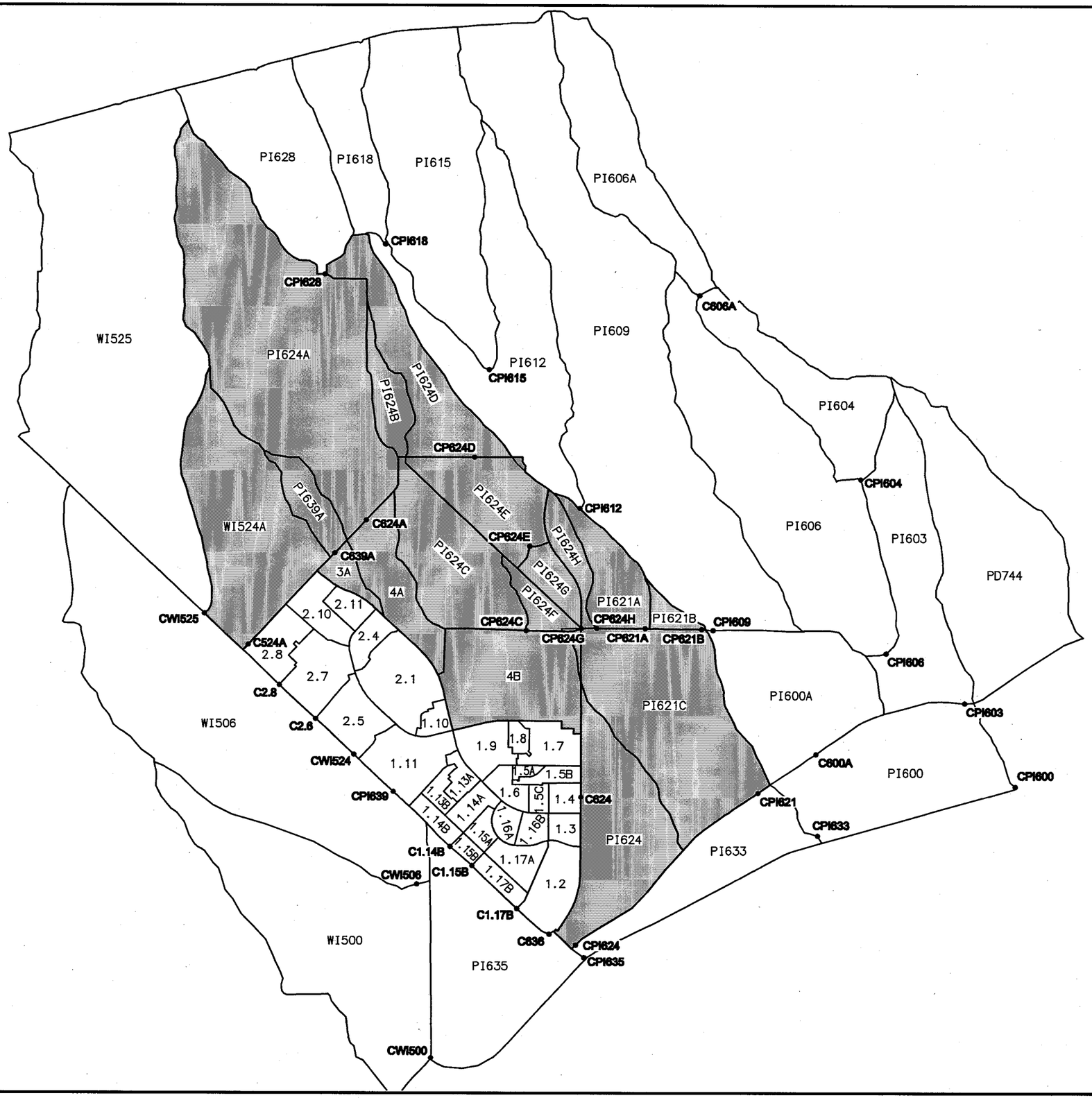
PLAN 9 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.62	0.00	12889.	2823.	0.00	27.25	0.00

*** NORMAL END OF HEC-1 ***

Existing Conditions 100-Year 24-Hour Storm HEC-1 Model Without Berm



DRAINAGE ID	HAPPY VALLEY CHANNEL WITHOUT BERM 100-YR 24-HR Q (cfs)
CPI618	629
CPI615	701
CPI612	1406
CP624D	217
CP624E	259
CP624G	405
CP624H	405
CP621A	1317
CP621B	607
CPI609	1740
CPI606	1026
C606A	363
CPI604	321
CPI603	2857
C600A	1277
CPI621 (PI621C)	929
CP624C	346
CWI525	1614
CPI628	750
C624A	1500
C639A	1550
C524A	1768
C2.8	1776
C2.6	1759
CWI524	1768
CPI639	353
CWI506	3353
CWI500	23515
CPI635	3017
C1.14B	204
C1.15B	217
C1.17B	236
C636	233
C624	549
CPI624	989
CPI633	3339
CPI600	4143

1500 0 1500 3000 4500

SCALE: 1"=3000'

HAPPY VALLEY CHANNEL DCR
HEC 1 RESULTS WO/ BERM

RBF CONSULTING
PLANNING ■ DESIGN ■ CONSTRUCTION
16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
602.467.2200 ■ FAX 602.467.2201 ■ www.RBF.com

LAYOUT	DRAFTED	CHECKED
NEF	DLP	NEF

DRAWING SCALE(S): 1"=3000'

PLAN DATE: DEC/2010

PROJECT NUMBER: 45104030

SHEET NO. 1 OF 1 SHEETS

H:\PDATA\45104030\CADD\STORMWATER\EXHIBITS\4030-SW-HEC1WOBERM-091109.DWG NFORD 12/8/10 11:07 am

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*           VERSION 4.1                *
*                                      *
* RUN DATE   19NOV10  TIME  11:26:32   *
*                                      *
****************************************
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****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104              *
*                                      *
****************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X    X         XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X    X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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1                                    HEC-1 INPUT                                    PAGE  1

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          1           ID   HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
          2           ID   100-YEAR 24-HOUR STORM - HAPPY VALLEY CHANNEL WITHOUT BERM
          3           ID   EXISTING CONDITIONS
          4           ID   ******************************************************************************
          5           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
          6           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
          7           ID   ******************************************************************************
          8           ID   **                                                                          **
          9           ID   **  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY    **
         10           ID   **                                                                          **
         11           ID   ******************************************************************************
         12           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
         13           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
         14           ID   ******************************************************************************
         15           ID   **                                                                          **
         16           ID   ** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS    **
         17           ID   ** DATED OCTOBER 2004:                                                      **
         18           ID   **                                                                          **
         19           ID   **     -Diversion added after CTW480                                        **
         20           ID   **          -Main flow (5%) to CTW478                                       **
         21           ID   **          -Diverted flow (95%) to CWI584                                  **
         22           ID   **          -Added concentration point CWI584 combining RD480 and WI584     **
         23           ID   **          -Hard coding was added to CTW478                                **
         24           ID   **          -Route added after D480 (Diversion Recovery)                    **
         25           ID   **          -Route RWI584 was adjusted                                      **
         26           ID   **          -Storage Route SCP050 was adjusted                              **
         27           ID   **          -Route R508* was adjusted                                       **
         28           ID   **          -Hard coding for CWI510 was adjusted                            **
         29           ID   **                                                                          **
         30           ID   **     -Diversion D618 was moved from after CPI618 to before RDCP12          **
         31           ID   **          -Updated route RD618 information                                **
         32           ID   **          -Hard coding on CPI618 was adjusted                             **
         33           ID   **          -Hard coding on CPI615 was adjusted                             **
         34           ID   **                                                                          **
         35           ID   **     -Route RPI639 changed from following US60 to CPI636 to route         **
         36           ID   **      through US60/RR structures and combine with CWI506                  **
         37           ID   **          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
         38           ID   **           following R624A to follow RWI524                               **
         39           ID   **          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
         40           ID   **          -RPI639 information was changed to reflect new route            **
         41           ID   **          -CWI506 changed from combining 3 to combine 4:                  **
         42           ID   **           RWI525, RWI524, RPI639 & WI506                                 **
         43           ID   **          -Hard coding on CWI506 was adjusted                             **
         44           ID   **          -Hard Coding on CWI500 was adjusted                             **
         45           ID   **                                                                          **
         46           ID   ******************************************************************************
         47           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
         48           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
         49           ID   ******************************************************************************
         50           ID
         51           ID
         52           ID
         53           ID   ******************************************************************************
         54           ID   ******************************************************************************
         55           ID   **                                                                          **
1                                    HEC-1 INPUT                                    PAGE  2

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         56           ID   **    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004        **
         57           ID   **                                                                          **
         58           ID   ******************************************************************************
         59           ID   ******************************************************************************
         60           ID
         61           ID   PROJECT:                Wittmann ADMS Update
         62           ID   CLIENT:                 Flood Control District of Maricopa County
         63           ID   PREPARED BY:            Entellus, Inc.
         64           ID   PROJECT No:             FCD 2002C029              Entellus 310.032
```

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 65          ID   FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
 66          ID                                          MODIFIED DATE: MAY 04, 2005
 67          ID
 68          ID   STORM:
 69          ID                        100-year 24-hour Storm
 70          ID
 71          ID   DEVELOPMENT CONDITIONS:
 72          ID                        Existing Conditions
 73          ID
 74          ID   MODELING ASSUMPTIONS:
 75          ID                        It was assumed that the US60 did not have adequate
 76          ID                        storage to cause any significant attenuation.
 77          ID
 78          ID                        The assumption was made that the CAP Canal embankment
 79          ID                        would not be breached under a large flood event.
 80          ID
 81          ID                        The assumption was made that the Beardsley Canal would
 82          ID                        not fail under a large storm event (Per District
 83          ID                        Instruction).  In addition, the berm north of the
 84          ID                        Beardsley canal and east of US60 was assumed to fail
 85          ID                        (per district Instruction).
 86          ID
 87          ID                        For both the CAP and Beardsley Canals, once the berm
 88          ID                        elevation was reached weir flow was assumed.  It was
 89          ID                        also assumed that any weir flow over the canal that
 90          ID                        might enter the canal and be diverted out of the study
 91          ID                        area was insignificant, and thus was ignored.  In other
 92          ID                        words all weir flow over the canal embankment reaches
 93          ID                        the downstream concentration point.
 94          ID
 95          ID                        Typical X-sects were developed, and it was assumed
 96          ID                        that a typical x-sect could adequately represent
 97          ID                        various reaches.
 98          ID
 99          ID                        Time-Area Relations were used base on the District's
100          ID                        Hydrology Manual criteria.  Two Time-Area Relation
101          ID                        Curves were utilized:
102          ID                                -Urban
103          ID                                -Natural
104          ID                        The Time-Area Relation Curves were taken directly
105          ID                        from the manual
106          ID
107          ID   MODELING METHODS:
108          ID                        This model utilizes QI cards to input the Padelford
109          ID                        hydrographs from the 100-year 6-hour existing
110          ID                        conditions model developed by A-N West Inc. for the
1                                          HEC-1 INPUT                                          PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

111          ID                        Padelford Wash Floodplain Delineation Study.  The
112          ID                        hydrograph was altered from its original form
113          ID                        (2-minute interval to 5-minute interval) through
114          ID                        simple interpolation.
115          ID
116          ID                        Clark Unit Hydrographs were used for all subbasins
117          ID                        except the two subbasins directly upstream of the
118          ID                        Bonita Dam (PD726B and PD740 use S-graphs).  The UC
119          ID                        parameters were calculated using the WMS7.0 software.
120          ID
121          ID                        For Basins PD726B and PD740 S-Graphs were utilized per
122          ID                        the request of the FCDMC.  Limited details regarding
123          ID                        the calculations of the S-graphs can be found in the
124          ID                        model by the basin KK card.  For full details of the
125          ID                        S-graph calculations refer to the Appendix.
126          ID
127          ID                        Normal Depth routing was used for all routing reaches.
128          ID
129          ID                        Hard coding was used to account for the percentage of
130          ID                        area associated with a diversion.  Because of the use
131          ID                        of JD cards and aereal reduction, hard coding  was
132          ID                        necessary to properly account for area.  For a given
133          ID                        diversion a percentage of the flow is routed to two
134          ID                        different locations.  The same percentage of area
135          ID                        follows that diverted flow.  In addition the area
136          ID                        downstream of the main path is reduced or increased and
137          ID                        is hard coded to account for the loss or gain of area.
138          ID                        Hard coding was performed based on the 24-hour existing
139          ID                        conditions model.
140          ID
141          ID                        Stage-storage was developed for all the structures
142          ID                        along the CAP Canal, as well as along the Beardsley
143          ID                        Canal.  In addition several stage-storage locations
144          ID                        were developed for areas with significant storage
145          ID                        along the SR74.  No storage was modeled along the US60
146          ID                        and railroad, but the culverts were analyzed for
147          ID                        diversion potential.  Diversions were placed in the
148          ID                        model where deemed appropriate.  See appendix for
149          ID                        details.
150          ID
151          ID                        FLO-2D was utilized to calculate the split flows at
152          ID                        concentration points CIW351. CIW357, CIW363 and CWI576.
153          ID                        See appendix for modeling details.
154          ID
155          ID   ******************************************************************************
156          ID   ******************************************************************************
157          ID
             *DIAGRAM
158          IT       5                0    1500
159          IO       5
160          IN      15                0
161          JD    4.18    0.01
             * 24-hour distribution
162          PC     0.0   0.002   0.005   0.008   0.011   0.014   0.017    0.02   0.023   0.026
163          PC   0.029   0.032   0.035   0.038   0.041   0.044   0.048   0.052   0.056    0.06
1                                          HEC-1 INPUT                                          PAGE  4
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 164          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 165          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 166          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 167          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 168          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 169          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 170          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 171          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 172          JD   3.929    10.0
 173          JD   3.856    20.0
 174          JD   3.725    40.0
 175          JD   3.599    80.0
 176          JD   3.532   120.0
 177          JD   3.444   200.0
 178          JD   3.385   300.0
 179          JD   3.289   500.0
              *
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP110

 180          KK  DCAP11
 181          BI  DCAP11      22
              *
              *
              * ROUTE UPDATED 4/14/4

 182          KK  RDCP11
 183          RS       5    FLOW     0.0     0.0
 184          RC   0.043   0.035   0.043    6377  0.0094
              * PITS10_2
 185          RX       0      89     103     136     185     206     261     280
 186          RY    1612  1610.5    1610  1608.5    1610    1611  1611.8    1612
              *
              * CAP Diversion Recovery: Outflow from structure CAP120

 187          KK  DCAP12
 188          BI  DCAP12      22
              *
              *
              * Diversion Out: Flow split FS11
              * Flow Split Diversion: Main path to CPI618, Diversion to CPI615
              * 53% of flow is diverted to CPI615

 189          KK    D618
 190          DT   DO618     0.0     0.0
 191          DI       0   10000
 192          DQ       0    5300
              *
              *
              * ROUTE UPDATED 4/14/4
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 193          KK  RDCP12
 194          RS       2    FLOW     0.0     0.0
 195          RC   0.043   0.035   0.043    6159  0.0094
              * PITS30
 196          RX       0      49     199     206     222     231     299     375
 197          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *

 198          KK   PI618
 199          BA  0.2886
 200          LG   0.281   0.235   4.623   0.332    9.32
 201          UC   0.500   0.407
              * Natural Time-Area Relation
 202          UA       0       3       5       8      12      20      43      75      90      96
 203          UA     100
              *
              *
              * Combines PI618, RDCP12 and RDCP11

 204          KK  CPI618
              * Hard Coded
 205          HC       3    5.48
              *
              *
              * ROUTE UPDATED 4/14/04

 206          KK  RPI618
 207          RS       5    FLOW     0.0     0.0
 208          RC   0.043   0.035   0.043   10443  0.0075
              * PITS20
 209          RX       0      50      84      87     123     125     156     285
 210          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP130

 211          KK  DCAP13
 212          BI  DCAP13      22
              *
              *
              * ROUTE UPDATED 4/14/4

 213          KK  RDCP13
 214          RS       6    FLOW     0.0     0.0
 215          RC   0.043   0.035   0.043   11034  0.0089
              * PITS30
```

```
 216          RX       0      49     199     206     222     231     299     375
 217          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                    HEC-1 INPUT                                                    PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 218          KK   PI615
 219          BA  0.8419
 220          LG   0.299   0.243   4.318   0.409   8.997
 221          UC   0.771    0.57
              * Urban Time-Area Relation
 222          UA       0       5      16      30      65      77      84      90      94      97
 223          UA     100
              *
              *
              * Diversion Recovery: Flow split FS11

 224          KK    D618
 225          DR   DO618
              *
              *
              * ROUTE UPDATED 05/04/2005

 226          KK   RD618
 227          RS       5    FLOW     0.0     0.0
 228          RC   0.043   0.035   0.043    9630  0.0091
              * PITS20
 229          RX       0      50      84      87     123     125     156     285
 230          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * Combines RD618, PI615 and RDCP13

 231          KK  CPI615
              * Hard Coded
 232          HC       3    6.21
              *
              *
              * ROUTE UPDATED 4/14/04

 233          KK  RPI615
 234          RS       2    FLOW     0.0     0.0
 235          RC   0.043   0.035   0.043    5109  0.0079
              * PITS20
 236          RX       0      50      84      87     123     125     156     285
 237          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 238          KK   PI612
 239          BA  0.7377
 240          LG   0.337    0.25   4.365     0.4   6.284
 241          UC   0.883   0.770
              * Natural Time-Area Relation
 242          UA       0       3       5       8      12      20      43      75      90      96
 243          UA     100
              *
              *
1                                    HEC-1 INPUT                                                    PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 244          KK  PI624B
 245          KM   OFFSITE SUBBASIN PI624B (North of Jomax Road, upstream of 36" culvert)
 246          BA   0.098
 247          LG   0.433   0.250   4.300   0.531   2.226
 248          UC   0.558   0.644
              * Natural Time-Area Relation
 249          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 250          UA     100
              *
              * Diversion to RX624B - Max Flow in 36" culvert w/4' depth = 47cfs (From DEI)
              *

 251          KK  DO624B
 252          KM   36" CONC CULVERT
 253          DT   D624B
 254          DI       0      47      87     200
 255          DQ       0      47      47      47
              *
              * ROUTE REMAINDER TO CP624D (From DEI)
              *

 256          KK  RX624B
 257          RS       3    FLOW     0.0     0.0
 258          RC   0.043   0.035   0.043    2000   0.006
 259          RX       0       4       8      12      20      24      28      32
 260          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 261          KK  PI624D
 262          KM   OFFSITE SUBBASIN PI624D (North of Jomax Road, upstream of 3-8x4 Box Culvert)
 263          BA   0.323
 264          LG   0.362   0.261   4.449   0.404   4.520
 265          UC   0.783   0.763
              * Natural Time-Area Relation
 266          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 267          UA     100
              * Hard Coded
```

```
268          KK  CP624D
269          HC       2    0.35
             *
             * MAIN FLOW NORTH RESTRICTION @ DESERT OASIS 3-10x4 BC CAPACITY TO DITCH
             * DIVERSION IS TO WASH 5 EAST

270          KK   D624D
271          DT  DO624D
272          DI       0     380     400
273          DQ       0     380     380
             *
             * ROUTING FROM DEI
1                                        HEC-1 INPUT                                                    PAGE  8

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

274          KK  RX624D
275          RS       3    FLOW     0.0     0.0
276          RC   0.043   0.035   0.043    3854   0.006
277          RX       0       4       8      12      20      24      28      32
278          RY    1454    1453    1452    1450    1450    1452    1452    1454
             * COMBINES PI612, RPI618, RPI615, and FLOW FROM NORTH RESTRICTION @ DESERT OASIS

279          KK  CPI612
             * Hard Coded
280          HC       4   12.43
             *
             *
             * Diversion Out: Flow split FS12
             * Flow Split Diversion: Main path to CPI609, Diversion to PI621

281          KK    D612
282          DT   DO612     0.0     0.0
283          DI       0   10000
284          DQ       0    7500
             *
             *
             * ROUTE UPDATED 4/14/04

285          KK  RPI612
286          RS       3    FLOW     0.0     0.0
287          RC   0.043   0.035   0.043    5754   0.006
             * PITS20
288          RX       0      50      84      87     123     125     156     285
289          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             *
             *
             * CAP Diversion Recovery: Outflow from structure CAP140

290          KK  DCAP14
291          BI  DCAP14      22
             *
             *
             * ROUTE UPDATED 4/14/4

292          KK  RDCP14
293          RS      12    FLOW     0.0     0.0
294          RC   0.043   0.035   0.043   20386  0.0086
             * PITS30
295          RX       0      49     199     206     222     231     299     375
296          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *
1                                        HEC-1 INPUT                                                    PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

297          KK   PI609
298          BA  1.9353
299          LG   0.321   0.247   4.529   0.368   8.386
300          UC   1.146   0.915
             * Urban Time-Area Relation
301          UA       0       5      16      30      65      77      84      90      94      97
302          UA     100
             *
             * Diversion Recovery: WASH 5 EAST IN DESERT OASIS

303          KK   D624D
304          DR  DO624D

305          KK  RD624D
306          RS       2    FLOW     0.0     0.0
307          RC   0.043   0.035   0.043    3140   0.008
308          RX       0       4       8      12      27      31      35      39
309          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             * ******************************************************************************
             * DESERT OASIS DEVELOPMENT ******************************************************
             * ******************************************************************************
             *

310          KK  PI624E
311          KM   OFFSITE SUBBASIN PI624E
312          BA   0.257
313          LG    0.25    0.25    4.55   0.419      35
314          UC   0.250   0.121
             * Urban Time-Area Relation
315          UA       0       5      16      30      65      77      84      90      94      97
316          UA     100
             *
             * RETENTION DIVERSION 80% OF REQUIRED 164 acres * 2.85/12 * 0.60 = 23.4 AcreFt
             * USE=18.75 AcreFt
```

```
317          KK  624ERT
318          KO       0       0
319          DT  RET624   18.75
320          DI   10000
321          DQ   10000
             * Hard Coded

322          KK  CP624E
323          HC       2   0.609

324          KK  RD624E
325          RS       3    FLOW     0.0     0.0
326          RC   0.043   0.035   0.043    2793   0.007
327          RX       0       4       8      12      27      31      35      39
328          RY    1454    1453    1452    1450    1450    1452    1452    1454
1                                          HEC-1 INPUT                                                          PAGE 10

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

329          KK  PI624G
330          KM   OFFSITE SUBBASIN PI624G (Undeveloped Desert Oasis Parcel)
331          BA   0.074
332          LG   0.350   0.250   4.550   0.354   5.000
333          UC   0.417   0.375
             * Natural Time-Area Relation
334          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
335          UA     100
             *

336          KK  PI624F
337          KM   OFFSITE SUBBASIN PI624F (Undeveloped Asante)
338          BA   0.060
339          LG   0.350   0.250   4.550   0.354   5.000
340          UC   0.492   0.603
             * Natural Time-Area Relation
341          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
342          UA     100
             *
             * CONCENTRATION POINT @ 163RD Ave Culvert (Wash 5 East)
             *
             * Diversion Recovery: Flow Split D624B (36" Culvert)

343          KK   D624B
344          DR   D624B

345          KK  RD624B
346          RS       8    FLOW     0.0     0.0
347          RC   0.043   0.035   0.043    6800   0.007
348          RX       0     170     195     198     201     204     241     414
349          RY    1434    1432    1430    1428    1428    1430    1432    1434
             *

350          KK  PI624C
351          BA   0.372
352          LG   0.350   0.250   4.692   0.320   5.000
353          UC   0.675   0.515
             * Natural Time-Area Relation
354          UA       0       3       5       8      12      20      43      75      90      96
355          UA     100
             *

356          KK  CP624C
             * Hard Coded
357          HC       2    0.44

358          KK  DO624C
359          KM   Asante Berm Breach
360          DT   D624C
361          DI       0     346
362          DQ       0     235
1                                          HEC-1 INPUT                                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

363          KK  RD624C
364          RS       3    FLOW     0.0     0.0
365          RC   0.043   0.035   0.043    1585  0.0032
366          RX       0    15.8    46.6    52.8    58.5    65.5    67.3    74.1
367          RY  1390.3    1390  1388.6    1388  1386.9    1387    1388    1390
             * Hard Coded

368          KK  CP624G
369          HC       4    0.88

370          KK  DO624G
371          KM   163rd Ave Culvert Flow Split
372          DT   D624G
373          DI       0     409
374          DQ       0      61
             * n value changed to match DEI's HEC-RAS n value

375          KK  RD624G
376          RS       1    FLOW     0.0     0.0
377          RC   0.056   0.025   0.056     442  0.0068
378          RX       0      91      97     103     116     126     139     165
379          RY    1390    1388    1386    1384    1386    1388    1390    1392

380          KK  PI624H
381          KM   OFFSITE SUBBASIN PI624H (Undeveloped Desert Oasis Parcel)
382          BA   0.075
383          LG   0.350   0.250   4.550   0.354   5.000
384          UC   0.521   0.663
             * Natural Time-Area Relation
385          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
```

```
 386          UA     100
              * Hard Coded

 387          KK  CP624H
 388          HC       2    0.83
              * Diversion Out To PI621C
              * Flow Split Diversion: Main path to CP621A

 389          KK   DHVC3
 390          DT  DOHVC3     0.0     0.0
 391          DI       0     405
 392          DQ       0     106
              *
              * n value changed to match DEI's HEC-RAS n value

 393          KK  RD624H
 394          RS       2    FLOW     0.0     0.0
 395          RC   0.056   0.025   0.056    1534  0.0026
 396          RX       0     117     121     126     128     131     134     137
 397          RY    1388    1386    1384    1382    1382    1384    1386    1388
              * Diversion Recovery: Flow split FS12
1                                        HEC-1 INPUT                                                          PAGE 12

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 398          KK    D612
 399          DR   DO612
              *
              *
              * ROUTE UPDATED 4/14/4
              * Length and Slope Updated

 400          KK   RD612
 401          RS       4    FLOW     0.0     0.0
 402          RC   0.043   0.035   0.043    4537  0.0066
              * PITS20
 403          RX       0      50      84      87     123     125     156     285
 404          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *

 405          KK  PI621A
 406          KM   OFFSITE SUBBASIN PI621A
 407          BA   0.167
 408          LG   0.350   0.250   4.550   0.354   5.000
 409          UC   0.608   0.603
              * Natural Time-Area Relation
 410          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 411          UA     100
              *
              * Hard Coded

 412          KK  CP621A
 413          HC       3    10.1
              * Diversion Out To PI621C
              * Flow Split Diversion: Main path to CP621B

 414          KK   DHVC4
 415          DT  DOHVC4     0.0     0.0
 416          DI       0    1317
 417          DQ       0     545
              *
              * n value changed to match DEI's HEC-RAS n value

 418          KK  R621A1
 419          RS       1    FLOW     0.0     0.0
 420          RC   0.056   0.025   0.056    1044  0.0038
 421          RX       0     213     228     242     256     265     267     269
 422          RY    1384    1382    1380    1378    1378    1380    1382    1384
              * Diversion Out To PI621C
              * Flow Split Diversion: Main path to CP621B

 423          KK   DHVC5
 424          DT  DOHVC5     0.0     0.0
 425          DI       0     772
 426          DQ       0     176
              *
              * n value changed to match DEI's HEC-RAS n value
1                                        HEC-1 INPUT                                                          PAGE 13

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 427          KK  R621A2
 428          RS       1    FLOW     0.0     0.0
 429          RC   0.056   0.025   0.056     543  0.0038
 430          RX       0     213     228     242     256     265     267     269
 431          RY    1384    1382    1380    1378    1378    1380    1382    1384
              *

 432          KK  PI621B
 433          KM   OFFSITE SUBBASIN PI621B
 434          BA   0.035
 435          LG   0.350   0.250   4.550   0.354   5.000
 436          UC   0.362   0.427
              * Natural Time-Area Relation
 437          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 438          UA     100
              * Hard Coded

 439          KK  CP621B
 440          HC       2    4.61
              * n value changed to match DEI's HEC-RAS n value

 441          KK  RD621B
 442          RS       1    FLOW     0.0     0.0
```

```
443          RC   0.056   0.025   0.056     342  0.0038
444          RX       0     213     228     242     256     265     267     269
445          RY    1384    1382    1380    1378    1378    1380    1382    1384
             * Combines RPI612, RDCP14, PI609, RD621B
             * Hard Coded

446          KK  CPI609
447          HC       4   12.71
             *
             *
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A

448          KK   DHVC1
449          DT  DOHVC1     0.0     0.0
450          DI       0    1740
451          DQ       0     899
             *
             * ROUTE UPDATED 4/14/04
             * n value changed to match DEI's HEC-RAS n value

452          KK  RPI609
453          RS       2    FLOW     0.0     0.0
454          RC   0.056   0.025   0.056    2822  0.0062
             * PITS40
455          RX       0       7      14      27      61      79      97     113
456          RY    1370    1368    1366    1364    1364    1366    1368    1370
             *
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A
1                                          HEC-1 INPUT                                                    PAGE 14

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

457          KK   DHVC2
458          DT  DOHVC2     0.0     0.0
459          DI       0     841
460          DQ       0     331
             *
             * ROUTE UPDATED 4/14/04
             * Length, Slope, and Cross Section Updated
             * n value changed to match DEI's HEC-RAS n value

461          KK  R6092N
462          RS       3    FLOW     0.0     0.0
463          RC   0.056   0.025   0.056    2449  0.0038
464          RX       0      44      72      85     129     139     145     152
465          RY    1374    1372    1370    1368    1368    1370    1372    1374
             *

466          KK  DCAP15
467          BI  RDCP15      22
             * ROUTE UPDATED 4/14/4

468          KK  RDCP15
469          RS       6    FLOW     0.0     0.0
470          RC   0.043   0.035   0.043    9602  0.0106
             * PITS30
471          RX       0      49     199     206     222     231     299     375
472          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *

473          KK  PI606A
474          BA  0.4572
475          LG   0.308   0.245   4.449   0.378  10.151
476          UC   0.667   0.586
             * Natural Time-Area Relation
477          UA       0       3       5       8      12      20      43      75      90      96
478          UA     100
             *
             *
             * COMBINES BASIN PI606A, RDCP15

479          KK   C606A
             * Hard Coded
480          HC       2    4.08
             *
             *
             * Diversion Out: Flow split FS14
             * Flow Split Diversion: Main path to CPI606, Diversion to CPI604
             * 41% of flow is diverted to CPI604
1                                          HEC-1 INPUT                                                    PAGE 15

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

481          KK   D606A
482          DT  DO606A     0.0     0.0
483          DI       0   10000
484          DQ       0    4100
             *
             *
             * ROUTE UPDATED 4/14/4

485          KK   R606A
486          RS       7    FLOW     0.0     0.0
487          RC   0.043   0.035   0.043   12583  0.0081
             * PDTS30
488          RX       0      47     318     322     356     364     463     604
489          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *

490          KK   PI606
```

```
491          BA  1.0765
492          LG   0.324    0.25   4.383   0.419  10.725
493          UC   0.879   0.635
             * Urban Time-Area Relation
494          UA       0       5      16      30      65      77      84      90      94      97
495          UA     100
             *
             *
             * COMBINES BASIN PI606, R606A, AND RPI6092N

496          KK  CPI606
             * Hard Coded
497          HC       3    7.22
             *
             *
             * ROUTE UPDATED 4/14/04

498          KK  RPI606
499          RS       3    FLOW     0.0     0.0
500          RC   0.043   0.035   0.043    2654  0.0055
             * TSR606
501          RX       0     241     598     949    1098    1381    2002    2039
502          RY    1354    1354    1350    1348    1348    1350    1352    1354
             *
             *

503          KK   PI604
504          BA  0.3628
505          LG   0.307    0.25    4.97   0.285  22.848
506          UC   0.688   0.579
             * Urban Time-Area Relation
507          UA       0       5      16      30      65      77      84      90      94      97
508          UA     100
             *
             *
             * Diversion Recovery: Flow split FS14
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

509          KK   D606A
510          DR  DO606A
             *
             *
             * ROUTE UDPATED 4/14/4

511          KK  RD606A
512          RS       6    FLOW     0.0     0.0
513          RC   0.043   0.035   0.043    7507  0.0087
             * PITS30
514          RX       0      49     199     206     222     231     299     375
515          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *
             * Combines RD606A and PI604

516          KK  CPI604
             * Hard Coded
517          HC       2    2.03
             *
             *
             * ROUTE UPDATED 4/14/04

518          KK  RPI604
519          RS       4    FLOW     0.0     0.0
520          RC   0.043   0.035   0.043    7442   0.007
             * PDTS30
521          RX       0      47     318     322     356     364     463     604
522          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *

523          KK   PD744
524          BA  0.7975
525          LG   0.342   0.249   4.427   0.357   5.989
526          UC   0.908   0.725
             * Natural Time-Area Relation
527          UA       0       3       5       8      12      20      43      75      90      96
528          UA     100
             *
             *Diversion Recovery

529          KK  DHVC1
530          DR  DOHVC1

531          KK  RDHVC1
532          RS       3    FLOW     0.0     0.0
533          RC   0.043   0.035   0.043    3750  0.0069
             * PITS40
534          RX       0       7      14      27      61      79      97     113
535          RY    1370    1368    1366    1364    1364    1366    1368    1370
             *
             *Diversion Recovery
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

536          KK  DHVC2
537          DR  DOHVC2

538          KK  RDHVC2
539          RS       3    FLOW     0.0     0.0
540          RC   0.043   0.035   0.043    3091  0.0065
             * PITS40
```

```
541          RX       0       7      14      27      61      79      97     113
542          RY    1370    1368    1366    1364    1364    1366    1368    1370
             *

543          KK  PI600A
544          BA  0.5202
545          LG   0.345   0.246   5.184   0.252   4.929
546          UC    0.45   0.205
             * Natural Time-Area Relation
547          UA       0       3       5       8      12      20      43      75      90      96
548          UA     100
             * Hard Coded

549          KK   C600A
550          HC       3    9.50
             * ROUTE UPDATED 4/14/4

551          KK  RD600A
552          RS       6    FLOW     0.0     0.0
553          RC   0.043   0.035   0.043    4775  0.0013
             * TSBEAR
554          RX       0      25      30      35      60     110     460     600
555          RY    1344    1344    1342    1340    1340    1342    1344    1345
             *
             *

556          KK   PI603
557          BA  0.5190
558          LG   0.344    0.25    4.66   0.316   7.957
559          UC   0.738   0.615
             * Natural Time-Area Relation
560          UA       0       3       5       8      12      20      43      75      90      96
561          UA     100
             *
             *
             * COMBINES RD600A, RPI606, RPI604, PD744 AND PI603

562          KK  CPI603
563          HC       5
             *
             *
             *
             * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
             * *** This storage includes the storage at basins PI603, PI600A and PD744
             * *** The Discharge represents the Discharge through the Beardsley Canal
             * *** structure as well as the weir flow across PI603, PI600A and PD744,
             * *** so the SQ card can be calculated by adding the flows for basins PI603
             * *** and PD744 as found in the appendix.
             * *** The Weir flow across PD744 is diverted out on the next KK card.
             * *** The weir flow for Basin PI600A is not diverted, because both
             * *** flows (from PI600A and PI603) go to CPI600.
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

564          KK  SPI603
565          RS       1    STOR       0
566          SQ       0     309     874    1605    2471    3453    4539   14797   33095   56636
567          SQ   84417
568          SE    1338    1339    1340    1341    1342    1343    1344  1344.5    1345  1345.5
569          SE    1346
             *
570          SA       0    0.48    5.26   27.16  105.96  105.98     106
571          SE    1336    1338    1340    1342    1344    1345    1346
             *
             *
             * This diversion is only weir flow across the boundary of Basin PD744
             * over the Beardsley Canal to CPD720.  This Diversion is being combined
             * with CPD726 and they are routed together.
             *
             * For overtopping of the berm, the Weir equation was used.
             * Q=C*L*H^1.5
             * C was assumed to be 2.7
             * L, the length of the weir was the basin boundary along the canal = 3652 ft
             * Berm Elevation was 1344
             * *** The remaing flow goes to CPI600 ***

572          KK    D744
573          DT   DO744     0.0     0.0
574          DI       0     309     874    1605    2471    3453    4539   14797   33095   56636
575          DI   84417
576          DQ       0       0       0       0       0       0       0    3486    9860   18115
577          DQ   27889
             *

578          KK  CWI504
579          BI  CWI504      22
             * ROUTE UPDATED 4/14/04

580          KK  RWI504
581          RS       1    FLOW     0.0     0.0
582          RC   0.045   0.035   0.045    1494   0.001
             * McMicken Dam Channel
583          RX       0      46     101     121     171     181    1421    3621
584          RY      25      14       4       0       0       4      14      25
             *

585          KK  CWI508
586          BI  CWI508      22
             *
             * Diversion Out: Flow split FS10
             * Flow Split Diversion: Main path to CWI510, Diversion to CWI500
             * 19% of flow is diverted to CWI500
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 587          KK    D508
 588          DT   DO508     0.0     0.0
 589          DI       0   10000
 590          DQ       0    1900
              *
              *

 591          KK  WI510A
 592          BA  1.1293
 593          LG   0.337    0.26   4.622   0.338   5.191
 594          UC   0.813   0.521
              * Natural Time-Area Relation
 595          UA       0       3       5       8      12      20      43      75      90      96
 596          UA     100
              *
              *
              * ROUTE UPDATED 4/14/4

 597          KK   R510A
 598          RS       8    FLOW     0.0     0.0
 599          RC    0.04    0.04    0.04   17257  0.0051
              * WITS70
 600          RX       0     450     700    1284    1435    1499    1745    2500
 601          RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
              *
              *

 602          KK   WI510
 603          BA  1.2273
 604          LG   0.339   0.274   5.732   0.204   5.364
 605          UC   1.313   1.287
              * Natural Time-Area Relation
 606          UA       0       3       5       8      12      20      43      75      90      96
 607          UA     100
              *
              *
              * COMBINES CWI508, WI510 AND R510A

 608          KK  CWI510
              * Hard Coded
 609          HC       3   35.84
              *
              *
              * ROUTE UPDATED 4/14/04

 610          KK  RWI510
 611          RS       2    FLOW     0.0     0.0
 612          RC    0.04    0.04    0.04    6492  0.0048
              * WITS70
 613          RX       0     450     700    1284    1435    1499    1745    2500
 614          RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
              *
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 615          KK   WI502
 616          BA  1.2082
 617          LG   0.344   0.251   5.448   0.229   6.516
 618          UC   1.179   1.004
              * Natural Time-Area Relation
 619          UA       0       3       5       8      12      20      43      75      90      96
 620          UA     100
              *
              *
              * COMBINES WI502, RWI510 AND RWI504

 621          KK  CWI502
 622          HC       3
              *
              *
              * ROUTE UPDATED 4/14/04

 623          KK  RWI502
 624          RS       1    FLOW     0.0     0.0
 625          RC   0.045   0.035   0.045    1679  0.0026
              * McMicken Dam Channel
 626          RX       0      46     101     121     171     181    1421    3621
 627          RY      25      14       4       0       0       4      14      25
              *

 628          KK  CWI525
 629          BI  CWI525      22
              *
              * Railroad Diversion: Main path to CWI506, Diversion to CWI524
              * From Structure RR630 and RR640, See Appendix D.5 for analysis

 630          KK    D525
 631          DT   DO525     0.0     0.0
 632          DI       0     269     463     699     969
 633          DQ       0       0       9      26      48
              *
              *
              * ROUTE UPDATED 4/14/04

 634          KK  RWI525
 635          RS       6    FLOW     0.0     0.0
 636          RC   0.043   0.035   0.043   11015  0.0064
              * WITS130
 637          RX       0     400     456     575     620     650     660     682
 638          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
```

```
                 *
                 * CAP Diversion Recovery: Outflow from structure CAP100

 639             KK  DCAP10
 640             BI  DCAP10      22
                 *
                 *
                 * ROUTE UPDATED 4/14/4
1                                          HEC-1 INPUT                                                    PAGE 21

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 641             KK  RDCP10
 642             RS       4    FLOW     0.0     0.0
 643             RC   0.043   0.035   0.043    6701  0.0081
                 * WITS120
 644             RX       0     100     292     409     492     567     718     886
 645             RY    1511    1510  1509.5  1507.5    1506    1509  1510.5    1511
                 *
                 *

 646             KK   PI628
 647             BA  0.5695
 648             LG   0.285    0.25    4.56   0.349   8.902
 649             UC   0.538   0.316
                 * Natural Time-Area Relation
 650             UA       0       3       5       8      12      20      43      75      90      96
 651             UA     100
                 *
                 *
                 * Combines PI628 and RDCP10

 652             KK  CPI628
                 * Hard Coded
 653             HC       2    4.11
                 *
                 *
                 * ROUTE UPDATED 10/25/10

 654             KK  RPI628
 655             RS       6    FLOW     0.0     0.0
 656             RC   0.043   0.035   0.043    7825  0.0077
                 * PITS20
 657             RX       0      50      84      87     123     125     156     285
 658             RY    1454    1453    1452    1450    1450    1452    1452    1454
                 *
                 *

 659             KK  PI624A
 660             BA   1.306
 661             LG    0.34    0.34    4.55    0.35       3
 662             UC   0.861   0.562
                 * Natural Time-Area Relation
 663             UA       0       3       5       8      12      20      43      75      90      96
 664             UA     100
                 *
                 *
                 * COMBINES RPI628 AND PI624A

 665             KK   C624A
 666             HC       2
                 *
                 *
                 * Asante Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)
1                                          HEC-1 INPUT                                                    PAGE 22

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 667             KK   R624A
 668             RS       1    FLOW     0.0     0.0
 669             RC   0.035   0.035   0.035     680  0.0050
 670             RX       0       4      50      62     122     134     180     184
 671             RY       4       3       3       0       0       3       3       4
                 *

 672             KK  PI639A
 673             BA   0.095
 674             LG    0.35    0.35    4.50    0.35       0
 675             UC   0.554   0.527
                 * Natural Time-Area Relation
 676             UA       0       3       5       8      12      20      43      75      90      96
 677             UA     100
                 *
                 * COMBINES R624A AND PI639A

 678             KK   C639A
 679             HC       2
                 * Asante Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)

 680             KK   R639A
 681             RS       2    FLOW     0.0     0.0
 682             RC   0.043   0.035   0.043    3360  0.0050
 683             RX       0       4      50      62     122     134     180     184
 684             RY       4       3       3       0       0       3       3       4
                 *

 685             KK  WI524A
 686             BA   0.599
 687             LG    0.35    0.35    4.40    0.37       0
 688             UC   0.758   0.517
                 * Natural Time-Area Relation
 689             UA       0       3       5       8      12      20      43      75      90      96
```

```
690          UA      100
             *
             *
             * Railroad Diversion Recovery: Outflow from structure RR630

691          KK     D525
692          DR    DO525
             *
             *
             * ROUTE UPDATED 4/14/4

693          KK    RD525
694          RS        6     FLOW      0.0      0.0
695          RC    0.043    0.035    0.043     6496   0.0065
             * WITS130
696          RX        0      400      456      575      620      650      660      682
697          RY   1396.5     1394   1393.5     1393     1392     1394     1395   1396.5
             *
             *
             * Combines RD525, WI524, AND R639A
1                                          HEC-1 INPUT                                                    PAGE 23

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

698          KK    C524A
             * Hard Coded
699          HC        3     6.67
             *
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

700          KK    R524A
701          RS        1     FLOW      0.0      0.0
702          RC    0.035    0.035    0.035     1025   0.0050
703          RX        0       12       18       24      117      123      129      141
704          RY        4        2        1        0        0        1        2        4
             *
             * ASANTE DATA OBTAINED FROM DEI DRAINAGE REPORT

705          KK      2.8
706          BA   0.0792
707          LG     0.25     0.25     5.70     0.24       35
708          UC    0.280    0.180
             * Urban Time-Area Relation
709          UA        0        5       16       30       65       77       84       90       94       97
710          UA      100

711          KK     C2.8
712          HC        2
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

713          KK     R2.8
714          RS        1     FLOW      0.0      0.0
715          RC    0.035    0.035    0.035     1810   0.0050
716          RX        0       12       18       24      117      123      129      141
717          RY        4        2        1        0        0        1        2        4
             * UNDEVELOPED ASANTE PHASE 3

718          KK       3A
719          BA    0.046
720          LG     0.35     0.35     4.60     0.33        0
721          UC    0.387    0.285
             * Natural Time-Area Relation
722          UA        0        3        5        8       12       20       43       75       90       96
723          UA      100
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

724          KK     R3A
725          RS        1     FLOW      0.0      0.0
726          RC    0.035    0.035    0.035      995   0.0050
727          RX        0        4        8       12       32       36       40       44
728          RY        3        2        1        0        0        1        2        3
             *
1                                          HEC-1 INPUT                                                    PAGE 24

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

729          KK     2.11
730          BA   0.0350
731          LG     0.25     0.25     4.65     0.38       35
732          UC    0.212    0.124
             * Urban Time-Area Relation
733          UA        0        5       16       30       65       77       84       90       94       97
734          UA      100
             * COMBINES UNDEVELOPED PARCEL 3 AND 2.11

735          KK    C2.11
736          HC        2
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

737          KK    R2.11
738          RS        1     FLOW      0.0      0.0
739          RC    0.035    0.035    0.035     1000   0.0070
740          RX        0        4        8       12       32       36       40       44
741          RY        3        2        1        0        0        1        2        3
             *

742          KK     2.10
743          BA   0.0675
744          LG     0.25     0.25     5.00     0.32       35
```

```
745          UC   0.309   0.254
             * Urban Time-Area Relation
746          UA       0       5      16      30      65      77      84      90      94      97
747          UA     100
             * FROM DEI

748          KK   S2.10
749          RS       1    STOR       0
750          SQ       0       0       0    14.2    92.8
751          SE       0       1     1.6       2       3
752          SV       0    1.36    3.28    5.83
753          SE       0       1       2       3
             *

754          KK     2.7
755          BA  0.1104
756          LG    0.25    0.25    5.30    0.28      35
757          UC   0.224   0.094
             * Urban Time-Area Relation
758          UA       0       5      16      30      65      77      84      90      94      97
759          UA     100
             *

760          KK     2.4
761          BA  0.0659
762          LG    0.25    0.25    4.55    0.41      35
763          UC   0.327   0.270
             * Urban Time-Area Relation
764          UA       0       5      16      30      65      77      84      90      94      97
765          UA     100
             * FROM DEI
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

766          KK    S2.4
767          RS       1    STOR       0
768          SQ       0    6.85   23.26   40.68   51.06   392.0
769          SE       0       1       2       3       4       5
770          SV       0    0.36    0.82    1.37    1.40    1.40
771          SE       0       1       2       3       4       5
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

772          KK    R2.4
773          RS       1    FLOW     0.0     0.0
774          RC   0.035   0.035   0.035     400  0.0080
775          RX       0       4       8      12      22      26      30      34
776          RY       3       2       1       0       0       1       2       3
             * COMBINES R2.4, 2.7, S2.10, AND R2.11

777          KK    C2.7
778          HC       4
             *

779          KK    S2.7
780          RS       1    STOR       0
781          SQ       0       1       1       1
782          SE       0       1     2.5       3
783          SV       0    8.63   18.42   29.32
784          SE       0       1       2       3
             * COMBINES S2.7 AND R2.8

785          KK    C2.6
786          HC       2
             * ASANTE CHANNEL FROM DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

787          KK    R2.6
788          RS       1    FLOW     0.0     0.0
789          RC   0.035   0.035   0.035    1700  0.0050
790          RX       0      12      18      24     117     123     129     141
791          RY       4       2       1       0       0       1       2       4
             *

792          KK     2.5
793          BA  0.0933
794          LG    0.25    0.25    5.10    0.31      35
795          UC   0.313   0.241
             * Urban Time-Area Relation
796          UA       0       5      16      30      65      77      84      90      94      97
797          UA     100
             * COMBINES 2.5 AND C2.6
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

798          KK  CWI524
799          HC       2
             *
             * Railroad Diversion: Main path to CWI506, Diversion to CPI639
             * From Structure RR650, See Appendix D.5 for analysis

800          KK    D524
801          DT   DO524     0.0     0.0
802          DI       0     595     906    1295    1748
803          DQ       0       0      38     119     230
             * ROUTE UPDATED 4/14/04

804          KK  RWI524
805          RS       2    FLOW     0.0     0.0
806          RC   0.043   0.035   0.043    4526  0.0062
             * WITS130
```

```
807          RX       0     400     456     575     620     650     660     682
808          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             * UNDEVELOPED PORTION OF PHASE 4

809          KK      4A
810          BA   0.185
811          LG    0.35    0.35    4.55    0.34       0
812          UC   0.621   0.486
             * Natural Time-Area Relation
813          UA       0       3       5       8      12      20      43      75      90      96
814          UA     100
             *
             * CHANNEL FROM DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

815          KK     R4A
816          RS       2    FLOW     0.0     0.0
817          RC   0.035   0.035   0.035    2160  0.0055
818          RX       0       4       8      12      32      36      40      44
819          RY       3       2       1       0       0       1       2       3
             *

820          KK     2.1
821          BA  0.1365
822          LG    0.25    0.25    4.55    0.41      35
823          UC   0.352   0.259
             * Urban Time-Area Relation
824          UA       0       5      16      30      65      77      84      90      94      97
825          UA     100
             * COMBINES UNDEVELOPED 4A AND 2.1

826          KK    C2.1
827          HC       2
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

828          KK    S2.1
829          RS       1    STOR       0
830          SQ       0    98.9   279.5   513.3   592.2
831          SE       0       1       2       3     3.3
832          SV       0    0.33    0.66    1.00    1.10
833          SE       0       1       2       3     3.3
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 40 ft)

834          KK    R2.1
835          RS       2    FLOW     0.0     0.0
836          RC   0.035   0.035   0.035    2310  0.0035
837          RX       0       4       8      12      52      56      60      64
838          RY       3       2       1       0       0       1       2       3
             *

839          KK    1.11
840          BA  0.1290
841          LG    0.25    0.25    4.90    0.34      35
842          UC   0.369   0.244
             * Urban Time-Area Relation
843          UA       0       5      16      30      65      77      84      90      94      97
844          UA     100
             *

845          KK    D524
846          DR   DO524
             * ASANTE Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

847          KK   RD524
848          RS       1    FLOW     0.0     0.0
849          RC   0.035   0.035   0.035    2040  0.0050
850          RX       0      12      18      24     117     123     129     141
851          RY       4       2       1       0       0       1       2       4
             * COMBINES RD524, 1.11, AND R2.1

852          KK  CPI639
853          HC       3    1.34
             *
             * ROUTE UPDATED 05/04/2005

854          KK  RPI639
855          RS       2    FLOW     0.0     0.0
856          RC   0.043   0.035   0.043    2635  0.0061
             * WITS130
857          RX       0     400     456     575     620     650     660     682
858          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

859          KK   WI506
860          BA  1.5757
861          LG   0.326    0.25   5.331   0.254  10.467
862          UC   1.083   0.781
             * Urban Time-Area Relation
863          UA       0       5      16      30      65      77      84      90      94      97
864          UA     100
             *

865          KK  CWI506
866          HC       4   17.54
             *
```

```
            * Diversion Recovery: Flow split FS10
867         KK    D508
868         DR   DO508
            *
            *
            * ROUTE UPDATED 4/14/4

869         KK   RD508
870         RS       2    FLOW     0.0     0.0
871         RC    0.04    0.04    0.04    5200  0.0065
            * WITS70
872         RX       0     450     700    1284    1435    1499    1745    2500
873         RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
            *
            *

874         KK   WI500
875         BA  1.0487
876         LG   0.349    0.25   5.521   0.224   5.124
877         UC   0.979   0.695
            * Natural Time-Area Relation
878         UA       0       3       5       8      12      20      43      75      90      96
879         UA     100
            *
            *
            * COMBINES WI500, RD508, RWI506 AND RWI502

880         KK  CWI500
            * Hard Coded
881         HC       4  227.89
            *
            *
            * STORAGE AT MCMICKEN DAM SPILLWAY
            *
            *
1                                          HEC-1 INPUT                                                    PAGE 29
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

882         KK  SSPILL
883         KM   MCMICKEN DAM OUTLET AND SPILLWAY RATING CURVES USED HERE
884         RS       1    STOR       0       0
885         SV       0    1370    5505   17501   20816   25623   30850   36661   38754   39849
886         SQ       0     675     810    4080    4325   21150   47400   81650   93160   99300
887         SE    1335    1340    1345  1352.5 1353.65 1355.65 1357.65 1359.65 1360.35  1360.7
888         ST  1360.7   12775    3.05     1.5
            *
            *
            * ROUTE UPDATED 4/14/04

889         KK  RWI500
890         RS       3    FLOW     0.0     0.0
891         RC   0.045   0.035   0.045    5659   0.001
            * McMicken Dam Channel
892         RX       0      46     101     121     171     181    1421    3621
893         RY      25      14       4       0       0       4      14      25
            *

894         KK   PI635
895         BA  0.6106
896         LG    0.29    0.27   5.391   0.237  15.959
897         UC   0.683   0.465
            * Natural Time-Area Relation
898         UA       0       3       5       8      12      20      43      75      90      96
899         UA     100
            *
            *
            * COMBINES PI635 AND RWI500

900         KK  CPI635
901         HC       2
            *
            * ROUTE UPDATED 4/14/04

902         KK  RPI635
903         RS       6    FLOW     0.0     0.0
904         RC   0.045   0.035   0.045    7557   0.001
            * McMicken Dam Channel
905         RX       0      46     101     121     171     181    1421    3621
906         RY      25      14       4       0       0       4      14      25
            *
            *

907         KK  PI621C
908         BA   0.701
909         LG   0.345   0.248   4.650   0.332   5.378
910         UC   0.621   0.305
            * Natural Time-Area Relation
911         UA       0       3       5       8      12      20      43      75      90      96
912         UA     100
            *
            * Diversion Recovery
1                                          HEC-1 INPUT                                                    PAGE 30
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

913         KK   DHVC3
914         DR  DOHVC3
            *
            *

915         KK  RDHVC3
916         RS       8    FLOW     0.0     0.0
```

```
917     RC   0.043   0.035   0.043    6823  0.0073
        * PITS40
918     RX       0       7      14      27      61      79      97     113
919     RY    1370    1368    1366    1364    1364    1366    1368    1370
        *
        *
        * Diversion Recovery

920     KK   DHVC4
921     DR  DOHVC4
        *
        *

922     KK  RDHVC4
923     RS       8    FLOW     0.0     0.0
924     RC   0.043   0.035   0.043    6229  0.0064
        * PITS40
925     RX       0       7      14      27      61      79      97     113
926     RY    1370    1368    1366    1364    1364    1366    1368    1370
        *
        *
        * Diversion Recovery

927     KK   DHVC5
928     DR  DOHVC5
        *
        *

929     KK  RDHVC5
930     RS       8    FLOW     0.0     0.0
931     RC   0.043   0.035   0.043    5105  0.0074
        * PITS40
932     RX       0       7      14      27      61      79      97     113
933     RY    1370    1368    1366    1364    1364    1366    1368    1370
        *
        *
        * COMBINES BASIN PI621C, RDHVC3, RDHVC4, AND RDHVC5

934     KK  CPI621
        * Hard Coded
935     HC       4    6.45
        *
        *
        * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
        * Berm Elevation = 1342
        * The storage behind this basin is contained, and does not flow to a siphon
        * For overtopping of the berm, the Weir equation was used.
        * Q=C*L*H^1.5
        * C was assumed to be 2.7
        * L, the length of the weir was the basin boundary along the canal = 3107 ft
```



```
LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

936     KK  SPI621
937     RS       1    STOR       0
938     SQ       0       0       0       0    2966    8389   15411   23727
939     SA       0    0.10    1.69   21.17   21.18   21.19   21.20   12.21
940     SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
        *
        *
        * ROUTE UPDATED 4/14/04

941     KK  RPI621
942     RS       1    FLOW     0.0     0.0
943     RC   0.043   0.035   0.043    2775  0.0079
        * TSR621
944     RX       0      20      32      79     118     139     374     400
945     RY    1344    1343    1342    1342    1340    1342    1344    1344
        *
        *

946     KK   PI633
947     BA  0.3359
948     LG   0.329   0.235   5.231   0.248   4.696
949     UC   0.708   0.635
        * Natural Time-Area Relation
950     UA       0       3       5       8      12      20      43      75      90      96
951     UA     100
        *
        *
        *

952     KK     1.8
953     BA  0.0176
954     LG    0.25    0.25    4.55    0.41      35
955     UC   0.178   0.136
        * Urban Time-Area Relation
956     UA       0       5      16      30      65      77      84      90      94      97
957     UA     100
        *

958     KK    S1.8
959     RS       1    STOR       0
960     SQ       0       0       0    47.8
961     SE  1369.0  1370.0  1371.1  1372.0
962     SV       0    0.20    0.50    0.93
963     SE  1369.0  1370.0  1371.0  1372.0
        *

964     KK     1.7
965     BA  0.0677
966     LG    0.25    0.25    5.20    0.29      35
967     UC   0.306   0.198
        * Urban Time-Area Relation
```

```
 968          UA       0       5      16      30      65      77      84      90      94      97
 969          UA     100
              *
1                                          HEC-1 INPUT                                                PAGE 32

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 970          KK    1.5A
 971          BA  0.0138
 972          LG    0.25    0.25    5.00    0.32      35
 973          UC   0.211   0.182
              * Urban Time-Area Relation
 974          UA       0       5      16      30      65      77      84      90      94      97
 975          UA     100
              * COMBINES 1.7, 1.5A, AND S1.8

 976          KK    C1.7
 977          HC       3
              *

 978          KK    S1.7
 979          RS       1    STOR       0
 980          SQ       0       0    61.6   174.2
 981          SE  1366.0  1367.0  1368.0  1369.0
 982          SV       0    1.81    3.78    6.09
 983          SE  1366.0  1367.0  1368.0  1369.0
              *

 984          KK     1.9
 985          BA  0.0723
 986          LG    0.25    0.25    4.55    0.41      35
 987          UC   0.330   0.251
              * Urban Time-Area Relation
 988          UA       0       5      16      30      65      77      84      90      94      97
 989          UA     100
              *

 990          KK     1.6
 991          BA  0.0450
 992          LG    0.25    0.25    4.55    0.41      35
 993          UC   0.279   0.173
              * Urban Time-Area Relation
 994          UA       0       5      16      30      65      77      84      90      94      97
 995          UA     100
              * COMBINES 1.9, 1.6, AND S1.7

 996          KK    C1.6
 997          HC       3
              *

 998          KK    S1.6
 999          RS       1    STOR       0
1000          SQ       0    65.9   186.4   342.2   431.3
1001          SE  1366.0  1367.0  1368.0  1369.0  1369.5
1002          SV       0    1.27    2.73    4.41    4.41
1003          SE  1366.0  1367.0  1368.0  1369.0  1369.5
              *
1                                          HEC-1 INPUT                                                PAGE 33

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1004          KK    1.10
1005          BA  0.0224
1006          LG    0.25    0.25    4.55    0.41      35
1007          UC   0.161   0.113
              * Urban Time-Area Relation
1008          UA       0       5      16      30      65      77      84      90      94      97
1009          UA     100
              * STREET SECTION

1010          KK   R1.10
1011          RS       2    FLOW     0.0     0.0
1012          RC   0.015   0.015   0.015    1700  0.0053
1013          RX       0    0.10   38.94   39.04   64.20   64.30  103.24  103.34
1014          RY       2       0    0.78    1.28    1.28    0.78       0       2
              *

1015          KK   1.13A
1016          BA  0.0279
1017          LG    0.25    0.25    4.55    0.41      35
1018          UC   0.213   0.152
              * Urban Time-Area Relation
1019          UA       0       5      16      30      65      77      84      90      94      97
1020          UA     100
              *

1021          KK   1.14A
1022          BA  0.0381
1023          LG    0.25    0.25    4.50    0.42      35
1024          UC   0.306   0.244
              * Urban Time-Area Relation
1025          UA       0       5      16      30      65      77      84      90      94      97
1026          UA     100
              * COMBINES 1.14A, 1.13A, R1.10, AND S4.11

1027          KK  C1.14A
1028          HC       4
              *

1029          KK  S1.14A
1030          RS       1    STOR       0
1031          SQ       0       0       0   316.8
1032          SE       0     1.0     2.5     3.0
1033          SV       0    6.64   13.49   20.53
```

```
1034        SE       0     1.0     2.5     3.0
            *

1035        KK   1.13B
1036        BA  0.0252
1037        LG    0.25    0.25    5.10    0.31      35
1038        UC   0.308   0.329
            * Urban Time-Area Relation
1039        UA       0       5      16      30      65      77      84      90      94      97
1040        UA     100
            * ASANTE Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)
1                                          HEC-1 INPUT                                          PAGE 34

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1041        KK  R1.13B
1042        RS       2    FLOW     0.0     0.0
1043        RC   0.035   0.035   0.035    1200  0.0050
1044        RX       0       6      12      18     111     117     123     129
1045        RY       3       2       1       0       0       1       2       3
            *

1046        KK   1.14B
1047        BA  0.0315
1048        LG    0.25    0.23    6.20    0.20      35
1049        UC   0.274   0.239
            * Urban Time-Area Relation
1050        UA       0       5      16      30      65      77      84      90      94      97
1051        UA     100
            * COMBINES 1.14B, R1.13B, AND S1.14A

1052        KK  C1.14B
1053        HC       3
            * ASANTE Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1054        KK  R1.14B
1055        RS       1    FLOW     0.0     0.0
1056        RC   0.035   0.035   0.035     820  0.0050
1057        RX       0       6      12      18     111     117     123     129
1058        RY       3       2       1       0       0       1       2       3
            *

1059        KK   1.16A
1060        BA  0.0265
1061        LG    0.25    0.25    4.50    0.42      35
1062        UC   0.181   0.120
            * Urban Time-Area Relation
1063        UA       0       5      16      30      65      77      84      90      94      97
1064        UA     100
            *

1065        KK  S1.16A
1066        RS       1    STOR       0
1067        SQ       0       0       0    17.2
1068        SE       0     1.0     2.0     3.0
1069        SV       0    0.92    1.91    2.98
1070        SE       0     1.0     2.0     3.0
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1071        KK  R1.16A
1072        RS       2    FLOW     0.0     0.0
1073        RC   0.035   0.035   0.035     590  0.0014
1074        RX       0       4       8      12      22      26      30      34
1075        RY       3       2       1       0       0       1       2       3
            *
1                                          HEC-1 INPUT                                          PAGE 35

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1076        KK   1.15A
1077        BA  0.0243
1078        LG    0.25    0.25    4.40    0.45      35
1079        UC   0.195   0.161
            * Urban Time-Area Relation
1080        UA       0       5      16      30      65      77      84      90      94      97
1081        UA     100
            *

1082        KK  S1.15A
1083        RS       1    STOR       0
1084        SQ       0       0       0    56.0
1085        SE       0     1.0     2.0     3.0
1086        SV       0    0.70    1.46    2.28
1087        SE       0     1.0     2.0     3.0
            *

1088        KK   1.15B
1089        BA  0.0156
1090        LG    0.25    0.15    7.30    0.13      35
1091        UC   0.207   0.157
            * Urban Time-Area Relation
1092        UA       0       5      16      30      65      77      84      90      94      97
1093        UA     100
            * COMBINES 1.15B, S1.15A, R1.16A, AND R1.14B

1094        KK  C1.15B
1095        HC       4
            *
            * ASANTE Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)
```

```
1096        KK  R1.15B
1097        RS       2    FLOW     0.0     0.0
1098        RC   0.035   0.035   0.035    1760  0.0050
1099        RX       0       6      12      18     111     117     123     129
1100        RY       3       2       1       0       0       1       2       3
            *

1101        KK   1.16B
1102        BA  0.0268
1103        LG    0.25    0.25    4.55    0.41      35
1104        UC   0.137   0.077
            * Urban Time-Area Relation
1105        UA       0       5      16      30      65      77      84      90      94      97
1106        UA     100
            *

1107        KK  S1.16B
1108        RS       1    STOR       0
1109        SQ       0       0       0    17.2
1110        SE       0     1.0     2.0     3.0
1111        SV       0    0.93    1.93    3.01
1112        SE       0     1.0     2.0     3.0
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)
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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1113        KK  R1.16B
1114        RS       4    FLOW     0.0     0.0
1115        RC   0.035   0.035   0.035    1630  0.0012
1116        RX       0       4       8      12      22      26      30      34
1117        RY       3       2       1       0       0       1       2       3
            *

1118        KK   1.17A
1119        BA  0.0521
1120        LG    0.25    0.25    4.20    0.50      35
1121        UC   0.282   0.197
            * Urban Time-Area Relation
1122        UA       0       5      16      30      65      77      84      90      94      97
1123        UA     100
            *

1124        KK  S1.17A
1125        RS       1    STOR       0
1126        SQ       0       0       0    56.0
1127        SE       0     1.0     2.0     3.0
1128        SV       0    1.84    3.78    5.84
1129        SE       0     1.0     2.0     3.0
            *

1130        KK   1.17B
1131        BA  0.0332
1132        LG    0.25    0.25    4.20    0.50      35
1133        UC   0.299   0.279
            * Urban Time-Area Relation
1134        UA       0       5      16      30      65      77      84      90      94      97
1135        UA     100
            * COMBINES 1.17B, S1.17A, R1.16B, AND R1.15B

1136        KK  C1.17B
1137        HC       4
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 40 ft)

1138        KK  R1.17B
1139        RS       1    FLOW     0.0     0.0
1140        RC   0.035   0.035   0.035     990  0.0050
1141        RX       0       6      12      18      58      64      70      76
1142        RY       3       2       1       0       0       1       2       3
            *

1143        KK     1.3
1144        BA  0.0285
1145        LG    0.25    0.25    4.55    0.41      35
1146        UC   0.204   0.152
            * Urban Time-Area Relation
1147        UA       0       5      16      30      65      77      84      90      94      97
1148        UA     100
            *
```



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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1149        KK    S1.3
1150        RS       1    STOR       0
1151        SQ       0       0       0    17.2
1152        SE       0     1.0     2.0     3.0
1153        SV       0    1.27    2.62    4.07
1154        SE       0     1.0     2.0     3.0
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1155        KK    R1.3
1156        RS       4    FLOW     0.0     0.0
1157        RC   0.035   0.035   0.035    2450  0.0050
1158        RX       0       4       8      12      22      26      30      34
1159        RY       3       2       1       0       0       1       2       3
            *

1160        KK     1.2
1161        BA  0.1074
1162        LG    0.25    0.25    4.50    0.42      35
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```
1163        UC   0.358   0.195
            * Urban Time-Area Relation
1164        UA       0       5      16      30      65      77      84      90      94      97
1165        UA     100
            *

1166        KK    S1.2
1167        RS       1    STOR       0
1168        SQ       0       0       0    56.0
1169        SE       0     1.0     2.0     3.0
1170        SV       0    4.92   10.01   15.28
1171        SE       0     1.0     2.0     3.0
            * COMBINES S1.2, R1.3, AND R1.17B

1172        KK    C636
1173        HC       3
            *
            * ROUTE UPDATED 4/14/04

1174        KK  RPI636
1175        RS       1    FLOW     0.0     0.0
1176        RC   0.043   0.035   0.043     730  0.0137
            * WITS130
1177        RX       0     400     456     575     620     650     660     682
1178        RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
            *
            * Diversion Recovery: ASANTE Berm Breach

1179        KK   D624C
1180        DR   D624C
```

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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1181        KK  RD624C
1182        RS       3    FLOW     0.0     0.0
1183        RC   0.043   0.035   0.043    3480  0.0057
            * PDTS40_1
1184        RX       0      86     158     492     543     560     776    1208
1185        RY    1330  1326.5    1326    1324    1320    1326    1328    1330
            *
            * Diversion Recovery: 163rd Ave Culvert Flow Split

1186        KK   D624G
1187        DR   D624G

1188        KK  RD624G
1189        RS       3    FLOW     0.0     0.0
1190        RC   0.043   0.035   0.043    3000  0.0063
            * PDTS40_1
1191        RX       0      86     158     492     543     560     776    1208
1192        RY    1330  1326.5    1326    1324    1320    1326    1328    1330
            *
            * UNDEVELOPED PORTION OF PHASE 4

1193        KK      4B
1194        BA   0.375
1195        LG    0.35    0.36    5.00    0.27       0
1196        UC   0.626   0.360
            * Natural Time-Area Relation
1197        UA       0       3       5       8      12      20      43      75      90      96
1198        UA     100
            *

1199        KK     C4B
1200        HC       3    0.81
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1201        KK     R4B
1202        RS       2    FLOW     0.0     0.0
1203        RC   0.035   0.035   0.035    1410  0.0050
1204        RX       0       4       8      12      22      26      30      34
1205        RY       3       2       1       0       0       1       2       3
            *

1206        KK    1.5B
1207        BA  0.0167
1208        LG    0.25    0.25    5.70    0.24      35
1209        UC   0.206   0.173
            * Urban Time-Area Relation
1210        UA       0       5      16      30      65      77      84      90      94      97
1211        UA     100
            *
```

1 HEC-1 INPUT PAGE 39

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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1212        KK   S1.5B
1213        RS       1    STOR       0
1214        SQ       0       0       0    14.2
1215        SE       0     1.0     2.6     3.0
1216        SV       0    0.57    1.19    1.88
1217        SE       0     1.0     2.0     3.0
            * COMBINES S1.5B AND UNDEVELOPED PARCEL 4

1218        KK   C1.5B
1219        HC       2
            * Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1220        KK   R1.5B
1221        RS       1    FLOW     0.0     0.0
1222        RC   0.035   0.035   0.035     800  0.0050
```

```
1223    RX       0       4       8      12      22      26      30      34
1224    RY       3       2       1       0       0       1       2       3
        *

1225    KK    1.5C
1226    BA  0.0133
1227    LG    0.25    0.25    5.20    0.29      35
1228    UC   0.133   0.080
        * Urban Time-Area Relation
1229    UA       0       5      16      30      65      77      84      90      94      97
1230    UA     100
        *

1231    KK   S1.5C
1232    RS       1    STOR       0
1233    SQ       0       0       0    14.2
1234    SE       0     1.0     2.6     3.0
1235    SV       0    0.45    0.95    1.51
1236    SE       0     1.0     2.0     3.0
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1237    KK   R1.5C
1238    RS       2    FLOW     0.0     0.0
1239    RC   0.035   0.035   0.035     845  0.0050
1240    RX       0       4       8      12      22      26      30      34
1241    RY       3       2       1       0       0       1       2       3
        *

1242    KK     1.4
1243    BA  0.0284
1244    LG    0.25    0.25    5.70    0.24      35
1245    UC   0.204   0.155
        * Urban Time-Area Relation
1246    UA       0       5      16      30      65      77      84      90      94      97
1247    UA     100
        *
```



```
LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1248    KK    S1.4
1249    RS       1    STOR       0
1250    SQ       0       0       0    14.2
1251    SE       0     1.0     2.6     3.0
1252    SV       0    1.26    2.60    4.04
1253    SE       0     1.0     2.0     3.0
        * COMBINES S1.4, R1.5C, AND R1.5B

1254    KK    C624
1255    HC       3
        *

1256    KK   PI624
1257    BA   0.452
1258    LG    0.35    0.35    4.80    0.29       0
1259    UC   0.915   0.764
        * Natural Time-Area Relation
1260    UA       0       3       5       8      12      20      43      75      90      96
1261    UA     100
        *

1262    KK  CPI624
1263    HC       3
        *
        * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
        * It was assumed that this basin is isolated, and can only overtop the canal.
        * Berm Elevation = 1342
        * For Overtopping of the berm, the Weir equation was used.
        * Q=C*B*H^1.5
        * C was assumed to be 2.7
        * B, the length of the weir was the basin boundary along the canal = 4305 ft

1264    KK  SPI624
1265    RS       1    STOR       0
1266    SQ       0       0       0       0    4110   11624   21354   32876
1267    SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
1268    SA       0    0.19    5.86   36.95   36.96   36.97
1269    SE    1336    1338    1340    1342    1343    1344
        *
        *
        * ROUTE UPDATED 4/14/04

1270    KK  RPI624
1271    RS       3    FLOW     0.0     0.0
1272    RC   0.043   0.035   0.043    5060  0.0043
        * TSR621-modified X-sect
1273    RX       0      40      52      99     138     159     394   511.5
1274    RY    1345    1343    1342    1342    1340    1342    1344    1345
        *
        *
        * Combines RPI635, D600A, RPI621, RPI624 and PI633
```



```
LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1275    KK  CPI633
1276    HC       4
        *
        * ROUTE UPDATED 4/14/04

1277    KK  RPI633
1278    RS       4    FLOW     0.0     0.0
1279    RC   0.045   0.035   0.045    5834   0.001
```

```
                    * McMicken Dam Channel
1280                RX       0      46     101     121     171     181    1421    3621
1281                RY      25      14       4       0       0       4      14      25
                    *

1282                KK   PI600
1283                BA  0.6050
1284                LG   0.342   0.244   5.047   0.268   4.887
1285                UC   0.542   0.341
                    * Natural Time-Area Relation
1286                UA       0       3       5       8      12      20      43      75      90      96
1287                UA     100
                    *
                    *
                    * COMBINES BASIN RPI633, RPI603 and  PI600

1288                KK  CPI600
1289                HC       3
                    *
                    * ROUTE UPDATED 4/14/04

1290                KK  RPI600
1291                RS       2    FLOW     0.0     0.0
1292                RC   0.045   0.035   0.045    4937   0.001
                    * McMicken Dam Channel
1293                RX       0      46     101     121     171     181    1421    3621
1294                RY      25      14       4       0       0       4      14      25
                    *
1295                ZZ
```

1

```
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   180     DCAP11
                V
                V
   182     RDCP11
                .
                .
   187          .      DCAP12
                .          .
                .          .
   190          .          .-------->   DO618
   189          .        D618
                .          V
                .          V
   193          .      RDCP12
                .          .
                .          .
   198          .          .       PI618
                .          .           .
                .          .           .
   204     CPI618.......................
                V
                V
   206     RPI618
                .
                .
   211          .      DCAP13
                .          V
                .          V
   213          .      RDCP13
                .          .
                .          .
   218          .          .       PI615
                .          .           .
                .          .           .
   225          .          .           .<-------   DO618
   224          .          .       D618
                .          .           V
                .          .           V
   226          .          .      RD618
                .          .           .
                .          .           .
   231          .      CPI615.......................
                .          V
                .          V
   233          .      RPI615
                .          .
                .          .
   238          .          .       PI612
                .          .           .
                .          .           .
   244          .          .      PI624B
                .          .           .
                .          .           .
   253          .          .           .-------->   D624B
   251          .          .      DO624B
                .          .           V
                .          .           V
   256          .          .      RX624B
                .          .           .
                .          .           .
   261          .          .           .      PI624D
                .          .           .           .
                .          .           .           .
   268          .          .      CP624D............
                .          .           .
                .          .           .
   271          .          .           .-------->  DO624D
   270          .          .       D624D
                .          .           V
                .          .           V
```

```
274          .          .          .      RX624D
             .          .          .          .
             .          .          .          .
279     CPI612.................................
             .
             .
282          .------->   DO612
281       D612
             V
             V
285     RPI612
             .
             .
290          .     DCAP14
             .          V
             .          V
292          .     RDCP14
             .          .
             .          .
297          .          .       PI609
             .          .          .
             .          .          .
304          .          .          .      .<-------  DO624D
303          .          .          .   D624D
             .          .          .      V
             .          .          .      V
305          .          .          .  RD624D
             .          .          .      .
             .          .          .      .
310          .          .          .      .     PI624E
             .          .          .      .          .
             .          .          .      .          .
319          .          .          .      .          .-------> RET624
317          .          .          .      .     624ERT
             .          .          .      .          .
             .          .          .      .          .
322          .          .          .  CP624E...........
             .          .          .      V
             .          .          .      V
324          .          .          .  RD624E
             .          .          .      .
             .          .          .      .
329          .          .          .      .     PI624G
             .          .          .      .          .
             .          .          .      .          .
336          .          .          .      .          .     PI624F
             .          .          .      .          .          .
             .          .          .      .          .          .
344          .          .          .      .          .          .<-------  D624B
343          .          .          .      .          .       D624B
             .          .          .      .          .          V
             .          .          .      .          .          V
345          .          .          .      .          .      RD624B
             .          .          .      .          .          .
             .          .          .      .          .          .
350          .          .          .      .          .          .     PI624C
             .          .          .      .          .          .          .
             .          .          .      .          .          .          .
356          .          .          .      .          .      CP624C...........
             .          .          .      .          .          .
             .          .          .      .          .          .
360          .          .          .      .          .          .-------> D624C
358          .          .          .      .          .      DO624C
             .          .          .      .          .          V
             .          .          .      .          .          V
363          .          .          .      .          .      RD624C
             .          .          .      .          .          .
             .          .          .      .          .          .
368          .          .          .  CP624G.................................
             .          .          .      .
             .          .          .      .-------> D624G
372          .          .          .
370          .          .          .  DO624G
             .          .          .      V
             .          .          .      V
375          .          .          .  RD624G
             .          .          .      .
             .          .          .      .
380          .          .          .      .     PI624H
             .          .          .      .          .
             .          .          .      .          .
387          .          .          .  CP624H...........
             .          .          .      .
             .          .          .      .
390          .          .          .      .-------> DOHVC3
389          .          .          .   DHVC3
             .          .          .      V
             .          .          .      V
393          .          .          .  RD624H
             .          .          .      .
             .          .          .      .
399          .          .          .      .          .<-------  DO612
398          .          .          .      .       D612
             .          .          .      .          V
             .          .          .      .          V
400          .          .          .      .      RD612
             .          .          .      .          .
             .          .          .      .          .
405          .          .          .      .          .     PI621A
             .          .          .      .          .          .
             .          .          .      .          .          .
412          .          .          .  CP621A........................
             .          .          .      .
             .          .          .      .
415          .          .          .      .-------> DOHVC4
414          .          .          .   DHVC4
```

```
                                                    V
                                                    V
418                                        R621A1
                                                    .
                                                    .
424                                                 .-------> DOHVC5
423                                         DHVC5
                                                    V
                                                    V
427                                        R621A2
                                                    .
                                                    .
432                                                 .     PI621B
                                                    .          .
                                                    .          .
439                                        CP621B............
                                                    V
                                                    V
441                                        RD621B
                                                    .
                                                    .
446     CPI609..................................
                .
                .
449             .-------> DOHVC1
448      DHVC1
                V
                V
452     RPI609
                .
                .
458             .-------> DOHVC2
457      DHVC2
                V
                V
461     R6092N
                .
                .
466             .     DCAP15
                .         V
                .         V
468             .     RDCP15
                .         .
                .         .
473             .           .     PI606A
                .           .          .
                .           .          .
479             .      C606A............
                .         .
                .         .
482             .         .-------> DO606A
481             .      D606A
                .         V
                .         V
485             .      R606A
                .         .
                .         .
490             .           .     PI606
                .           .          .
                .           .          .
496     CPI606........................
                V
                V
498     RPI606
                .
                .
503             .      PI604
                .         .
                .         .
510             .         .          .<------- DO606A
509             .         .     D606A
                .         .         V
                .         .         V
511             .         .    RD606A
                .         .          .
                .         .          .
516             .     CPI604............
                .         V
                .         V
518             .     RPI604
                .         .
                .         .
523             .         .     PD744
                .         .          .
                .         .          .
530             .         .          .          .<------- DOHVC1
529             .         .          .     DHVC1
                .         .          .         V
                .         .          .         V
531             .         .          .    RDHVC1
                .         .          .         .
                .         .          .         .
537             .         .          .         .          .<------- DOHVC2
536             .         .          .         .     DHVC2
                .         .          .         .         V
                .         .          .         .         V
538             .         .          .         .    RDHVC2
                .         .          .         .         .
                .         .          .         .         .
543             .         .          .         .         .     PI600A
                .         .          .         .         .          .
                .         .          .         .         .          .
549             .         .          .      C600A........................
                .         .          .         V
                .         .          .         V
551             .         .          .     RD600A
```

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                                                                  .
                                                                  .
556                                                               .      PI603
                                                                  .        .
                                                                  .        .
562     CPI603.............................................
            V
            V
564     SPI603
            .
            .
573         .-------->   DO744
572       D744
            .
            .
578         .     CWI504
            .         V
            .         V
580         .     RWI504
            .         .
            .         .
585         .         .     CWI508
            .         .         .
            .         .         .
588         .         .         .-------->   DO508
587         .         .       D508
            .         .         .
            .         .         .
591         .         .         .     WI510A
            .         .         .         V
            .         .         .         V
597         .         .         .      R510A
            .         .         .         .
            .         .         .         .
602         .         .         .         .      WI510
            .         .         .         .        .
            .         .         .         .        .
608         .         .     CWI510.......................
            .         .         V
            .         .         V
610         .         .     RWI510
            .         .         .
            .         .         .
615         .         .         .      WI502
            .         .         .         .
            .         .         .         .
621         .     CWI502.......................
            .         V
            .         V
623         .     RWI502
            .         .
            .         .
628         .         .     CWI525
            .         .         .
            .         .         .
631         .         .         .-------->   DO525
630         .         .       D525
            .         .         V
            .         .         V
634         .         .     RWI525
            .         .         .
            .         .         .
639         .         .         .     DCAP10
            .         .         .         V
            .         .         .         V
641         .         .         .     RDCP10
            .         .         .         .
            .         .         .         .
646         .         .         .         .      PI628
            .         .         .         .        .
            .         .         .         .        .
652         .         .         .     CPI628............
            .         .         .         V
            .         .         .         V
654         .         .         .     RPI628
            .         .         .         .
            .         .         .         .
659         .         .         .         .     PI624A
            .         .         .         .        .
            .         .         .         .        .
665         .         .         .      C624A............
            .         .         .         V
            .         .         .         V
667         .         .         .      R624A
            .         .         .         .
            .         .         .         .
672         .         .         .         .     PI639A
            .         .         .         .        .
            .         .         .         .        .
678         .         .         .      C639A............
            .         .         .         V
            .         .         .         V
680         .         .         .      R639A
            .         .         .         .
            .         .         .         .
685         .         .         .         .     WI524A
            .         .         .         .        .
            .         .         .         .        .
692         .         .         .         .        .<-------   DO525
691         .         .         .         .      D525
            .         .         .         .        V
            .         .         .         .        V
693         .         .         .         .     RD525
            .         .         .         .        .
            .         .         .         .        .
698         .         .         .      C524A.......................
```

```
                                                  V
                                                  V
700                                           R524A
                                                  .
                                                  .
705                                                   2.8
                                                      .
                                                      .
711                                           C2.8............
                                                  V
                                                  V
713                                           R2.8
                                                  .
                                                  .
718                                                   3A
                                                      V
                                                      V
724                                                 R3A
                                                      .
                                                      .
729                                                   .       2.11
                                                      .         .
                                                      .         .
735                                                 C2.11...........
                                                      V
                                                      V
737                                                 R2.11
                                                      .
                                                      .
742                                                   .       2.10
                                                      .         V
                                                      .         V
748                                                   .      S2.10
                                                      .         .
                                                      .         .        2.7
                                                      .         .         .
                                                      .         .         .
760                                                   .         .         .        2.4
                                                      .         .         .         V
                                                      .         .         .         V
766                                                   .         .         .       S2.4
                                                      .         .         .         V
                                                      .         .         .         V
772                                                   .         .         .       R2.4
                                                      .         .         .         .
                                                      .         .         .         .
777                                                 C2.7.................................
                                                      V
                                                      V
779                                                 S2.7
                                                      .
                                                      .
785                                           C2.6............
                                                  V
                                                  V
787                                           R2.6
                                                  .
                                                  .
792                                                   2.5
                                                      .
                                                      .
798                                          CWI524...........
                                                  .
                                                  .-------->   DO524
801
800                                            D524
                                                  V
                                                  V
804                                          RWI524
                                                  .
                                                  .
809                                                   4A
                                                      V
                                                      V
815                                                 R4A
                                                      .
                                                      .
820                                                   .        2.1
                                                      .         .
                                                      .         .
826                                                 C2.1............
                                                      V
                                                      V
828                                                 S2.1
                                                      V
                                                      V
834                                                 R2.1
                                                      .
                                                      .
839                                                   .       1.11
                                                      .         .
                                                      .         .
846                                                   .         .        .<-------   DO524
845                                                   .         .       D524
                                                      .         .         V
                                                      .         .         V
847                                                   .         .      RD524
                                                      .         .         .
                                                      .         .         .
852                                                 CPI639......................
                                                      V
                                                      V
854                                                 RPI639
                                                      .
                                                      .
```

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                                                  HVC_EX_WOBERM.OH1
859                                                          WI506
                                                                 .
                                                                 .
865                    CWI506.................................
                                 .
868                              .<-------   DO508
867                          D508
                                 V
                                 V
869                         RD508
                                 .
                                 .
874                              .      WI500
                                 .          .
                                 .          .
880            CWI500..............................
                    V
                    V
882            SSPILL
                    V
                    V
889            RWI500
                    .
                    .
894                    PI635
                        .
                        .
900            CPI635............
                    V
                    V
902            RPI635
                    .
                    .
907                    PI621C
                        .
                        .
914                              .<-------  DOHVC3
913                         DHVC3
                                 V
                                 V
915                        RDHVC3
                                 .
                                 .
921                              .          .<-------  DOHVC4
920                              .      DHVC4
                                 .          V
                                 .          V
922                              .     RDHVC4
                                 .          .
                                 .          .
928                              .          .          .<-------  DOHVC5
927                              .          .      DHVC5
                                 .          .          V
                                 .          .          V
929                              .          .     RDHVC5
                                 .          .          .
                                 .          .          .
934                    CPI621.................................
                        V
                        V
936                    SPI621
                        V
                        V
941                    RPI621
                        .
                        .
946                         PI633
                                 .
                                 .
952                              .        1.8
                                 .          V
                                 .          V
958                              .       S1.8
                                 .          .
                                 .          .
964                              .          .        1.7
                                 .          .          .
970                              .          .          .       1.5A
                                 .          .          .          .
976                              .       C1.7.......................
                                 .          V
                                 .          V
978                              .       S1.7
                                 .          .
                                 .          .
984                              .          .        1.9
                                 .          .          .
990                              .          .          .        1.6
                                 .          .          .          .
996                              .       C1.6.......................
                                 .          V
                                 .          V
998                              .       S1.6
                                 .          .
                                 .          .
1004                             .          .       1.10
                                 .          .          V
1010                             .          .      R1.10
                                 .          .          .
```

```
1015    .    .    .    .    .    .    1.13A
1021    .    .    .    .    .    .    .         1.14A
1027    .    .    .    .   C1.14A.............................
                                V
                                V
1029    .    .    .    .   S1.14A
1035    .    .    .    .        .    1.13B
                                        V
                                        V
1041    .    .    .    .        .   R1.13B
1046    .    .    .    .        .        .    1.14B
1052    .    .    .    .   C1.14B....................
                                V
                                V
1054    .    .    .    .   R1.14B
1059    .    .    .    .        .    1.16A
                                        V
                                        V
1065    .    .    .    .        .   S1.16A
                                        V
                                        V
1071    .    .    .    .        .   R1.16A
1076    .    .    .    .        .        .    1.15A
                                                  V
                                                  V
1082    .    .    .    .        .        .   S1.15A
1088    .    .    .    .        .        .        .    1.15B
1094    .    .    .    .   C1.15B.............................
                                V
                                V
1096    .    .    .    .   R1.15B
1101    .    .    .    .        .    1.16B
                                        V
                                        V
1107    .    .    .    .        .   S1.16B
                                        V
                                        V
1113    .    .    .    .        .   R1.16B
1118    .    .    .    .        .        .    1.17A
                                                  V
                                                  V
1124    .    .    .    .        .        .   S1.17A
1130    .    .    .    .        .        .        .    1.17B
1136    .    .    .    .   C1.17B.............................
                                V
                                V
1138    .    .    .    .   R1.17B
1143    .    .    .    .        .      1.3
                                        V
                                        V
1149    .    .    .    .        .     S1.3
                                        V
                                        V
1155    .    .    .    .        .     R1.3
1160    .    .    .    .        .        .      1.2
                                                  V
                                                  V
1166    .    .    .    .        .        .     S1.2
1172    .    .    .    .     C636....................
                                V
                                V
1174    .    .    .    .   RPI636
1180    .    .    .    .        .       .<-------   D624C
1179    .    .    .    .        .   D624C
                                        V
                                        V
1181    .    .    .    .        .  RD624C
1187    .    .    .    .        .        .       .<-------   D624G
1186    .    .    .    .        .        .   D624G
                                                  V
```

```
                                                    HVC_EX_WOBERM.OH1
                                                                                  V
1188                                                                        RD624G
                                                                                  .
1193                                                                                  .          4B
                                                                                  .          .
1199                                                                  C4B.......................
                                                                        V
                                                                        V
1201                                                                  R4B
                                                                        .
1206                                                                            1.5B
                                                                                  V
                                                                                  V
1212                                                                          S1.5B
                                                                                  .
1218                                                                .....C1.5B.....
                                                                        V
                                                                        V
1220                                                                R1.5B
                                                                        .
1225                                                                            1.5C
                                                                                  V
                                                                                  V
1231                                                                          S1.5C
                                                                                  V
                                                                                  V
1237                                                                          R1.5C
                                                                                  .
1242                                                                                  .          1.4
                                                                                  .            V
                                                                                  .            V
1248                                                                                  .        S1.4
                                                                                  .          .
1254                                                                  C624.......................
                                                                        .
1256                                                                          PI624
                                                                                  .
                                                                                  .
1262                                                        CPI624.......................
                                                                 V
                                                                 V
1264                                                        SPI624
                                                                 V
                                                                 V
1270                                                        RPI624
                                                                 .
                                                                 .
1275                                  CPI633.................................
                                           V
                                           V
1277                                  RPI633
                                           .
                                           .
1282                                                 PI600
                                                         .
                                                         .
1288                            CPI600.......................
                                     V
                                     V
1290                            RPI600
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *   U.S. ARMY CORPS OF ENGINEERS       *
*             JUN   1998               *                    *   HYDROLOGIC ENGINEERING CENTER      *
*           VERSION 4.1                *                    *         609 SECOND STREET            *
*                                      *                    *      DAVIS, CALIFORNIA 95616         *
*  RUN DATE   19NOV10  TIME  11:26:32  *                    *          (916) 756-1104              *
*                                      *                    *                                      *
****************************************                    ****************************************
```

```
HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
100-YEAR 24-HOUR STORM - HAPPY VALLEY CHANNEL WITHOUT BERM
EXISTING CONDITIONS
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
**  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY   **
**                                                                         **
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS   **
** DATED OCTOBER 2004:                                                     **
**                                                                         **
**     -Diversion added after CTW480                                       **
**          -Main flow (5%) to CTW478                                      **
**          -Diverted flow (95%) to CWI584                                 **
**          -Added concentration point CWI584 combining RD480 and WI584    **
```

```
**          -Hard coding was added to CTW478                                **
**          -Route added after D480 (Diversion Recovery)                    **
**          -Route RWI584 was adjusted                                      **
**          -Storage Route SCP050 was adjusted                              **
**          -Route R508* was adjusted                                       **
**          -Hard coding for CWI510 was adjusted                            **
**                                                                          **
**     -Diversion D618 was moved from after CPI618 to before RDCP12         **
**          -Updated route RD618 information                                **
**          -Hard coding on CPI618 was adjusted                             **
**          -Hard coding on CPI615 was adjusted                             **
**                                                                          **
**     -Route RPI639 changed from following US60 to CPI636 to route         **
**      through US60/RR structures and combine with CWI506                  **
**          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
**           following R624A to follow RWI524                               **
**          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
**          -RPI639 information was changed to reflect new route            **
**          -CWI506 changed from combining 3 to combine 4:                  **
**           RWI525, RWI524, RPI639 & WI506                                 **
**          -Hard coding on CWI506 was adjusted                             **
**          -Hard Coding on CWI500 was adjusted                             **
**                                                                          **
******************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
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******************************************************************************
**                                                                          **
**    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004       **
**                                                                          **
******************************************************************************
******************************************************************************

PROJECT:                Wittmann ADMS Update
CLIENT:                 Flood Control District of Maricopa County
PREPARED BY:            Entellus, Inc.
PROJECT No:             FCD 2002C029              Entellus 310.032
FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
                                       MODIFIED DATE: MAY 04, 2005

STORM:
                        100-year 24-hour Storm

DEVELOPMENT CONDITIONS:
                        Existing Conditions

MODELING ASSUMPTIONS:
                        It was assumed that the US60 did not have adequate
                        storage to cause any significant attenuation.

                        The assumption was made that the CAP Canal embankment
                        would not be breached under a large flood event.

                        The assumption was made that the Beardsley Canal would
                        not fail under a large storm event (Per District
                        Instruction).  In addition, the berm north of the
                        Beardsley canal and east of US60 was assumed to fail
                        (per district Instruction).

                        For both the CAP and Beardsley Canals, once the berm
                        elevation was reached weir flow was assumed.  It was
                        also assumed that any weir flow over the canal that
                        might enter the canal and be diverted out of the study
                        area was insignificant, and thus was ignored.  In other
                        words all weir flow over the canal embankment reaches
                        the downstream concentration point.

                        Typical X-sects were developed, and it was assumed
                        that a typical x-sect could adequately represent
                        various reaches.

                        Time-Area Relations were used base on the District's
                        Hydrology Manual criteria.  Two Time-Area Relation
                        Curves were utilized:
                                -Urban
                                -Natural
                        The Time-Area Relation Curves were taken directly
                        from the manual

MODELING METHODS:
                        This model utilizes QI cards to input the Padelford
                        hydrographs from the 100-year 6-hour existing
                        conditions model developed by A-N West Inc. for the
                        Padelford Wash Floodplain Delineation Study.  The
                        hydrograph was altered from its original form
                        (2-minute interval to 5-minute interval) through
                        simple interpolation.

                        Clark Unit Hydrographs were used for all subbasins
                        except the two subbasins directly upstream of the
                        Bonita Dam (PD726B and PD740 use S-graphs).  The UC
                        parameters were calculated using the WMS7.0 software.

                        For Basins PD726B and PD740 S-Graphs were utilized per
                        the request of the FCDMC.  Limited details regarding
                        the calculations of the S-graphs can be found in the
                        model by the basin KK card.  For full details of the
                        S-graph calculations refer to the Appendix.

                        Normal Depth routing was used for all routing reaches.
```

Hard coding was used to account for the percentage of area associated with a diversion. Because of the use of JD cards and aereal reduction, hard coding was necessary to properly account for area. For a given diversion a percentage of the flow is routed to two different locations. The same percentage of area follows that diverted flow. In addition the area downstream of the main path is reduced or increased and is hard coded to account for the loss or gain of area. Hard coding was performed based on the 24-hour existing conditions model.

Stage-storage was developed for all the structures along the CAP Canal, as well as along the Beardsley Canal. In addition several stage-storage locations were developed for areas with significant storage along the SR74. No storage was modeled along the US60 and railroad, but the culverts were analyzed for diversion potential. Diversions were placed in the model where deemed appropriate. See appendix for details.

FLO-2D was utilized to calculate the split flows at concentration points CIW351. CIW357, CIW363 and CWI576. See appendix for modeling details.

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159 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                   NMIN           5  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1    0  STARTING DATE
                  ITIME        0000  STARTING TIME
                     NQ        1500  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      6    0  ENDING DATE
                 NDTIME        0455  ENDING TIME
                  ICENT          19  CENTURY MARK

           COMPUTATION INTERVAL    0.08 HOURS
                TOTAL TIME BASE  124.92 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

161 JD        INDEX STORM NO. 1
                   STRM        4.18  PRECIPITATION DEPTH
                   TRDA        0.01  TRANSPOSITION DRAINAGE AREA

162 PI          PRECIPITATION PATTERN
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

```
172 JD        INDEX STORM NO. 2
                   STRM        3.93  PRECIPITATION DEPTH
                   TRDA       10.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

173 JD INDEX STORM NO. 3
STRM 3.86 PRECIPITATION DEPTH
TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

174 JD INDEX STORM NO. 4
STRM 3.72 PRECIPITATION DEPTH
TRDA 40.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

175 JD INDEX STORM NO. 5
STRM 3.60 PRECIPITATION DEPTH
TRDA 80.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

176 JD INDEX STORM NO. 6

STRM 3.53 PRECIPITATION DEPTH
TRDA 120.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

177 JD INDEX STORM NO. 7

STRM 3.44 PRECIPITATION DEPTH
TRDA 200.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

178 JD INDEX STORM NO. 8

STRM 3.38 PRECIPITATION DEPTH
TRDA 300.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

179 JD        INDEX STORM NO. 9
                 STRM        3.29  PRECIPITATION DEPTH
                 TRDA      500.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

181 BI        READ STATION   DCAP11 HYDROGRAPH FROM UNIT 22

188 BI        READ STATION   DCAP12 HYDROGRAPH FROM UNIT 22

212 BI        READ STATION   DCAP13 HYDROGRAPH FROM UNIT 22

291 BI        READ STATION   DCAP14 HYDROGRAPH FROM UNIT 22


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          *            *
317 KK    *    624ERT  *
          *            *
          **************

318 KO        OUTPUT CONTROL VARIABLES
                IPRNT          5  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

467 BI        READ STATION   RDCP15 HYDROGRAPH FROM UNIT 22
      WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

579 BI        READ STATION   CWI504 HYDROGRAPH FROM UNIT 22

586 BI        READ STATION   CWI508 HYDROGRAPH FROM UNIT 22

629 BI        READ STATION   CWI525 HYDROGRAPH FROM UNIT 22

640 BI        READ STATION   DCAP10 HYDROGRAPH FROM UNIT 22
      WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

WARNING --- ROUTED OUTFLOW (    444.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    544.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    592.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    590.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    560.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    513.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    458.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    405.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    355.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
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WARNING --- ROUTED OUTFLOW (    400.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    512.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    579.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    593.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    572.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    530.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    477.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    422.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    372.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    398.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    485.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    525.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    524.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    497.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    458.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    413.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    367.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    357.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    458.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    515.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    527.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    507.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    472.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    428.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    382.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    384.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    469.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    507.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    504.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    479.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    442.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    399.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    356.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    344.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    443.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    497.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    507.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    489.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    455.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    414.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    370.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    360.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    441.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    474.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    471.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    448.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    414.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    375.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    416.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    466.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
WARNING --- ROUTED OUTFLOW (    474.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	DCAP11	424.	16.08	411.	256.	88.	53.75		
+	ROUTED TO	RDCP11	424.	16.33	410.	256.	88.	53.75		
+	HYDROGRAPH AT	DCAP12	410.	16.08	394.	243.	84.	53.75		
+	DIVERSION TO	DO618	218.	16.08	209.	129.	45.	53.75		
+	HYDROGRAPH AT	D618	193.	16.08	185.	114.	40.	53.75		
+	ROUTED TO	RDCP12	193.	16.33	185.	114.	40.	53.75		
+	HYDROGRAPH AT	PI618	323.	12.33	43.	12.	4.	0.29		
+	3 COMBINED AT	CPI618	629.	16.17	605.	390.	135.	5.48		
+	ROUTED TO	RPI618	628.	16.75	604.	390.	135.	5.48		
+	HYDROGRAPH AT	DCAP13	420.	16.08	404.	248.	88.	53.75		
+	ROUTED TO	RDCP13	420.	16.67	403.	248.	88.	53.75		
+	HYDROGRAPH AT	PI615	625.	12.33	115.	31.	10.	0.84		
+	HYDROGRAPH AT	D618	218.	16.08	209.	129.	45.	53.75		
+	ROUTED TO	RD618	217.	16.42	209.	129.	45.	53.75		
+	3 COMBINED AT	CPI615	701.	12.33	626.	416.	146.	6.21		
+	ROUTED TO	RPI615	653.	16.75	626.	416.	146.	6.21		
+	HYDROGRAPH AT	PI612	458.	12.67	96.	26.	9.	0.74		
+	HYDROGRAPH AT	PI624B	67.	12.42	11.	3.	1.	0.10		
+	DIVERSION TO	D624B	47.	12.25	10.	3.	1.	0.10		
+	HYDROGRAPH AT	DO624B	20.	12.42	1.	0.	0.	0.10		
+	ROUTED TO	RX624B	15.	12.58	1.	0.	0.	0.10		
+	HYDROGRAPH AT	PI624D	204.	12.58	41.	11.	4.	0.32		
+	2 COMBINED AT	CP624D	217.	12.58	42.	11.	4.	0.35		
+	DIVERSION TO	DO624D	217.	12.58	42.	11.	4.	0.35		
+	HYDROGRAPH AT	D624D	0.	0.00	0.	0.	0.	0.35		
+	ROUTED TO	RX624D	0.	0.00	0.	0.	0.	0.35		
+	4 COMBINED AT	CPI612	1406.	12.67	1232.	826.	288.	12.43		
+	DIVERSION TO	DO612	1055.	12.67	924.	620.	216.	12.43		
+	HYDROGRAPH AT	D612	352.	12.67	308.	207.	72.	12.43		

+	ROUTED TO	RPI612	335.	12.92	308.	207.	72.	12.43
+	HYDROGRAPH AT	DCAP14	362.	16.08	347.	185.	62.	53.75
+	ROUTED TO	RDCP14	362.	17.25	346.	185.	62.	53.75
+	HYDROGRAPH AT	PI609	960.	12.50	262.	71.	24.	1.94
+	HYDROGRAPH AT	D624D	217.	12.58	42.	11.	4.	0.35
+	ROUTED TO	RD624D	205.	12.67	42.	11.	4.	0.35
+	HYDROGRAPH AT	PI624E	512.	12.08	48.	15.	5.	0.26
+	DIVERSION TO	RET624	512.	12.08	35.	9.	3.	0.26
+	HYDROGRAPH AT	624ERT	229.	12.17	18.	5.	2.	0.26
+	2 COMBINED AT	CP624E	259.	12.25	59.	16.	5.	0.61
+	ROUTED TO	RD624E	226.	12.75	59.	16.	5.	0.61
+	HYDROGRAPH AT	PI624G	86.	12.25	10.	3.	1.	0.07
+	HYDROGRAPH AT	PI624F	51.	12.33	8.	2.	1.	0.06
+	HYDROGRAPH AT	D624B	47.	12.25	10.	3.	1.	0.10
+	ROUTED TO	RD624B	46.	12.83	10.	3.	1.	0.10
+	HYDROGRAPH AT	PI624C	331.	12.50	51.	13.	4.	0.37
+	2 COMBINED AT	CP624C	346.	12.50	61.	16.	5.	0.44
+	DIVERSION TO	D624C	235.	12.50	41.	11.	4.	0.44
+	HYDROGRAPH AT	DO624C	111.	12.50	20.	5.	2.	0.44
+	ROUTED TO	RD624C	107.	12.67	20.	5.	2.	0.44
+	4 COMBINED AT	CP624G	405.	12.42	95.	26.	9.	0.88
+	DIVERSION TO	D624G	60.	12.42	14.	4.	1.	0.88
+	HYDROGRAPH AT	DO624G	345.	12.42	81.	22.	7.	0.88
+	ROUTED TO	RD624G	348.	12.42	81.	22.	7.	0.88
+	HYDROGRAPH AT	PI624H	59.	12.33	10.	3.	1.	0.08
+	2 COMBINED AT	CP624H	405.	12.42	91.	24.	8.	0.83
+	DIVERSION TO	DOHVC3	106.	12.42	24.	6.	2.	0.83
+	HYDROGRAPH AT	DHVC3	299.	12.42	67.	18.	6.	0.83
+	ROUTED TO	RD624H	280.	12.58	67.	18.	6.	0.83
+	HYDROGRAPH AT	D612	1055.	12.67	924.	620.	216.	12.43
+	ROUTED TO	RD612	1004.	13.00	924.	620.	216.	12.43
+	HYDROGRAPH AT	PI621A	137.	12.42	23.	6.	2.	0.17
+	3 COMBINED AT	CP621A	1317.	12.92	962.	644.	224.	10.10
+	DIVERSION TO	DOHVC4	545.	12.92	398.	266.	93.	10.10
+	HYDROGRAPH AT	DHVC4	772.	12.92	564.	377.	131.	10.10
	ROUTED TO							

+		R621A1	768.	12.92	564.	377.	131.	10.10
+	DIVERSION TO	DOHVC5	175.	12.92	129.	86.	30.	10.10
+	HYDROGRAPH AT	DHVC5	593.	12.92	435.	291.	101.	10.10
+	ROUTED TO	R621A2	593.	13.00	435.	291.	101.	10.10
+	HYDROGRAPH AT	PI621B	39.	12.25	5.	1.	0.	0.04
+	2 COMBINED AT	CP621B	607.	13.00	439.	293.	102.	4.61
+	ROUTED TO	RD621B	608.	13.00	439.	293.	102.	4.61
+	4 COMBINED AT	CPI609	1740.	12.83	1198.	754.	260.	12.71
+	DIVERSION TO	DOHVC1	899.	12.83	619.	389.	134.	12.71
+	HYDROGRAPH AT	DHVC1	841.	12.83	579.	364.	126.	12.71
+	ROUTED TO	RPI609	838.	12.92	578.	364.	126.	12.71
+	DIVERSION TO	DOHVC2	330.	12.92	228.	143.	49.	12.71
+	HYDROGRAPH AT	DHVC2	508.	12.92	351.	221.	76.	12.71
+	ROUTED TO	R6092N	506.	13.00	350.	221.	76.	12.71
+	HYDROGRAPH AT	DCAP15	248.	14.42	216.	66.	22.	39.36
+	ROUTED TO	RDCP15	246.	14.75	215.	66.	22.	39.36
+	HYDROGRAPH AT	PI606A	374.	12.50	65.	18.	6.	0.46
+	2 COMBINED AT	C606A	363.	12.50	253.	97.	32.	4.08
+	DIVERSION TO	DO606A	149.	12.50	104.	40.	13.	4.08
+	HYDROGRAPH AT	D606A	214.	12.50	149.	57.	19.	4.08
+	ROUTED TO	R606A	166.	18.25	148.	57.	19.	4.08
+	HYDROGRAPH AT	PI606	708.	12.42	147.	40.	13.	1.08
+	3 COMBINED AT	CPI606	1026.	12.67	588.	315.	108.	7.22
+	ROUTED TO	RPI606	1012.	13.00	585.	315.	108.	7.22
+	HYDROGRAPH AT	PI604	312.	12.33	63.	18.	6.	0.36
+	HYDROGRAPH AT	D606A	149.	12.50	104.	40.	13.	4.08
+	ROUTED TO	RD606A	131.	12.83	104.	40.	13.	4.08
+	2 COMBINED AT	CPI604	321.	12.67	144.	58.	19.	2.03
+	ROUTED TO	RPI604	312.	12.92	141.	58.	19.	2.03
+	HYDROGRAPH AT	PD744	531.	12.67	107.	28.	9.	0.80
+	HYDROGRAPH AT	DHVC1	899.	12.83	619.	389.	134.	12.71
+	ROUTED TO	RDHVC1	892.	13.00	618.	389.	134.	12.71
+	HYDROGRAPH AT	DHVC2	330.	12.92	228.	143.	49.	12.71
+	ROUTED TO	RDHVC2	327.	13.08	227.	143.	49.	12.71
+	HYDROGRAPH AT	PI600A	822.	12.25	76.	20.	7.	0.52
+	3 COMBINED AT	C600A	1277.	12.92	882.	553.	191.	9.50

+	ROUTED TO	RD600A	1232.	13.42	872.	553.	191.	9.50
+	HYDROGRAPH AT	PI603	418.	12.50	74.	20.	7.	0.52
+	5 COMBINED AT	CPI603	2857.	13.00	1691.	951.	328.	20.07
+	ROUTED TO	SPI603	2645.	13.42	1684.	951.	328.	20.07
+	DIVERSION TO	DO744	0.	0.00	0.	0.	0.	20.07
+	HYDROGRAPH AT	D744	2645.	13.42	1684.	951.	328.	20.07
+	HYDROGRAPH AT	CWI504	17196.	16.08	15524.	5927.	2016.	164.40
+	ROUTED TO	RWI504	17161.	16.17	15515.	5927.	2016.	164.40
+	HYDROGRAPH AT	CWI508	7401.	16.33	4749.	1821.	616.	41.34
+	DIVERSION TO	DO508	1406.	16.33	902.	346.	117.	41.34
+	HYDROGRAPH AT	D508	5995.	16.33	3847.	1475.	499.	41.34
+	HYDROGRAPH AT	WI510A	937.	12.58	151.	39.	13.	1.13
+	ROUTED TO	R510A	553.	13.75	149.	39.	13.	1.13
+	HYDROGRAPH AT	WI510	563.	13.00	179.	47.	16.	1.23
+	3 COMBINED AT	CWI510	6176.	16.25	4065.	1565.	529.	35.84
+	ROUTED TO	RWI510	6035.	16.67	3938.	1565.	529.	35.84
+	HYDROGRAPH AT	WI502	669.	12.83	179.	47.	16.	1.21
+	3 COMBINED AT	CWI502	21379.	16.58	18774.	7288.	2477.	201.44
+	ROUTED TO	RWI502	21344.	16.67	18768.	7288.	2477.	201.44
+	HYDROGRAPH AT	CWI525	1614.	12.58	834.	557.	190.	8.92
+	DIVERSION TO	DO525	101.	12.58	37.	20.	7.	8.92
+	HYDROGRAPH AT	D525	1514.	12.58	797.	538.	183.	8.92
+	ROUTED TO	RWI525	1184.	13.33	781.	537.	183.	8.92
+	HYDROGRAPH AT	DCAP10	420.	16.08	404.	253.	86.	53.75
+	ROUTED TO	RDCP10	420.	16.50	404.	252.	86.	53.75
+	HYDROGRAPH AT	PI628	695.	12.33	81.	22.	7.	0.57
+	2 COMBINED AT	CPI628	750.	12.33	413.	280.	96.	4.11
+	ROUTED TO	RPI628	616.	12.75	412.	280.	96.	4.11
+	HYDROGRAPH AT	PI624A	960.	12.58	158.	41.	14.	1.31
+	2 COMBINED AT	C624A	1500.	12.67	545.	319.	109.	5.42
+	ROUTED TO	R624A	1500.	12.67	545.	319.	109.	5.42
+	HYDROGRAPH AT	PI639A	79.	12.42	11.	3.	1.	0.09
+	2 COMBINED AT	C639A	1550.	12.67	554.	321.	110.	5.51
+	ROUTED TO	R639A	1471.	12.83	552.	321.	110.	5.51
+	HYDROGRAPH AT	WI524A	463.	12.50	68.	17.	6.	0.60

+	HYDROGRAPH AT	D525	101.	12.58	37.	20.	7.	8.92
+	ROUTED TO	RD525	63.	13.58	36.	20.	7.	8.92
+	3 COMBINED AT	C524A	1768.	12.75	641.	357.	122.	6.67
+	ROUTED TO	R524A	1766.	12.83	640.	357.	122.	6.67
+	HYDROGRAPH AT	2.8	151.	12.08	16.	5.	2.	0.08
+	2 COMBINED AT	C2.8	1776.	12.83	646.	361.	124.	6.75
+	ROUTED TO	R2.8	1759.	12.83	645.	361.	124.	6.75
+	HYDROGRAPH AT	3A	59.	12.25	6.	1.	0.	0.05
+	ROUTED TO	R3A	54.	12.33	6.	1.	0.	0.05
+	HYDROGRAPH AT	2.11	73.	12.00	7.	2.	1.	0.04
+	2 COMBINED AT	C2.11	91.	12.08	12.	3.	1.	0.08
+	ROUTED TO	R2.11	88.	12.17	12.	3.	1.	0.08
+	HYDROGRAPH AT	2.10	107.	12.08	13.	4.	1.	0.07
+	ROUTED TO	S2.10	50.	12.42	10.	3.	1.	0.07
+	HYDROGRAPH AT	2.7	250.	12.00	22.	7.	2.	0.11
+	HYDROGRAPH AT	2.4	98.	12.08	12.	4.	1.	0.07
+	ROUTED TO	S2.4	96.	12.17	12.	4.	1.	0.07
+	ROUTED TO	R2.4	91.	12.25	12.	4.	1.	0.07
+	4 COMBINED AT	C2.7	357.	12.08	55.	16.	6.	0.32
+	ROUTED TO	S2.7	1.	12.08	1.	1.	1.	0.32
+	2 COMBINED AT	C2.6	1759.	12.83	645.	362.	125.	7.07
+	ROUTED TO	R2.6	1752.	12.92	644.	362.	124.	7.07
+	HYDROGRAPH AT	2.5	152.	12.08	18.	6.	2.	0.09
+	2 COMBINED AT	CWI524	1766.	12.92	650.	367.	126.	7.17
+	DIVERSION TO	DO524	234.	12.92	27.	7.	2.	7.17
+	HYDROGRAPH AT	D524	1532.	12.92	622.	360.	124.	7.17
+	ROUTED TO	RWI524	1418.	13.17	618.	360.	124.	7.17
+	HYDROGRAPH AT	4A	162.	12.42	22.	6.	2.	0.19
+	ROUTED TO	R4A	151.	12.50	22.	6.	2.	0.19
+	HYDROGRAPH AT	2.1	201.	12.08	26.	8.	3.	0.14
+	2 COMBINED AT	C2.1	230.	12.42	47.	13.	4.	0.32
+	ROUTED TO	S2.1	229.	12.50	47.	13.	4.	0.32
+	ROUTED TO	R2.1	224.	12.58	47.	13.	4.	0.32
+	HYDROGRAPH AT	1.11	198.	12.08	25.	8.	3.	0.13
+	HYDROGRAPH AT	D524	234.	12.92	27.	7.	2.	7.17
	ROUTED TO							

+		RD524	206.	13.08	27.	7.	2.	7.17
+	3 COMBINED AT	CPI639	353.	13.00	99.	28.	9.	1.34
+	ROUTED TO	RPI639	340.	13.17	99.	28.	9.	1.34
+	HYDROGRAPH AT	WI506	961.	12.50	239.	65.	22.	1.58
+	4 COMBINED AT	CWI506	3353.	13.17	1591.	971.	334.	17.54
+	HYDROGRAPH AT	D508	1406.	16.33	902.	346.	117.	41.34
+	ROUTED TO	RD508	1389.	16.58	902.	346.	117.	41.34
+	HYDROGRAPH AT	WI500	765.	12.67	154.	40.	13.	1.05
+	4 COMBINED AT	CWI500	23515.	16.75	20602.	8472.	2882.	227.89
+	ROUTED TO	SSPILL	3018.	27.08	2999.	2754.	1896.	227.89
+	ROUTED TO	RWI500	3017.	27.67	2999.	2753.	1896.	227.89
+	HYDROGRAPH AT	PI635	622.	12.50	100.	28.	9.	0.61
+	2 COMBINED AT	CPI635	3017.	27.67	2999.	2753.	1896.	228.50
+	ROUTED TO	RPI635	3016.	28.42	2998.	2752.	1896.	228.50
+	HYDROGRAPH AT	PI621C	830.	12.42	96.	25.	8.	0.70
+	HYDROGRAPH AT	DHVC3	106.	12.42	24.	6.	2.	0.83
+	ROUTED TO	RDHVC3	94.	13.08	24.	6.	2.	0.83
+	HYDROGRAPH AT	DHVC4	545.	12.92	398.	266.	93.	10.10
+	ROUTED TO	RDHVC4	536.	13.17	398.	266.	93.	10.10
+	HYDROGRAPH AT	DHVC5	175.	12.92	129.	86.	30.	10.10
+	ROUTED TO	RDHVC5	172.	13.25	128.	86.	30.	10.10
+	4 COMBINED AT	CPI621	929.	12.42	598.	383.	133.	6.45
+	ROUTED TO	SPI621	907.	13.08	597.	381.	130.	6.45
+	ROUTED TO	RPI621	887.	13.25	592.	381.	130.	6.45
+	HYDROGRAPH AT	PI633	280.	12.50	50.	13.	4.	0.34
+	HYDROGRAPH AT	1.8	37.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.8	31.	12.08	3.	1.	0.	0.02
+	HYDROGRAPH AT	1.7	122.	12.08	13.	4.	1.	0.07
+	HYDROGRAPH AT	1.5A	26.	12.08	3.	1.	0.	0.01
+	3 COMBINED AT	C1.7	177.	12.08	19.	6.	2.	0.10
+	ROUTED TO	S1.7	111.	12.25	18.	5.	2.	0.10
+	HYDROGRAPH AT	1.9	111.	12.08	14.	4.	1.	0.07
+	HYDROGRAPH AT	1.6	83.	12.08	9.	3.	1.	0.05
+	3 COMBINED AT	C1.6	275.	12.17	39.	11.	4.	0.22
+	ROUTED TO	S1.6	234.	12.25	39.	11.	4.	0.22
+	HYDROGRAPH AT	1.10	50.	12.00	4.	1.	0.	0.02

+	ROUTED TO	R1.10	41.	12.08	4.	1.	0.	0.02
+	HYDROGRAPH AT	1.13A	54.	12.00	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14A	60.	12.08	7.	2.	1.	0.04
+	4 COMBINED AT	C1.14A	341.	12.17	55.	17.	6.	0.30
+	ROUTED TO	S1.14A	171.	12.58	35.	10.	3.	0.30
+	HYDROGRAPH AT	1.13B	36.	12.08	5.	2.	1.	0.03
+	ROUTED TO	R1.13B	30.	12.33	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14B	55.	12.08	7.	2.	1.	0.03
+	3 COMBINED AT	C1.14B	204.	12.58	45.	13.	4.	0.36
+	ROUTED TO	R1.14B	200.	12.67	45.	13.	4.	0.36
+	HYDROGRAPH AT	1.16A	57.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16A	7.	12.42	2.	1.	0.	0.03
+	ROUTED TO	R1.16A	7.	12.58	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.15A	46.	12.00	5.	1.	0.	0.02
+	ROUTED TO	S1.15A	21.	12.25	2.	1.	0.	0.02
+	HYDROGRAPH AT	1.15B	33.	12.00	4.	1.	0.	0.02
+	4 COMBINED AT	C1.15B	217.	12.58	52.	15.	5.	0.43
+	ROUTED TO	R1.15B	210.	12.75	52.	15.	5.	0.43
+	HYDROGRAPH AT	1.16B	66.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16B	7.	12.33	2.	1.	0.	0.03
+	ROUTED TO	R1.16B	6.	12.83	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.17A	89.	12.08	10.	3.	1.	0.05
+	ROUTED TO	S1.17A	15.	12.58	4.	1.	0.	0.05
+	HYDROGRAPH AT	1.17B	48.	12.08	6.	2.	1.	0.03
+	4 COMBINED AT	C1.17B	236.	12.75	62.	19.	6.	0.54
+	ROUTED TO	R1.17B	233.	12.83	62.	19.	6.	0.54
+	HYDROGRAPH AT	1.3	55.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.3	2.	13.33	1.	0.	0.	0.03
+	ROUTED TO	R1.3	2.	13.92	1.	0.	0.	0.03
+	HYDROGRAPH AT	1.2	180.	12.08	20.	6.	2.	0.11
+	ROUTED TO	S1.2	5.	13.92	3.	1.	0.	0.11
+	3 COMBINED AT	C636	233.	12.83	65.	20.	7.	0.68
+	ROUTED TO	RPI636	229.	12.83	65.	20.	7.	0.68
+	HYDROGRAPH AT	D624C	235.	12.50	41.	11.	4.	0.44
+	ROUTED TO	RD624C	217.	12.75	41.	11.	4.	0.44

+	HYDROGRAPH AT	D624G	60.	12.42	14.	4.	1.	0.88
+	ROUTED TO	RD624G	56.	12.83	14.	4.	1.	0.88
+	HYDROGRAPH AT	4B	401.	12.42	47.	12.	4.	0.38
+	3 COMBINED AT	C4B	555.	12.50	102.	26.	9.	0.81
+	ROUTED TO	R4B	551.	12.58	101.	26.	9.	0.81
+	HYDROGRAPH AT	1.5B	33.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.5B	3.	12.67	1.	0.	0.	0.02
+	2 COMBINED AT	C1.5B	552.	12.58	102.	26.	9.	0.83
+	ROUTED TO	R1.5B	549.	12.58	102.	26.	9.	0.83
+	HYDROGRAPH AT	1.5C	34.	12.00	3.	1.	0.	0.01
+	ROUTED TO	S1.5C	2.	12.42	1.	0.	0.	0.01
+	ROUTED TO	R1.5C	1.	12.75	1.	0.	0.	0.01
+	HYDROGRAPH AT	1.4	58.	12.00	6.	2.	1.	0.03
+	ROUTED TO	S1.4	0.	23.50	0.	0.	0.	0.03
+	3 COMBINED AT	C624	549.	12.58	102.	26.	9.	0.87
+	HYDROGRAPH AT	PI624	281.	12.67	56.	14.	5.	0.45
+	3 COMBINED AT	CPI624	989.	12.67	218.	59.	20.	2.00
+	ROUTED TO	SPI624	815.	13.00	138.	38.	13.	2.00
+	ROUTED TO	RPI624	563.	13.50	136.	38.	13.	2.00
+	4 COMBINED AT	CPI633	3339.	26.25	3303.	2920.	1994.	237.28
+	ROUTED TO	RPI633	3339.	26.83	3302.	2919.	1994.	237.28
+	HYDROGRAPH AT	PI600	731.	12.33	87.	23.	8.	0.61
+	3 COMBINED AT	CPI600	4143.	24.50	4046.	3338.	2266.	257.95
+	ROUTED TO	RPI600	4138.	24.92	4042.	3338.	2265.	257.95

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SSPILL
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.56	0.00	17661.	4092.	0.00	25.92	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.75	0.00	16294.	3751.	0.00	26.25	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.50	0.00	15899.	3643.	0.00	26.33	0.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.06	0.00	15198.	3452.	0.00	26.58	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.64	0.00	14526.	3269.	0.00	26.75	0.00

PLAN 6 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.42	0.00	14170.	3172.	0.00	26.92	0.00

PLAN 7 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.13	0.00	13704.	3045.	0.00	27.08	0.00

PLAN 8 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.93	0.00	13394.	2960.	0.00	27.17	0.00

PLAN 9 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.62	0.00	12889.	2823.	0.00	27.25	0.00

*** NORMAL END OF HEC-1 ***

Preferred Alternative 100-Year 24-Hour Storm HEC-1 Model

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1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   23NOV10  TIME  14:01:01  *
*                                      *
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*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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1                                    HEC-1 INPUT                                    PAGE  1

  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

    1           ID   HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
    2           ID   100-YEAR 24-HOUR STORM
    3           ID   PREFERRED ALTERNATIVE EXISTING CONDITIONS
    4           ID   ******************************************************************************
    5           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
    6           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
    7           ID   ******************************************************************************
    8           ID   **                                                                          **
    9           ID   **  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY    **
   10           ID   **                                                                          **
   11           ID   ******************************************************************************
   12           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
   13           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
   14           ID   ******************************************************************************
   15           ID   **                                                                          **
   16           ID   ** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS    **
   17           ID   ** DATED OCTOBER 2004:                                                      **
   18           ID   **                                                                          **
   19           ID   **     -Diversion added after CTW480                                        **
   20           ID   **          -Main flow (5%) to CTW478                                       **
   21           ID   **          -Diverted flow (95%) to CWI584                                  **
   22           ID   **          -Added concentration point CWI584 combining RD480 and WI584     **
   23           ID   **          -Hard coding was added to CTW478                                **
   24           ID   **          -Route added after D480 (Diversion Recovery)                    **
   25           ID   **          -Route RWI584 was adjusted                                      **
   26           ID   **          -Storage Route SCP050 was adjusted                              **
   27           ID   **          -Route R508* was adjusted                                       **
   28           ID   **          -Hard coding for CWI510 was adjusted                            **
   29           ID   **                                                                          **
   30           ID   **     -Diversion D618 was moved from after CPI618 to before RDCP12         **
   31           ID   **          -Updated route RD618 information                                **
   32           ID   **          -Hard coding on CPI618 was adjusted                             **
   33           ID   **          -Hard coding on CPI615 was adjusted                             **
   34           ID   **                                                                          **
   35           ID   **     -Route RPI639 changed from following US60 to CPI636 to route         **
   36           ID   **      through US60/RR structures and combine with CWI506                  **
   37           ID   **          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from  **
   38           ID   **           following R624A to follow RWI524                               **
   39           ID   **          -CPI636 was removed-no longer needed to combine PI636 & RPI639  **
   40           ID   **          -RPI639 information was changed to reflect new route            **
   41           ID   **          -CWI506 changed from combining 3 to combine 4:                  **
   42           ID   **           RWI525, RWI524, RPI639 & WI506                                 **
   43           ID   **          -Hard coding on CWI506 was adjusted                             **
   44           ID   **          -Hard Coding on CWI500 was adjusted                             **
   45           ID   **                                                                          **
   46           ID   ******************************************************************************
   47           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
   48           ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
   49           ID   ******************************************************************************
   50           ID
   51           ID
   52           ID
   53           ID   ******************************************************************************
   54           ID   ******************************************************************************
   55           ID   **                                                                          **
1                                    HEC-1 INPUT                                    PAGE  2

  LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   56           ID   **    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004        **
   57           ID   **                                                                          **
   58           ID   ******************************************************************************
   59           ID   ******************************************************************************
   60           ID
   61           ID   PROJECT:                Wittmann ADMS Update
   62           ID   CLIENT:                 Flood Control District of Maricopa County
   63           ID   PREPARED BY:            Entellus, Inc.
   64           ID   PROJECT No:             FCD 2002C029              Entellus 310.032
```

```
 65          ID   FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
 66          ID                                          MODIFIED DATE: MAY 04, 2005
 67          ID
 68          ID   STORM:
 69          ID                        100-year 24-hour Storm
 70          ID
 71          ID   DEVELOPMENT CONDITIONS:
 72          ID                        Existing Conditions
 73          ID
 74          ID   MODELING ASSUMPTIONS:
 75          ID                        It was assumed that the US60 did not have adequate
 76          ID                        storage to cause any significant attenuation.
 77          ID
 78          ID                        The assumption was made that the CAP Canal embankment
 79          ID                        would not be breached under a large flood event.
 80          ID
 81          ID                        The assumption was made that the Beardsley Canal would
 82          ID                        not fail under a large storm event (Per District
 83          ID                        Instruction).  In addition, the berm north of the
 84          ID                        Beardsley canal and east of US60 was assumed to fail
 85          ID                        (per district Instruction).
 86          ID
 87          ID                        For both the CAP and Beardsley Canals, once the berm
 88          ID                        elevation was reached weir flow was assumed.  It was
 89          ID                        also assumed that any weir flow over the canal that
 90          ID                        might enter the canal and be diverted out of the study
 91          ID                        area was insignificant, and thus was ignored.  In other
 92          ID                        words all weir flow over the canal embankment reaches
 93          ID                        the downstream concentration point.
 94          ID
 95          ID                        Typical X-sects were developed, and it was assumed
 96          ID                        that a typical x-sect could adequately represent
 97          ID                        various reaches.
 98          ID
 99          ID                        Time-Area Relations were used base on the District's
100          ID                        Hydrology Manual criteria.  Two Time-Area Relation
101          ID                        Curves were utilized:
102          ID                                -Urban
103          ID                                -Natural
104          ID                        The Time-Area Relation Curves were taken directly
105          ID                        from the manual
106          ID
107          ID   MODELING METHODS:
108          ID                        This model utilizes QI cards to input the Padelford
109          ID                        hydrographs from the 100-year 6-hour existing
110          ID                        conditions model developed by A-N West Inc. for the
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

111          ID                        Padelford Wash Floodplain Delineation Study.  The
112          ID                        hydrograph was altered from its original form
113          ID                        (2-minute interval to 5-minute interval) through
114          ID                        simple interpolation.
115          ID
116          ID                        Clark Unit Hydrographs were used for all subbasins
117          ID                        except the two subbasins directly upstream of the
118          ID                        Bonita Dam (PD726B and PD740 use S-graphs).  The UC
119          ID                        parameters were calculated using the WMS7.0 software.
120          ID
121          ID                        For Basins PD726B and PD740 S-Graphs were utilized per
122          ID                        the request of the FCDMC.  Limited details regarding
123          ID                        the calculations of the S-graphs can be found in the
124          ID                        model by the basin KK card.  For full details of the
125          ID                        S-graph calculations refer to the Appendix.
126          ID
127          ID                        Normal Depth routing was used for all routing reaches.
128          ID
129          ID                        Hard coding was used to account for the percentage of
130          ID                        area associated with a diversion.  Because of the use
131          ID                        of JD cards and aereal reduction, hard coding  was
132          ID                        necessary to properly account for area.  For a given
133          ID                        diversion a percentage of the flow is routed to two
134          ID                        different locations.  The same percentage of area
135          ID                        follows that diverted flow.  In addition the area
136          ID                        downstream of the main path is reduced or increased and
137          ID                        is hard coded to account for the loss or gain of area.
138          ID                        Hard coding was performed based on the 24-hour existing
139          ID                        conditions model.
140          ID
141          ID                        Stage-storage was developed for all the structures
142          ID                        along the CAP Canal, as well as along the Beardsley
143          ID                        Canal.  In addition several stage-storage locations
144          ID                        were developed for areas with significant storage
145          ID                        along the SR74.  No storage was modeled along the US60
146          ID                        and railroad, but the culverts were analyzed for
147          ID                        diversion potential.  Diversions were placed in the
148          ID                        model where deemed appropriate.  See appendix for
149          ID                        details.
150          ID
151          ID                        FLO-2D was utilized to calculate the split flows at
152          ID                        concentration points CIW351. CIW357, CIW363 and CWI576.
153          ID                        See appendix for modeling details.
154          ID
155          ID   ******************************************************************************
156          ID   ******************************************************************************
157          ID
             *DIAGRAM
158          IT       5                0    1500
159          IO       5
160          IN      15                0
161          JD    4.18     0.01
             * 24-hour distribution
162          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
163          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 164          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 165          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 166          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 167          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 168          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 169          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 170          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 171          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 172          JD   3.929    10.0
 173          JD   3.856    20.0
 174          JD   3.725    40.0
 175          JD   3.599    80.0
 176          JD   3.532   120.0
 177          JD   3.444   200.0
 178          JD   3.385   300.0
 179          JD   3.289   500.0
              *
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP110

 180          KK  DCAP11
 181          BI  DCAP11      22
              *
              *
              * ROUTE UPDATED 4/14/4

 182          KK  RDCP11
 183          RS       5    FLOW     0.0     0.0
 184          RC   0.043   0.035   0.043    6377  0.0094
              * PITS10_2
 185          RX       0      89     103     136     185     206     261     280
 186          RY    1612  1610.5    1610  1608.5    1610    1611  1611.8    1612
              *
              * CAP Diversion Recovery: Outflow from structure CAP120

 187          KK  DCAP12
 188          BI  DCAP12      22
              *
              *
              * Diversion Out: Flow split FS11
              * Flow Split Diversion: Main path to CPI618, Diversion to CPI615
              * 53% of flow is diverted to CPI615

 189          KK    D618
 190          DT   DO618     0.0     0.0
 191          DI       0   10000
 192          DQ       0    5300
              *
              *
              * ROUTE UPDATED 4/14/4
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 193          KK  RDCP12
 194          RS       2    FLOW     0.0     0.0
 195          RC   0.043   0.035   0.043    6159  0.0094
              * PITS30
 196          RX       0      49     199     206     222     231     299     375
 197          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *

 198          KK   PI618
 199          BA  0.2886
 200          LG   0.281   0.235   4.623   0.332    9.32
 201          UC   0.500   0.407
              * Natural Time-Area Relation
 202          UA       0       3       5       8      12      20      43      75      90      96
 203          UA     100
              *
              *
              * Combines PI618, RDCP12 and RDCP11

 204          KK  CPI618
              * Hard Coded
 205          HC       3    5.48
              *
              *
              * ROUTE UPDATED 4/14/04

 206          KK  RPI618
 207          RS       5    FLOW     0.0     0.0
 208          RC   0.043   0.035   0.043   10443  0.0075
              * PITS20
 209          RX       0      50      84      87     123     125     156     285
 210          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP130

 211          KK  DCAP13
 212          BI  DCAP13      22
              *
              *
              * ROUTE UPDATED 4/14/4

 213          KK  RDCP13
 214          RS       6    FLOW     0.0     0.0
 215          RC   0.043   0.035   0.043   11034  0.0089
              * PITS30
```

```
 216          RX       0      49     199     206     222     231     299     375
 217          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                          HEC-1 INPUT                                                    PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 218          KK   PI615
 219          BA  0.8419
 220          LG   0.299   0.243   4.318   0.409   8.997
 221          UC   0.771    0.57
              * Urban Time-Area Relation
 222          UA       0       5      16      30      65      77      84      90      94      97
 223          UA     100
              *
              *
              * Diversion Recovery: Flow split FS11

 224          KK    D618
 225          DR   DO618
              *
              *
              * ROUTE UPDATED 05/04/2005

 226          KK   RD618
 227          RS       5    FLOW     0.0     0.0
 228          RC   0.043   0.035   0.043    9630  0.0091
              * PITS20
 229          RX       0      50      84      87     123     125     156     285
 230          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * Combines RD618, PI615 and RDCP13

 231          KK  CPI615
              * Hard Coded
 232          HC       3    6.21
              *
              *
              * ROUTE UPDATED 4/14/04

 233          KK  RPI615
 234          RS       2    FLOW     0.0     0.0
 235          RC   0.043   0.035   0.043    5109  0.0079
              * PITS20
 236          RX       0      50      84      87     123     125     156     285
 237          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 238          KK   PI612
 239          BA  0.7377
 240          LG   0.337    0.25   4.365     0.4   6.284
 241          UC   0.883   0.770
              * Natural Time-Area Relation
 242          UA       0       3       5       8      12      20      43      75      90      96
 243          UA     100
              *
              *
1                                          HEC-1 INPUT                                                    PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 244          KK  PI624B
 245          KM   OFFSITE SUBBASIN PI624B (North of Jomax Road, upstream of 36" culvert)
 246          BA   0.098
 247          LG   0.433   0.250   4.300   0.531   2.226
 248          UC   0.558   0.644
              * Natural Time-Area Relation
 249          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 250          UA     100
              *
              * Diversion to RX624B - Max Flow in 36" culvert w/4' depth = 47cfs (From DEI)
              *

 251          KK  DO624B
 252          KM   36" CONC CULVERT
 253          DT   D624B
 254          DI       0      47      87     200
 255          DQ       0      47      47      47
              *
              * ROUTE REMAINDER TO CP624D (From DEI)
              *

 256          KK  RX624B
 257          RS       3    FLOW     0.0     0.0
 258          RC   0.043   0.035   0.043    2000   0.006
 259          RX       0       4       8      12      20      24      28      32
 260          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 261          KK  PI624D
 262          KM   OFFSITE SUBBASIN PI624D (North of Jomax Road, upstream of 3-8x4 Box Culvert)
 263          BA   0.323
 264          LG   0.362   0.261   4.449   0.404   4.520
 265          UC   0.783   0.763
              * Natural Time-Area Relation
 266          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 267          UA     100
              * Hard Coded
```

```
 268          KK  CP624D
 269          HC       2    0.35
              *
              * MAIN FLOW NORTH RESTRICTION @ DESERT OASIS 3-8x4 BC CAPACITY TO DITCH
              * DIVERSION IS TO WASH 5 EAST

 270          KK   D624D
 271          DT  DO624D
 272          DI       0     380     400
 273          DQ       0     380     380
              *
              * ROUTING FROM DEI
1                                          HEC-1 INPUT                                                    PAGE  8

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 274          KK  RX624D
 275          RS       3    FLOW     0.0     0.0
 276          RC   0.043   0.035   0.043    3854   0.006
 277          RX       0       4       8      12      20      24      28      32
 278          RY    1454    1453    1452    1450    1450    1452    1452    1454
              * COMBINES PI612, RPI618, RPI615, and FLOW FROM NORTH RESTRICTION @ DESERT OASIS

 279          KK  CPI612
              * Hard Coded
 280          HC       4   12.43
              *
              *
              * Diversion Out: Flow split FS12
              * Flow Split Diversion: Main path to CPI609, Diversion to PI621

 281          KK    D612
 282          DT   DO612     0.0     0.0
 283          DI       0   10000
 284          DQ       0    7500
              *
              *
              * ROUTE UPDATED 4/14/04

 285          KK  RPI612
 286          RS       3    FLOW     0.0     0.0
 287          RC   0.043   0.035   0.043    5754   0.006
              * PITS20
 288          RX       0      50      84      87     123     125     156     285
 289          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP140

 290          KK  DCAP14
 291          BI  DCAP14      22
              *
              *
              * ROUTE UPDATED 4/14/4

 292          KK  RDCP14
 293          RS      12    FLOW     0.0     0.0
 294          RC   0.043   0.035   0.043   20386  0.0086
              * PITS30
 295          RX       0      49     199     206     222     231     299     375
 296          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                          HEC-1 INPUT                                                    PAGE  9

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 297          KK   PI609
 298          BA  1.9353
 299          LG   0.321   0.247   4.529   0.368   8.386
 300          UC   1.146   0.915
              * Urban Time-Area Relation
 301          UA       0       5      16      30      65      77      84      90      94      97
 302          UA     100
              *
              * Diversion Recovery: WASH 5 EAST IN DESERT OASIS

 303          KK   D624D
 304          DR  DO624D

 305          KK  RD624D
 306          RS       2    FLOW     0.0     0.0
 307          RC   0.043   0.035   0.043    3140   0.008
 308          RX       0       4       8      12      27      31      35      39
 309          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              * ******************************************************************************
              * DESERT OASIS DEVELOPMENT ******************************************************
              * ******************************************************************************
              *

 310          KK  PI624E
 311          KM   OFFSITE SUBBASIN PI624E
 312          BA   0.257
 313          LG    0.25    0.25    4.55   0.419      35
 314          UC   0.250   0.121
              * Urban Time-Area Relation
 315          UA       0       5      16      30      65      77      84      90      94      97
 316          UA     100
              *
              * RETENTION DIVERSION 80% OF REQUIRED 164 acres * 2.85/12 * 0.60 = 23.4 AcreFt
              * USE=18.75 AcreFt
```

```
317          KK  624ERT
318          KO       0       0
319          DT  RET624   18.75
320          DI   10000
321          DQ   10000
             * Hard Coded

322          KK  CP624E
323          HC       2   0.609

324          KK  RD624E
325          RS       3    FLOW     0.0     0.0
326          RC   0.043   0.035   0.043    2793   0.007
327          RX       0       4       8      12      27      31      35      39
328          RY    1454    1453    1452    1450    1450    1452    1452    1454
1                                         HEC-1 INPUT                                                          PAGE 10

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

329          KK  PI624G
330          KM   OFFSITE SUBBASIN PI624G (Undeveloped Desert Oasis Parcel)
331          BA   0.074
332          LG   0.350   0.250   4.550   0.354   5.000
333          UC   0.417   0.375
             * Natural Time-Area Relation
334          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
335          UA     100
             *

336          KK  PI624F
337          KM   OFFSITE SUBBASIN PI624F (Undeveloped Asante)
338          BA   0.060
339          LG   0.350   0.250   4.550   0.354   5.000
340          UC   0.492   0.603
             * Natural Time-Area Relation
341          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
342          UA     100
             *
             *
             * Diversion Recovery: Flow Split D624B (36" Culvert)

343          KK   D624B
344          DR   D624B

345          KK  RD624B
346          RS       8    FLOW     0.0     0.0
347          RC   0.043   0.035   0.043    6800   0.007
348          RX       0     170     195     198     201     204     241     414
349          RY    1434    1432    1430    1428    1428    1430    1432    1434
             *

350          KK  PI624C
351          BA   0.372
352          LG   0.350   0.250   4.692   0.320   5.000
353          UC   0.675   0.515
             * Natural Time-Area Relation
354          UA       0       3       5       8      12      20      43      75      90      96
355          UA     100
             *

356          KK  CP624C
             * Hard Coded
357          HC       2    0.44
             *

358          KK  DO624C
359          KM   Asante Berm Breach
360          DT   D624C
361          DI       0     346
362          DQ       0     235
1                                         HEC-1 INPUT                                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

363          KK  RD624C
364          RS       3    FLOW     0.0     0.0
365          RC   0.043   0.035   0.043    1585  0.0032
366          RX       0    15.8    46.6    52.8    58.5    65.5    67.3    74.1
367          RY  1390.3    1390  1388.6    1388  1386.9    1387    1388    1390
             * CONCENTRATION POINT @ 163RD Ave Culvert (Wash 5 East)
             * Hard Coded

368          KK  CP624G
369          HC       4    0.88

370          KK  DO624G
371          KM   163rd Ave Culvert Flow Split
372          DT   D624G
373          DI       0     409
374          DQ       0      61
             * Happy Valley Channel Cross Section 1

375          KK  RD624G
376          RS       1    FLOW     0.0     0.0
377          RC   0.035   0.035   0.035     442  0.0024
378          RX       0      15      30      38      46      54      69      84
379          RY       5     2.5       0       0       0       0     2.5       5

380          KK  PI624H
381          KM   OFFSITE SUBBASIN PI624H (Undeveloped Desert Oasis Parcel)
382          BA   0.075
383          LG   0.350   0.250   4.550   0.354   5.000
384          UC   0.521   0.663
             * Natural Time-Area Relation
```

```
385          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
386          UA     100
             *

387          KK  CP624H
388          HC       2
             * Happy Valley Channel Cross Section 1

389          KK  RD624H
390          RS       1    FLOW     0.0     0.0
391          RC   0.035   0.035   0.035     550  0.0024
392          RX       0      15      30      38      46      54      69      84
393          RY       5     2.5       0       0       0       0     2.5       5
             * Happy Valley Channel Cross Section 2

394          KK  RD624H
395          RS       1    FLOW     0.0     0.0
396          RC   0.035   0.035   0.035     985  0.0019
397          RX       0      15      30      50      70      96     111     126
398          RY       5     2.5       0       0       0       0     2.5       5
             * Diversion Recovery: Flow split FS12
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

399          KK    D612
400          DR   DO612
             *
             *
             * ROUTE UPDATED 4/14/4
             * Length and Slope Updated

401          KK   RD612
402          RS       4    FLOW     0.0     0.0
403          RC   0.043   0.035   0.043    4537  0.0066
             * PITS20
404          RX       0      50      84      87     123     125     156     285
405          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *

406          KK  PI621A
407          KM   OFFSITE SUBBASIN PI621A
408          BA   0.167
409          LG   0.350   0.250   4.550   0.354   5.000
410          UC   0.608   0.603
             * Natural Time-Area Relation
411          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
412          UA     100
             *
             * Hard Coded

413          KK  CP621A
414          HC       3   10.31
             * Happy Valley Channel Cross Section 2

415          KK  RD621A
416          RS       1    FLOW     0.0     0.0
417          RC   0.035   0.035   0.035    1587  0.0019
418          RX       0      15      30      50      70      96     111     126
419          RY       5     2.5       0       0       0       0     2.5       5

420          KK  PI621B
421          KM   OFFSITE SUBBASIN PI621B
422          BA   0.035
423          LG   0.350   0.250   4.550   0.354   5.000
424          UC   0.362   0.427
             * Natural Time-Area Relation
425          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
426          UA     100
             *

427          KK  CP621B
428          HC       2
             * Happy Valley Channel Cross Section 3
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

429          KK  RD621B
430          RS       1    FLOW     0.0     0.0
431          RC   0.035   0.035   0.035     342  0.0017
432          RX       0      15      30      80     100     160     175     190
433          RY       5     2.5       0       0       0       0     2.5       5
             * Combines RPI612, RDCP14, PI609, RD621B

434          KK  CPI609
             * Hard Coded
435          HC       4   18.45
             *
             *
             * Happy Valley Channel Cross Section 3

436          KK  R609-1
437          RS       1    FLOW     0.0     0.0
438          RC   0.035   0.035   0.035     615  0.0026
439          RX       0      15      30      56      82     132     147     162
440          RY       5     2.5       0       0       0       0     2.5       5
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A

441          KK   DHVC1
442          DT  DOHVC1     0.0     0.0
443          DI       0    2393
444          DQ       0    1689
```

```
                 * Happy Valley Channel Cross Section 4

445              KK  R609-2
446              RS       3    FLOW     0.0     0.0
447              RC   0.035   0.035   0.035    4635  0.0024
448              RX       0      15      30      35      45      52      67      82
449              RY       5     2.5       0       0       0       0     2.5       5
                 *

450              KK  DCAP15
451              BI  RDCP15      22
                 * ROUTE UPDATED 4/14/4

452              KK  RDCP15
453              RS       6    FLOW     0.0     0.0
454              RC   0.043   0.035   0.043    9602  0.0106
                 * PITS30
455              RX       0      49     199     206     222     231     299     375
456              RY    1532    1532    1530    1528    1528    1530    1532    1532
                 *
                 *

457              KK  PI606A
458              BA  0.4572
459              LG   0.308   0.245   4.449   0.378  10.151
460              UC   0.667   0.586
                 * Natural Time-Area Relation
461              UA       0       3       5       8      12      20      43      75      90      96
1                                          HEC-1 INPUT                                                PAGE 14

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

462              UA     100
                 *
                 *
                 * COMBINES BASIN PI606A, RDCP15

463              KK   C606A
                 * Hard Coded
464              HC       2    4.08
                 *
                 *
                 * Diversion Out: Flow split FS14
                 * Flow Split Diversion: Main path to CPI606, Diversion to CPI604
                 * 41% of flow is diverted to CPI604

465              KK   D606A
466              DT  DO606A     0.0     0.0
467              DI       0   10000
468              DQ       0    4100
                 *
                 *
                 * ROUTE UPDATED 4/14/4

469              KK   R606A
470              RS       7    FLOW     0.0     0.0
471              RC   0.043   0.035   0.043   12583  0.0081
                 * PDTS30
472              RX       0      47     318     322     356     364     463     604
473              RY    1416    1414    1410    1408    1408    1410    1412    1414
                 *
                 *

474              KK   PI606
475              BA  1.0765
476              LG   0.324    0.25   4.383   0.419  10.725
477              UC   0.879   0.635
                 * Urban Time-Area Relation
478              UA       0       5      16      30      65      77      84      90      94      97
479              UA     100
                 *
                 *
                 * COMBINES BASIN PI606, R606A, AND RPI609

480              KK  CPI606
                 * Hard Coded
481              HC       3    8.92
                 *
                 *
                 * ROUTE UPDATED 4/14/04

482              KK  RPI606
483              RS       3    FLOW     0.0     0.0
484              RC   0.043   0.035   0.043    2654  0.0055
                 * TSR606
485              RX       0     241     598     949    1098    1381    2002    2039
486              RY    1354    1354    1350    1348    1348    1350    1352    1354
                 *
                 *
1                                          HEC-1 INPUT                                                PAGE 15

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

487              KK   PI604
488              BA  0.3628
489              LG   0.307    0.25    4.97   0.285  22.848
490              UC   0.688   0.579
                 * Urban Time-Area Relation
491              UA       0       5      16      30      65      77      84      90      94      97
492              UA     100
                 *
                 *
                 * Diversion Recovery: Flow split FS14

493              KK   D606A
```

```
494          DR  DO606A
             *
             *
             * ROUTE UDPATED 4/14/4

495          KK  RD606A
496          RS       6    FLOW     0.0     0.0
497          RC   0.043   0.035   0.043    7507  0.0087
             * PITS30
498          RX       0      49     199     206     222     231     299     375
499          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *
             * Combines RD606A and PI604

500          KK  CPI604
             * Hard Coded
501          HC       2    2.03
             *
             *
             * ROUTE UPDATED 4/14/04

502          KK  RPI604
503          RS       4    FLOW     0.0     0.0
504          RC   0.043   0.035   0.043    7442   0.007
             * PDTS30
505          RX       0      47     318     322     356     364     463     604
506          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *

507          KK   PD744
508          BA  0.7975
509          LG   0.342   0.249   4.427   0.357   5.989
510          UC   0.908   0.725
             * Natural Time-Area Relation
511          UA       0       3       5       8      12      20      43      75      90      96
512          UA     100
             *
             *Diversion Recovery
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

513          KK  DHVC1
514          DR  DOHVC1
             * 155TH AVE Channel Section 1

515          KK  RDHVC1
516          RS       3    FLOW     0.0     0.0
517          RC   0.035   0.035   0.035    4900  0.0018
518          RX       0      15      30      60      90     116     131     146
519          RY       5     2.5       0       0       0       0     2.5       5
             *

520          KK  PI600A
521          BA    0.56
522          LG   0.345   0.247   5.176   0.253   4.930
523          UC   0.538   0.266
             * Natural Time-Area Relation
524          UA       0       3       5       8      12      20      43      75      90      96
525          UA     100
             * Hard Coded

526          KK   C600A
527          HC       2   13.58

528          KK   PI603
529          BA  0.5190
530          LG   0.344    0.25    4.66   0.316   7.957
531          UC   0.738   0.615
             * Natural Time-Area Relation
532          UA       0       3       5       8      12      20      43      75      90      96
533          UA     100
             *
             *
             * COMBINES RD600A, RPI606, RPI604, PD744 AND PI603

534          KK  CPI603
535          HC       5
             *
             *
             *
             * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
             * *** This storage includes the storage at basins PI603, PI600A and PD744
             * *** The Discharge represents the Discharge through the Beardsley Canal
             * *** structure as well as the weir flow across PI603, PI600A and PD744,
             * *** so the SQ card can be calculated by adding the flows for basins PI603
             * *** and PD744 as found in the appendix.
             * *** The Weir flow across PD744 is diverted out on the next KK card.
             * *** The weir flow for Basin PI600A is not diverted, because both
             * *** flows (from PI600A and PI603) go to CPI600.
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

536          KK  SPI603
537          RS       1    STOR       0
538          SQ       0     309     874    1605    2471    3453    4539   14797   33095   56636
539          SQ   84417
540          SE    1338    1339    1340    1341    1342    1343    1344  1344.5    1345  1345.5
541          SE    1346
             *
             * ADDITIONAL STORAGE ON STATE LAND PROPERTY
```

```
542          SA        0   28.57   33.69   52.61   87.31   87.33   87.35
543          SE     1336    1338    1340    1342    1344    1345    1346
             *
             *
             * This diversion is only weir flow across the boundary of Basin PD744
             * over the Beardsley Canal to CPD720.  This Diversion is being combined
             * with CPD726 and they are routed together.
             *
             * For overtopping of the berm, the Weir equation was used.
             * Q=C*L*H^1.5
             * C was assumed to be 2.7
             * L, the length of the weir was the basin boundary along the canal = 3652 ft
             * Berm Elevation was 1344
             * *** The remaing flow goes to CPI600 ***

544          KK    D744
545          DT   DO744     0.0     0.0
546          DI       0     309     874    1605    2471    3453    4539   14797   33095   56636
547          DI   84417
548          DQ       0       0       0       0       0       0       0    3486    9860   18115
549          DQ   27889
             *

550          KK  CWI504
551          BI  CWI504      22
             * ROUTE UPDATED 4/14/04

552          KK  RWI504
553          RS       1    FLOW     0.0     0.0
554          RC   0.045   0.035   0.045    1494   0.001
             * McMicken Dam Channel
555          RX       0      46     101     121     171     181    1421    3621
556          RY      25      14       4       0       0       4      14      25
             *

557          KK  CWI508
558          BI  CWI508      22
             *
             * Diversion Out: Flow split FS10
             * Flow Split Diversion: Main path to CWI510, Diversion to CWI500
             * 19% of flow is diverted to CWI500
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

559          KK    D508
560          DT   DO508     0.0     0.0
561          DI       0   10000
562          DQ       0    1900
             *
             *

563          KK  WI510A
564          BA  1.1293
565          LG   0.337    0.26   4.622   0.338   5.191
566          UC   0.813   0.521
             * Natural Time-Area Relation
567          UA       0       3       5       8      12      20      43      75      90      96
568          UA     100
             *
             *
             * ROUTE UPDATED 4/14/4

569          KK   R510A
570          RS       8    FLOW     0.0     0.0
571          RC    0.04    0.04    0.04   17257  0.0051
             * WITS70
572          RX       0     450     700    1284    1435    1499    1745    2500
573          RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
             *
             *

574          KK   WI510
575          BA  1.2273
576          LG   0.339   0.274   5.732   0.204   5.364
577          UC   1.313   1.287
             * Natural Time-Area Relation
578          UA       0       3       5       8      12      20      43      75      90      96
579          UA     100
             *
             *
             * COMBINES CWI508, WI510 AND R510A

580          KK  CWI510
             * Hard Coded
581          HC       3   35.84
             *
             *
             * ROUTE UPDATED 4/14/04

582          KK  RWI510
583          RS       2    FLOW     0.0     0.0
584          RC    0.04    0.04    0.04    6492  0.0048
             * WITS70
585          RX       0     450     700    1284    1435    1499    1745    2500
586          RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
             *
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

587          KK   WI502
588          BA  1.2082
```

```
589          LG   0.344   0.251   5.448   0.229   6.516
590          UC   1.179   1.004
             * Natural Time-Area Relation
591          UA       0       3       5       8      12      20      43      75      90      96
592          UA     100
             *
             *
             * COMBINES WI502, RWI510 AND RWI504

593          KK  CWI502
594          HC       3
             *
             *
             * ROUTE UPDATED 4/14/04

595          KK  RWI502
596          RS       1    FLOW     0.0     0.0
597          RC   0.045   0.035   0.045    1679  0.0026
             * McMicken Dam Channel
598          RX       0      46     101     121     171     181    1421    3621
599          RY      25      14       4       0       0       4      14      25
             *

600          KK  CWI525
601          BI  CWI525      22
             *
             * Railroad Diversion: Main path to CWI506, Diversion to CWI524
             * From Structure RR630 and RR640, See Appendix D.5 for analysis

602          KK    D525
603          DT   DO525     0.0     0.0
604          DI       0     269     463     699     969
605          DQ       0       0       9      26      48
             *
             *
             * ROUTE UPDATED 4/14/04

606          KK  RWI525
607          RS       6    FLOW     0.0     0.0
608          RC   0.043   0.035   0.043   11015  0.0064
             * WITS130
609          RX       0     400     456     575     620     650     660     682
610          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *
             * CAP Diversion Recovery: Outflow from structure CAP100

611          KK  DCAP10
612          BI  DCAP10      22
             *
             *
             * ROUTE UPDATED 4/14/4
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

613          KK  RDCP10
614          RS       4    FLOW     0.0     0.0
615          RC   0.043   0.035   0.043    6701  0.0081
             * WITS120
616          RX       0     100     292     409     492     567     718     886
617          RY    1511    1510  1509.5  1507.5    1506    1509  1510.5    1511
             *
             *

618          KK   PI628
619          BA  0.5695
620          LG   0.285    0.25    4.56   0.349   8.902
621          UC   0.538   0.316
             * Natural Time-Area Relation
622          UA       0       3       5       8      12      20      43      75      90      96
623          UA     100
             *
             *
             * Combines PI628 and RDCP10

624          KK  CPI628
             * Hard Coded
625          HC       2    4.11
             *
             *
             * ROUTE UPDATED 10/25/10

626          KK  RPI628
627          RS       6    FLOW     0.0     0.0
628          RC   0.043   0.035   0.043    7825  0.0077
             * PITS20
629          RX       0      50      84      87     123     125     156     285
630          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             *

631          KK  PI624A
632          BA   1.306
633          LG    0.34    0.34    4.55    0.35       3
634          UC   0.861   0.562
             * Natural Time-Area Relation
635          UA       0       3       5       8      12      20      43      75      90      96
636          UA     100
             *
             *
             * COMBINES RPI628 AND PI624A

637          KK   C624A
638          HC       2
             *
```

```
                    *
                    * Asante Channel From DEI
                    * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)
1                                          HEC-1 INPUT                                                    PAGE 21

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 639                KK   R624A
 640                RS       1    FLOW     0.0     0.0
 641                RC   0.035   0.035   0.035     680  0.0050
 642                RX       0       4      50      62     122     134     180     184
 643                RY       4       3       3       0       0       3       3       4
                    *

 644                KK  PI639A
 645                BA   0.095
 646                LG    0.35    0.35    4.50    0.35       0
 647                UC   0.554   0.527
                    * Natural Time-Area Relation
 648                UA       0       3       5       8      12      20      43      75      90      96
 649                UA     100
                    *
                    * COMBINES R624A AND PI639A

 650                KK   C639A
 651                HC       2
                    * Asante Channel From DEI
                    * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)

 652                KK   R639A
 653                RS       2    FLOW     0.0     0.0
 654                RC   0.043   0.035   0.043    3360  0.0050
 655                RX       0       4      50      62     122     134     180     184
 656                RY       4       3       3       0       0       3       3       4
                    *

 657                KK  WI524A
 658                BA   0.599
 659                LG    0.35    0.35    4.40    0.37       0
 660                UC   0.758   0.517
                    * Natural Time-Area Relation
 661                UA       0       3       5       8      12      20      43      75      90      96
 662                UA     100
                    *
                    *
                    * Railroad Diversion Recovery: Outflow from structure RR630

 663                KK    D525
 664                DR   DO525
                    *
                    *
                    * ROUTE UPDATED 4/14/4

 665                KK   RD525
 666                RS       6    FLOW     0.0     0.0
 667                RC   0.043   0.035   0.043    6496  0.0065
                    * WITS130
 668                RX       0     400     456     575     620     650     660     682
 669                RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
                    *
                    *
                    * Combines RD525, WI524, AND R639A
1                                          HEC-1 INPUT                                                    PAGE 22

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 670                KK   C524A
                    * Hard Coded
 671                HC       3    6.67
                    *
                    * Asante Channel From DEI
                    * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

 672                KK   R524A
 673                RS       1    FLOW     0.0     0.0
 674                RC   0.035   0.035   0.035    1025  0.0050
 675                RX       0      12      18      24     117     123     129     141
 676                RY       4       2       1       0       0       1       2       4
                    *
                    * ASANTE DATA OBTAINED FROM DEI DRAINAGE REPORT

 677                KK     2.8
 678                BA  0.0792
 679                LG    0.25    0.25    5.70    0.24      35
 680                UC   0.280   0.180
                    * Urban Time-Area Relation
 681                UA       0       5      16      30      65      77      84      90      94      97
 682                UA     100

 683                KK    C2.8
 684                HC       2
                    * Asante Channel From DEI
                    * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

 685                KK    R2.8
 686                RS       1    FLOW     0.0     0.0
 687                RC   0.035   0.035   0.035    1810  0.0050
 688                RX       0      12      18      24     117     123     129     141
 689                RY       4       2       1       0       0       1       2       4
                    * UNDEVELOPED ASANTE PHASE 3

 690                KK      3A
 691                BA   0.046
 692                LG    0.35    0.35    4.60    0.33       0
```

```
693          UC   0.387   0.285
             * Natural Time-Area Relation
694          UA       0       3       5       8      12      20      43      75      90      96
695          UA     100
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

696          KK    R3A
697          RS       1    FLOW     0.0     0.0
698          RC   0.035   0.035   0.035     995  0.0050
699          RX       0       4       8      12      32      36      40      44
700          RY       3       2       1       0       0       1       2       3
             *
1                                          HEC-1 INPUT                                                    PAGE 23

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

701          KK    2.11
702          BA  0.0350
703          LG    0.25    0.25    4.65    0.38      35
704          UC   0.212   0.124
             * Urban Time-Area Relation
705          UA       0       5      16      30      65      77      84      90      94      97
706          UA     100
             * COMBINES UNDEVELOPED PARCEL 3 AND 2.11

707          KK   C2.11
708          HC       2
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

709          KK   R2.11
710          RS       1    FLOW     0.0     0.0
711          RC   0.035   0.035   0.035    1000  0.0070
712          RX       0       4       8      12      32      36      40      44
713          RY       3       2       1       0       0       1       2       3
             *

714          KK    2.10
715          BA  0.0675
716          LG    0.25    0.25    5.00    0.32      35
717          UC   0.309   0.254
             * Urban Time-Area Relation
718          UA       0       5      16      30      65      77      84      90      94      97
719          UA     100
             * FROM DEI

720          KK   S2.10
721          RS       1    STOR       0
722          SQ       0       0       0    14.2    92.8
723          SE       0       1     1.6       2       3
724          SV       0    1.36    3.28    5.83
725          SE       0       1       2       3
             *

726          KK     2.7
727          BA  0.1104
728          LG    0.25    0.25    5.30    0.28      35
729          UC   0.224   0.094
             * Urban Time-Area Relation
730          UA       0       5      16      30      65      77      84      90      94      97
731          UA     100
             *

732          KK     2.4
733          BA  0.0659
734          LG    0.25    0.25    4.55    0.41      35
735          UC   0.327   0.270
             * Urban Time-Area Relation
736          UA       0       5      16      30      65      77      84      90      94      97
737          UA     100
             * FROM DEI
1                                          HEC-1 INPUT                                                    PAGE 24

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

738          KK    S2.4
739          RS       1    STOR       0
740          SQ       0    6.85   23.26   40.68   51.06   392.0
741          SE       0       1       2       3       4       5
742          SV       0    0.36    0.82    1.37    1.40    1.40
743          SE       0       1       2       3       4       5
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

744          KK    R2.4
745          RS       1    FLOW     0.0     0.0
746          RC   0.035   0.035   0.035     400  0.0080
747          RX       0       4       8      12      22      26      30      34
748          RY       3       2       1       0       0       1       2       3
             * COMBINES R2.4, 2.7, S2.10, AND R2.11

749          KK    C2.7
750          HC       4
             *

751          KK    S2.7
752          RS       1    STOR       0
753          SQ       0       1       1       1
754          SE       0       1     2.5       3
755          SV       0    8.63   18.42   29.32
756          SE       0       1       2       3
```

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                 * COMBINES S2.7 AND R2.8

757              KK    C2.6
758              HC       2
                 * ASANTE CHANNEL FROM DEI
                 * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

759              KK    R2.6
760              RS       1    FLOW     0.0     0.0
761              RC   0.035   0.035   0.035    1700  0.0050
762              RX       0      12      18      24     117     123     129     141
763              RY       4       2       1       0       0       1       2       4
                 *

764              KK     2.5
765              BA  0.0933
766              LG    0.25    0.25    5.10    0.31      35
767              UC   0.313   0.241
                 * Urban Time-Area Relation
768              UA       0       5      16      30      65      77      84      90      94      97
769              UA     100
                 * COMBINES 2.5 AND C2.6
1                                          HEC-1 INPUT                                          PAGE 25

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

770              KK  CWI524
771              HC       2
                 *
                 * Railroad Diversion: Main path to CWI506, Diversion to CPI639
                 * From Structure RR650, See Appendix D.5 for analysis

772              KK    D524
773              DT   DO524     0.0     0.0
774              DI       0     595     906    1295    1748
775              DQ       0       0      38     119     230
                 * ROUTE UPDATED 4/14/04

776              KK  RWI524
777              RS       2    FLOW     0.0     0.0
778              RC   0.043   0.035   0.043    4526  0.0062
                 * WITS130
779              RX       0     400     456     575     620     650     660     682
780              RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
                 * UNDEVELOPED PORTION OF PHASE 4

781              KK      4A
782              BA   0.185
783              LG    0.35    0.35    4.55    0.34       0
784              UC   0.621   0.486
                 * Natural Time-Area Relation
785              UA       0       3       5       8      12      20      43      75      90      96
786              UA     100
                 *
                 * CHANNEL FROM DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

787              KK     R4A
788              RS       2    FLOW     0.0     0.0
789              RC   0.035   0.035   0.035    2160  0.0055
790              RX       0       4       8      12      32      36      40      44
791              RY       3       2       1       0       0       1       2       3
                 *

792              KK     2.1
793              BA  0.1365
794              LG    0.25    0.25    4.55    0.41      35
795              UC   0.352   0.259
                 * Urban Time-Area Relation
796              UA       0       5      16      30      65      77      84      90      94      97
797              UA     100
                 * COMBINES UNDEVELOPED 4A AND 2.1

798              KK    C2.1
799              HC       2
                 *
1                                          HEC-1 INPUT                                          PAGE 26

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

800              KK    S2.1
801              RS       1    STOR       0
802              SQ       0    98.9   279.5   513.3   592.2
803              SE       0       1       2       3     3.3
804              SV       0    0.33    0.66    1.00    1.10
805              SE       0       1       2       3     3.3
                 *
                 * Channel From DEI
                 * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 40 ft)

806              KK    R2.1
807              RS       2    FLOW     0.0     0.0
808              RC   0.035   0.035   0.035    2310  0.0035
809              RX       0       4       8      12      52      56      60      64
810              RY       3       2       1       0       0       1       2       3
                 *

811              KK    1.11
812              BA  0.1290
813              LG    0.25    0.25    4.90    0.34      35
814              UC   0.369   0.244
                 * Urban Time-Area Relation
815              UA       0       5      16      30      65      77      84      90      94      97
816              UA     100
```

```
                *

817             KK    D524
818             DR   DO524
                * ASANTE Channel From DEI
                * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

819             KK   RD524
820             RS       1    FLOW     0.0     0.0
821             RC   0.035   0.035   0.035    2040  0.0050
822             RX       0      12      18      24     117     123     129     141
823             RY       4       2       1       0       0       1       2       4
                * COMBINES RD524, 1.11, AND R2.1

824             KK  CPI639
825             HC       3    1.34
                *
                * ROUTE UPDATED 05/04/2005

826             KK  RPI639
827             RS       2    FLOW     0.0     0.0
828             RC   0.043   0.035   0.043    2635  0.0061
                * WITS130
829             RX       0     400     456     575     620     650     660     682
830             RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
                *
1                                          HEC-1 INPUT                                                    PAGE 27

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

831             KK   WI506
832             BA  1.5757
833             LG   0.326    0.25   5.331   0.254  10.467
834             UC   1.083   0.781
                * Urban Time-Area Relation
835             UA       0       5      16      30      65      77      84      90      94      97
836             UA     100
                *

837             KK  CWI506
838             HC       4   17.54
                *
                * Diversion Recovery: Flow split FS10

839             KK    D508
840             DR   DO508
                *
                *
                * ROUTE UPDATED 4/14/4

841             KK   RD508
842             RS       2    FLOW     0.0     0.0
843             RC    0.04    0.04    0.04    5200  0.0065
                * WITS70
844             RX       0     450     700    1284    1435    1499    1745    2500
845             RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
                *
                *

846             KK   WI500
847             BA  1.0487
848             LG   0.349    0.25   5.521   0.224   5.124
849             UC   0.979   0.695
                * Natural Time-Area Relation
850             UA       0       3       5       8      12      20      43      75      90      96
851             UA     100
                *
                *
                * COMBINES WI500, RD508, RWI506 AND RWI502

852             KK  CWI500
                * Hard Coded
853             HC       4  227.89
                *
                *
                * STORAGE AT MCMICKEN DAM SPILLWAY
                *
                *
1                                          HEC-1 INPUT                                                    PAGE 28

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

854             KK  SSPILL
855             KM   MCMICKEN DAM OUTLET AND SPILLWAY RATING CURVES USED HERE
856             RS       1    STOR       0       0
857             SV       0    1370    5505   17501   20816   25623   30850   36661   38754   39849
858             SQ       0     675     810    4080    4325   21150   47400   81650   93160   99300
859             SE    1335    1340    1345  1352.5 1353.65 1355.65 1357.65 1359.65 1360.35  1360.7
860             ST  1360.7   12775    3.05     1.5
                *
                *
                * ROUTE UPDATED 4/14/04

861             KK  RWI500
862             RS       3    FLOW     0.0     0.0
863             RC   0.045   0.035   0.045    5659   0.001
                * McMicken Dam Channel
864             RX       0      46     101     121     171     181    1421    3621
865             RY      25      14       4       0       0       4      14      25
                *

866             KK   PI635
867             BA  0.6106
868             LG    0.29    0.27   5.391   0.237  15.959
```

```
869          UC   0.683   0.465
             * Natural Time-Area Relation
870          UA       0       3       5       8      12      20      43      75      90      96
871          UA     100
             *
             *
             * COMBINES PI635 AND RWI500

872          KK  CPI635
873          HC       2
             *
             * ROUTE UPDATED 4/14/04

874          KK  RPI635
875          RS       6    FLOW     0.0     0.0
876          RC   0.045   0.035   0.045    7557   0.001
             * McMicken Dam Channel
877          RX       0      46     101     121     171     181    1421    3621
878          RY      25      14       4       0       0       4      14      25
             *
             *

879          KK  PI621C
880          BA    0.66
881          LG   0.347   0.249   4.635   0.336   5.401
882          UC   0.638   0.351
             * Natural Time-Area Relation
883          UA       0       3       5       8      12      20      43      75      90      96
884          UA     100
             *
             *
             * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
             * Berm Elevation = 1342
             * The storage behind this basin is contained, and does not flow to a siphon
             * For overtopping of the berm, the Weir equation was used.
             * Q=C*L*H^1.5
             * C was assumed to be 2.7
             * L, the length of the weir was the basin boundary along the canal = 3107 ft
1                                          HEC-1 INPUT                                          PAGE 29

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

885          KK  SPI621
886          RS       1    STOR       0
887          SQ       0       0       0       0    2966    8389   15411   23727
888          SA       0    0.10    1.69   21.17   21.18   21.19   21.20   12.21
889          SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
             *
             *
             * ROUTE UPDATED 4/14/04

890          KK  RPI621
891          RS       1    FLOW     0.0     0.0
892          RC   0.043   0.035   0.043    2775  0.0079
             * TSR621
893          RX       0      20      32      79     118     139     374     400
894          RY    1344    1343    1342    1342    1340    1342    1344    1344
             *

895          KK   PI633
896          BA  0.3359
897          LG   0.329   0.235   5.231   0.248   4.696
898          UC   0.708   0.635
             * Natural Time-Area Relation
899          UA       0       3       5       8      12      20      43      75      90      96
900          UA     100
             *
             *
             *

901          KK     1.8
902          BA  0.0176
903          LG    0.25    0.25    4.55    0.41      35
904          UC   0.178   0.136
             * Urban Time-Area Relation
905          UA       0       5      16      30      65      77      84      90      94      97
906          UA     100
             *

907          KK    S1.8
908          RS       1    STOR       0
909          SQ       0       0       0    47.8
910          SE  1369.0  1370.0  1371.1  1372.0
911          SV       0    0.20    0.50    0.93
912          SE  1369.0  1370.0  1371.0  1372.0
             *

913          KK     1.7
914          BA  0.0677
915          LG    0.25    0.25    5.20    0.29      35
916          UC   0.306   0.198
             * Urban Time-Area Relation
917          UA       0       5      16      30      65      77      84      90      94      97
918          UA     100
             *
1                                          HEC-1 INPUT                                          PAGE 30

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

919          KK    1.5A
920          BA  0.0138
921          LG    0.25    0.25    5.00    0.32      35
922          UC   0.211   0.182
             * Urban Time-Area Relation
```

```
923          UA       0       5      16      30      65      77      84      90      94      97
924          UA     100
             * COMBINES 1.7, 1.5A, AND S1.8

925          KK    C1.7
926          HC       3
             *

927          KK    S1.7
928          RS       1    STOR       0
929          SQ       0       0    61.6   174.2
930          SE  1366.0  1367.0  1368.0  1369.0
931          SV       0    1.81    3.78    6.09
932          SE  1366.0  1367.0  1368.0  1369.0
             *

933          KK     1.9
934          BA  0.0723
935          LG    0.25    0.25    4.55    0.41      35
936          UC   0.330   0.251
             * Urban Time-Area Relation
937          UA       0       5      16      30      65      77      84      90      94      97
938          UA     100
             *

939          KK     1.6
940          BA  0.0450
941          LG    0.25    0.25    4.55    0.41      35
942          UC   0.279   0.173
             * Urban Time-Area Relation
943          UA       0       5      16      30      65      77      84      90      94      97
944          UA     100
             * COMBINES 1.9, 1.6, AND S1.7

945          KK    C1.6
946          HC       3
             *

947          KK    S1.6
948          RS       1    STOR       0
949          SQ       0    65.9   186.4   342.2   431.3
950          SE  1366.0  1367.0  1368.0  1369.0  1369.5
951          SV       0    1.27    2.73    4.41    4.41
952          SE  1366.0  1367.0  1368.0  1369.0  1369.5
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

953          KK    1.10
954          BA  0.0224
955          LG    0.25    0.25    4.55    0.41      35
956          UC   0.161   0.113
             * Urban Time-Area Relation
957          UA       0       5      16      30      65      77      84      90      94      97
958          UA     100
             * STREET SECTION

959          KK   R1.10
960          RS       2    FLOW     0.0     0.0
961          RC   0.015   0.015   0.015    1700  0.0053
962          RX       0    0.10   38.94   39.04   64.20   64.30  103.24  103.34
963          RY       2       0    0.78    1.28    1.28    0.78       0       2
             *

964          KK   1.13A
965          BA  0.0279
966          LG    0.25    0.25    4.55    0.41      35
967          UC   0.213   0.152
             * Urban Time-Area Relation
968          UA       0       5      16      30      65      77      84      90      94      97
969          UA     100
             *

970          KK   1.14A
971          BA  0.0381
972          LG    0.25    0.25    4.50    0.42      35
973          UC   0.306   0.244
             * Urban Time-Area Relation
974          UA       0       5      16      30      65      77      84      90      94      97
975          UA     100
             * COMBINES 1.14A, 1.13A, R1.10, AND S4.11

976          KK  C1.14A
977          HC       4
             *

978          KK  S1.14A
979          RS       1    STOR       0
980          SQ       0       0       0   316.8
981          SE       0     1.0     2.5     3.0
982          SV       0    6.64   13.49   20.53
983          SE       0     1.0     2.5     3.0
             *

984          KK   1.13B
985          BA  0.0252
986          LG    0.25    0.25    5.10    0.31      35
987          UC   0.308   0.329
             * Urban Time-Area Relation
988          UA       0       5      16      30      65      77      84      90      94      97
989          UA     100
             * ASANTE Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)
```

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 990          KK  R1.13B
 991          RS       2    FLOW     0.0     0.0
 992          RC   0.035   0.035   0.035    1200  0.0050
 993          RX       0       6      12      18     111     117     123     129
 994          RY       3       2       1       0       0       1       2       3
              *

 995          KK   1.14B
 996          BA  0.0315
 997          LG    0.25    0.23    6.20    0.20      35
 998          UC   0.274   0.239
              * Urban Time-Area Relation
 999          UA       0       5      16      30      65      77      84      90      94      97
1000          UA     100
              * COMBINES 1.14B, R1.13B, AND S1.14A

1001          KK  C1.14B
1002          HC       3
              * ASANTE Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1003          KK  R1.14B
1004          RS       1    FLOW     0.0     0.0
1005          RC   0.035   0.035   0.035     820  0.0050
1006          RX       0       6      12      18     111     117     123     129
1007          RY       3       2       1       0       0       1       2       3
              *

1008          KK   1.16A
1009          BA  0.0265
1010          LG    0.25    0.25    4.50    0.42      35
1011          UC   0.181   0.120
              * Urban Time-Area Relation
1012          UA       0       5      16      30      65      77      84      90      94      97
1013          UA     100
              *

1014          KK  S1.16A
1015          RS       1    STOR       0
1016          SQ       0       0       0    17.2
1017          SE       0     1.0     2.0     3.0
1018          SV       0    0.92    1.91    2.98
1019          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1020          KK  R1.16A
1021          RS       2    FLOW     0.0     0.0
1022          RC   0.035   0.035   0.035     590  0.0014
1023          RX       0       4       8      12      22      26      30      34
1024          RY       3       2       1       0       0       1       2       3
              *
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1025          KK   1.15A
1026          BA  0.0243
1027          LG    0.25    0.25    4.40    0.45      35
1028          UC   0.195   0.161
              * Urban Time-Area Relation
1029          UA       0       5      16      30      65      77      84      90      94      97
1030          UA     100
              *

1031          KK  S1.15A
1032          RS       1    STOR       0
1033          SQ       0       0       0    56.0
1034          SE       0     1.0     2.0     3.0
1035          SV       0    0.70    1.46    2.28
1036          SE       0     1.0     2.0     3.0
              *

1037          KK   1.15B
1038          BA  0.0156
1039          LG    0.25    0.15    7.30    0.13      35
1040          UC   0.207   0.157
              * Urban Time-Area Relation
1041          UA       0       5      16      30      65      77      84      90      94      97
1042          UA     100
              * COMBINES 1.15B, S1.15A, R1.16A, AND R1.14B

1043          KK  C1.15B
1044          HC       4
              *
              * ASANTE Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1045          KK  R1.15B
1046          RS       2    FLOW     0.0     0.0
1047          RC   0.035   0.035   0.035    1760  0.0050
1048          RX       0       6      12      18     111     117     123     129
1049          RY       3       2       1       0       0       1       2       3
              *

1050          KK   1.16B
1051          BA  0.0268
1052          LG    0.25    0.25    4.55    0.41      35
1053          UC   0.137   0.077
              * Urban Time-Area Relation
1054          UA       0       5      16      30      65      77      84      90      94      97
```

```
1055          UA     100
              *

1056          KK  S1.16B
1057          RS       1    STOR       0
1058          SQ       0       0       0    17.2
1059          SE       0     1.0     2.0     3.0
1060          SV       0    0.93    1.93    3.01
1061          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1062          KK  R1.16B
1063          RS       4    FLOW     0.0     0.0
1064          RC   0.035   0.035   0.035    1630  0.0012
1065          RX       0       4       8      12      22      26      30      34
1066          RY       3       2       1       0       0       1       2       3
              *

1067          KK   1.17A
1068          BA  0.0521
1069          LG    0.25    0.25    4.20    0.50      35
1070          UC   0.282   0.197
              * Urban Time-Area Relation
1071          UA       0       5      16      30      65      77      84      90      94      97
1072          UA     100
              *

1073          KK  S1.17A
1074          RS       1    STOR       0
1075          SQ       0       0       0    56.0
1076          SE       0     1.0     2.0     3.0
1077          SV       0    1.84    3.78    5.84
1078          SE       0     1.0     2.0     3.0
              *

1079          KK   1.17B
1080          BA  0.0332
1081          LG    0.25    0.25    4.20    0.50      35
1082          UC   0.299   0.279
              * Urban Time-Area Relation
1083          UA       0       5      16      30      65      77      84      90      94      97
1084          UA     100
              * COMBINES 1.17B, S1.17A, R1.16B, AND R1.15B

1085          KK  C1.17B
1086          HC       4
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 40 ft)

1087          KK  R1.17B
1088          RS       1    FLOW     0.0     0.0
1089          RC   0.035   0.035   0.035     990  0.0050
1090          RX       0       6      12      18      58      64      70      76
1091          RY       3       2       1       0       0       1       2       3
              *

1092          KK     1.3
1093          BA  0.0285
1094          LG    0.25    0.25    4.55    0.41      35
1095          UC   0.204   0.152
              * Urban Time-Area Relation
1096          UA       0       5      16      30      65      77      84      90      94      97
1097          UA     100
              *
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1098          KK    S1.3
1099          RS       1    STOR       0
1100          SQ       0       0       0    17.2
1101          SE       0     1.0     2.0     3.0
1102          SV       0    1.27    2.62    4.07
1103          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1104          KK    R1.3
1105          RS       4    FLOW     0.0     0.0
1106          RC   0.035   0.035   0.035    2450  0.0050
1107          RX       0       4       8      12      22      26      30      34
1108          RY       3       2       1       0       0       1       2       3
              *

1109          KK     1.2
1110          BA  0.1074
1111          LG    0.25    0.25    4.50    0.42      35
1112          UC   0.358   0.195
              * Urban Time-Area Relation
1113          UA       0       5      16      30      65      77      84      90      94      97
1114          UA     100
              *

1115          KK    S1.2
1116          RS       1    STOR       0
1117          SQ       0       0       0    56.0
1118          SE       0     1.0     2.0     3.0
1119          SV       0    4.92   10.01   15.28
1120          SE       0     1.0     2.0     3.0
              * COMBINES S1.2, R1.3, AND R1.17B
```

```
1121          KK    C636
1122          HC       3
              *
              * ROUTE UPDATED 4/14/04

1123          KK  RPI636
1124          RS       1    FLOW     0.0     0.0
1125          RC   0.043   0.035   0.043     730  0.0137
              * WITS130
1126          RX       0     400     456     575     620     650     660     682
1127          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
              *
              * Diversion Recovery: ASANTE Berm Breach

1128          KK   D624C
1129          DR   D624C
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1130          KK  RD624C
1131          RS       3    FLOW     0.0     0.0
1132          RC   0.043   0.035   0.043    3480  0.0057
              * PDTS40_1
1133          RX       0      86     158     492     543     560     776    1208
1134          RY    1330  1326.5    1326    1324    1320    1326    1328    1330
              *
              * Diversion Recovery: 163rd Ave Culvert Flow Split

1135          KK   D624G
1136          DR   D624G

1137          KK  RD624G
1138          RS       3    FLOW     0.0     0.0
1139          RC   0.043   0.035   0.043    3000  0.0063
              * PDTS40_1
1140          RX       0      86     158     492     543     560     776    1208
1141          RY    1330  1326.5    1326    1324    1320    1326    1328    1330
              *
              * UNDEVELOPED PORTION OF PHASE 4

1142          KK      4B
1143          BA   0.375
1144          LG    0.35    0.36    5.00    0.27       0
1145          UC   0.626   0.360
              * Natural Time-Area Relation
1146          UA       0       3       5       8      12      20      43      75      90      96
1147          UA     100
              *

1148          KK     C4B
1149          HC       3    0.81
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1150          KK     R4B
1151          RS       2    FLOW     0.0     0.0
1152          RC   0.035   0.035   0.035    1410  0.0050
1153          RX       0       4       8      12      22      26      30      34
1154          RY       3       2       1       0       0       1       2       3
              *

1155          KK    1.5B
1156          BA  0.0167
1157          LG    0.25    0.25    5.70    0.24      35
1158          UC   0.206   0.173
              * Urban Time-Area Relation
1159          UA       0       5      16      30      65      77      84      90      94      97
1160          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1161          KK   S1.5B
1162          RS       1    STOR       0
1163          SQ       0       0       0    14.2
1164          SE       0     1.0     2.6     3.0
1165          SV       0    0.57    1.19    1.88
1166          SE       0     1.0     2.0     3.0
              * COMBINES S1.5B AND UNDEVELOPED PARCEL 4

1167          KK   C1.5B
1168          HC       2
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1169          KK   R1.5B
1170          RS       1    FLOW     0.0     0.0
1171          RC   0.035   0.035   0.035     800  0.0050
1172          RX       0       4       8      12      22      26      30      34
1173          RY       3       2       1       0       0       1       2       3
              *

1174          KK    1.5C
1175          BA  0.0133
1176          LG    0.25    0.25    5.20    0.29      35
1177          UC   0.133   0.080
              * Urban Time-Area Relation
1178          UA       0       5      16      30      65      77      84      90      94      97
1179          UA     100
              *
```

```
1180    KK   S1.5C
1181    RS       1    STOR       0
1182    SQ       0       0       0    14.2
1183    SE       0     1.0     2.6     3.0
1184    SV       0    0.45    0.95    1.51
1185    SE       0     1.0     2.0     3.0
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1186    KK   R1.5C
1187    RS       2    FLOW     0.0     0.0
1188    RC   0.035   0.035   0.035     845  0.0050
1189    RX       0       4       8      12      22      26      30      34
1190    RY       3       2       1       0       0       1       2       3
        *

1191    KK     1.4
1192    BA  0.0284
1193    LG    0.25    0.25    5.70    0.24      35
1194    UC   0.204   0.155
        * Urban Time-Area Relation
1195    UA       0       5      16      30      65      77      84      90      94      97
1196    UA     100
        *
1                                    HEC-1 INPUT                                          PAGE 38

LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1197    KK    S1.4
1198    RS       1    STOR       0
1199    SQ       0       0       0    14.2
1200    SE       0     1.0     2.6     3.0
1201    SV       0    1.26    2.60    4.04
1202    SE       0     1.0     2.0     3.0
        * COMBINES S1.4, R1.5C, AND R1.5B

1203    KK    C624
1204    HC       3
        *

1205    KK   PI624
1206    BA   0.452
1207    LG    0.35    0.35    4.80    0.29       0
1208    UC   0.915   0.764
        * Natural Time-Area Relation
1209    UA       0       3       5       8      12      20      43      75      90      96
1210    UA     100
        *

1211    KK  CPI624
1212    HC       3
        *
        * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
        * It was assumed that this basin is isolated, and can only overtop the canal.
        * Berm Elevation = 1342
        * For Overtopping of the berm, the Weir equation was used.
        * Q=C*B*H^1.5
        * C was assumed to be 2.7
        * B, the length of the weir was the basin boundary along the canal = 4305 ft

1213    KK  SPI624
1214    RS       1    STOR       0
1215    SQ       0       0       0       0    4110   11624   21354   32876
1216    SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
1217    SA       0    0.19    5.86   36.95   36.96   36.97
1218    SE    1336    1338    1340    1342    1343    1344
        *
        *
        * ROUTE UPDATED 4/14/04

1219    KK  RPI624
1220    RS       3    FLOW     0.0     0.0
1221    RC   0.043   0.035   0.043    5060  0.0043
        * TSR621-modified X-sect
1222    RX       0      40      52      99     138     159     394   511.5
1223    RY    1345    1343    1342    1342    1340    1342    1344    1345
        *
        *
        * Combines RPI635, D600A, RPI621, RPI624 and PI633
1                                    HEC-1 INPUT                                          PAGE 39

LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1224    KK  CPI633
1225    HC       4
        *
        * ROUTE UPDATED 4/14/04

1226    KK  RPI633
1227    RS       4    FLOW     0.0     0.0
1228    RC   0.045   0.035   0.045    5834   0.001
        * McMicken Dam Channel
1229    RX       0      46     101     121     171     181    1421    3621
1230    RY      25      14       4       0       0       4      14      25
        *
        *

1231    KK   PI600
1232    BA  0.6050
1233    LG   0.342   0.244   5.047   0.268   4.887
1234    UC   0.542   0.341
        * Natural Time-Area Relation
1235    UA       0       3       5       8      12      20      43      75      90      96
1236    UA     100
```

```
                    *
                    *
                    * COMBINES BASIN RPI633, RPI603 and  PI600

1237                KK  CPI600
1238                HC       3
                    *
                    * ROUTE UPDATED 4/14/04

1239                KK  RPI600
1240                RS       2    FLOW     0.0     0.0
1241                RC   0.045   0.035   0.045    4937   0.001
                    * McMicken Dam Channel
1242                RX       0      46     101     121     171     181    1421    3621
1243                RY      25      14       4       0       0       4      14      25
                    *
1244                ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   180      DCAP11
                 V
                 V
   182      RDCP11
                 .
                 .
   187           .      DCAP12
                 .           -
                 .           .
   190           .           .-------->   DO618
   189           .        D618
                 .           V
                 .           V
   193           .      RDCP12
                 .           -
                 .           .
   198           .           .       PI618
                 .           .           .
   204      CPI618.......................
                 V
                 V
   206      RPI618
                 .
                 .
   211           .      DCAP13
                 .           V
                 .           V
   213           .      RDCP13
                 .           -
                 .           .
   218           .           .       PI615
                 .           .           .
   225           .           .           .<-------   DO618
   224           .           .        D618
                 .           .           V
                 .           .           V
   226           .           .       RD618
                 .           .           .
                 .           .           .
   231           .      CPI615.......................
                 .           V
                 .           V
   233           .      RPI615
                 .           -
                 .           .
   238           .           .       PI612
                 .           .           .
   244           .           .           .     PI624B
                 .           .           .           .
   253           .           .           .           .-------->   D624B
   251           .           .           .     DO624B
                 .           .           .           V
                 .           .           .           V
   256           .           .           .     RX624B
                 .           .           .           .
                 .           .           .           .
   261           .           .           .           .     PI624D
                 .           .           .           .           .
                 .           .           .           .           .
   268           .           .           .     CP624D............
                 .           .           .           .
                 .           .           .           .
   271           .           .           .           .-------->  DO624D
   270           .           .           .      D624D
                 .           .           .           V
                 .           .           .           V
   274           .           .           .     RX624D
                 .           .           .           .
                 .           .           .           .
   279      CPI612.....................................
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                 .
   282           .-------->   DO612
   281        D612
                 V
                 V
   285      RPI612
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290          .      DCAP14
             .          V
             .          V
292          .      RDCP14
             .          .
297          .          .      PI609
             .          .          .
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304          .          .          .<-------  DO624D
303          .          .      D624D
             .          .          V
             .          .          V
305          .          .      RD624D
             .          .          .
             .          .          .
310          .          .          .      PI624E
             .          .          .          .
             .          .          .          .
319          .          .          .          .-------->  RET624
317          .          .          .      624ERT
             .          .          .          .
             .          .          .          .
322          .          .      CP624E............
             .          .          V
             .          .          V
324          .          .      RD624E
             .          .          .
             .          .          .
329          .          .          .      PI624G
             .          .          .          .
             .          .          .          .
336          .          .          .          .      PI624F
             .          .          .          .          .
             .          .          .          .          .
344          .          .          .          .          .<-------   D624B
343          .          .          .          .          .      D624B
             .          .          .          .          .          V
             .          .          .          .          .          V
345          .          .          .          .          .      RD624B
             .          .          .          .          .          .
             .          .          .          .          .          .
350          .          .          .          .          .          .      PI624C
             .          .          .          .          .          .          .
             .          .          .          .          .          .          .
356          .          .          .          .          .      CP624C............
             .          .          .          .          .          .
             .          .          .          .          .          .
360          .          .          .          .          .          .-------->   D624C
358          .          .          .          .          .      DO624C
             .          .          .          .          .          V
             .          .          .          .          .          V
363          .          .          .          .          .      RD624C
             .          .          .          .          .          .
             .          .          .          .          .          .
368          .          .      CP624G...................................
             .          .          .
             .          .          .
372          .          .          .-------->   D624G
370          .          .      DO624G
             .          .          V
             .          .          V
375          .          .      RD624G
             .          .          .
             .          .          .
380          .          .          .      PI624H
             .          .          .          .
             .          .          .          .
387          .          .      CP624H............
             .          .          V
             .          .          V
389          .          .      RD624H
             .          .          V
             .          .          V
394          .          .      RD624H
             .          .          .
             .          .          .
400          .          .          .          .<-------   DO612
399          .          .          .       D612
             .          .          .          V
             .          .          .          V
401          .          .          .      RD612
             .          .          .          .
             .          .          .          .
406          .          .          .          .      PI621A
             .          .          .          .          .
             .          .          .          .          .
413          .          .      CP621A........................
             .          .          V
             .          .          V
415          .          .      RD621A
             .          .          .
             .          .          .
420          .          .          .      PI621B
             .          .          .          .
             .          .          .          .
427          .          .      CP621B............
             .          .          V
             .          .          V
429          .          .      RD621B
             .          .          .
             .          .          .
434      CPI609.....................................
             V
             V
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436     R609-1
            .
            .
442         .------->  DOHVC1
441      DHVC1
            V
            V
445     R609-2
            .
            .
450         .      DCAP15
            .          V
            .          V
452         .      RDCP15
            .          .
            .          .
457         .          .      PI606A
            .          .          .
            .          .          .
463         .       C606A............
            .          .
            .          .
466         .          .-------->  DO606A
465         .       D606A
            .          V
            .          V
469         .       R606A
            .          .
            .          .
474         .          .       PI606
            .          .          .
            .          .          .
480     CPI606......................
            V
            V
482     RPI606
            .
            .
487         .       PI604
            .          .
            .          .
494         .          .          .<-------  DO606A
493         .          .       D606A
            .          .          V
            .          .          V
495         .          .      RD606A
            .          .          .
            .          .          .
500         .      CPI604............
            .          V
            .          V
502         .      RPI604
            .          .
            .          .
507         .          .       PD744
            .          .          .
            .          .          .
514         .          .          .          .<-------  DOHVC1
513         .          .          .      DHVC1
            .          .          .          V
            .          .          .          V
515         .          .          .      RDHVC1
            .          .          .          .
            .          .          .          .
520         .          .          .          .      PI600A
            .          .          .          .          .
            .          .          .          .          .
526         .          .          .       C600A............
            .          .          .          .
            .          .          .          .
528         .          .          .          .       PI603
            .          .          .          .          .
            .          .          .          .          .
534     CPI603.............................................
            V
            V
536     SPI603
            .
            .
545         .------->   DO744
544       D744
            .
            .
550         .      CWI504
            .          V
            .          V
552         .      RWI504
            .          .
            .          .
557         .          .      CWI508
            .          .          .
            .          .          .
560         .          .          .-------->   DO508
559         .          .       D508
            .          .          .
            .          .          .
563         .          .          .      WI510A
            .          .          .          V
            .          .          .          V
569         .          .          .       R510A
            .          .          .          .
            .          .          .          .
574         .          .          .          .       WI510
            .          .          .          .          .
            .          .          .          .          .
580         .          .      CWI510......................
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                                                                  V
                                                                  V
582                                                       RWI510
                                                                  .
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587                                                                .      WI502
                                                                  .         .
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593                                            CWI502.......................
                                                    V
                                                    V
595                                            RWI502
                                                    .
                                                    .
600                                                       CWI525
                                                                  .
                                                                  .
603                                                               .-------->   DO525
602                                                         D525
                                                                  V
                                                                  V
606                                                       RWI525
                                                                  .
                                                                  .
611                                                               .     DCAP10
                                                                  .        V
                                                                  .        V
613                                                               .     RDCP10
                                                                  .        .
                                                                  .        .
618                                                               .        .       PI628
                                                                  .        .         .
                                                                  .        .         .
624                                                               .     CPI628............
                                                                  .        V
                                                                  .        V
626                                                               .     RPI628
                                                                  .        .
                                                                  .        .
631                                                               .        .      PI624A
                                                                  .        .         .
                                                                  .        .         .
637                                                               .      C624A............
                                                                  .        V
                                                                  .        V
639                                                               .      R624A
                                                                  .        .
                                                                  .        .
644                                                               .        .      PI639A
                                                                  .        .         .
                                                                  .        .         .
650                                                               .      C639A............
                                                                  .        V
                                                                  .        V
652                                                               .      R639A
                                                                  .        .
                                                                  .        .
657                                                               .        .      WI524A
                                                                  .        .         .
                                                                  .        .         .
664                                                               .        .         .<-------   DO525
663                                                               .        .       D525
                                                                  .        .         V
                                                                  .        .         V
665                                                               .        .      RD525
                                                                  .        .         .
                                                                  .        .         .
670                                                               .      C524A.......................
                                                                  .        V
                                                                  .        V
672                                                               .      R524A
                                                                  .        .
                                                                  .        .
677                                                               .        .        2.8
                                                                  .        .         .
                                                                  .        .         .
683                                                               .       C2.8............
                                                                  .        V
                                                                  .        V
685                                                               .       R2.8
                                                                  .        .
                                                                  .        .
690                                                               .        .         3A
                                                                  .        .         V
                                                                  .        .         V
696                                                               .        .       R3A
                                                                  .        .         .
                                                                  .        .         .
701                                                               .        .         .        2.11
                                                                  .        .         .         .
                                                                  .        .         .         .
707                                                               .        .       C2.11............
                                                                  .        .         V
                                                                  .        .         V
709                                                               .        .       R2.11
                                                                  .        .         .
                                                                  .        .         .
714                                                               .        .         .        2.10
                                                                  .        .         .         V
                                                                  .        .         .         V
720                                                               .        .         .       S2.10
                                                                  .        .         .         .
                                                                  .        .         .         .
726                                                               .        .         .         .         2.7
                                                                  .        .         .         .          .
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                                                PA_EX.OH1
732                                                                    2.4
                                                                        V
                                                                        V
738                                                                   S2.4
                                                                        V
                                                                        V
744                                                                   R2.4
                                                                        .
                                                                        .
749                                           C2.7.................................
                                                V
                                                V
751                                           S2.7
                                                .
                                                .
757                                     C2.6............
                                          V
                                          V
759                                     R2.6
                                          .
                                          .
764                                           2.5
                                                .
                                                .
770                                  CWI524............
                                          .
                                          .
773                                       .------->   DO524
772                                     D524
                                          V
                                          V
776                                  RWI524
                                          .
                                          .
781                                           4A
                                                V
                                                V
787                                          R4A
                                                .
                                                .
792                                                        2.1
                                                            .
                                                            .
798                                           C2.1............
                                                V
                                                V
800                                           S2.1
                                                V
                                                V
806                                           R2.1
                                                .
                                                .
811                                                       1.11
                                                            .
                                                            .
818                                                            .<-------   DO524
817                                                         D524
                                                             V
                                                             V
819                                                        RD524
                                                            .
                                                            .
824                                        CPI639........................
                                                V
                                                V
826                                        RPI639
                                                .
                                                .
831                                                     WI506
                                                            .
                                                            .
837                                 CWI506..................................
                                          .
                                          .
840                                       .<-------   DO508
839                                     D508
                                          V
                                          V
841                                    RD508
                                          .
                                          .
846                                       .      WI500
                                                    .
                                                    .
852                           CWI500..................................
                                   V
                                   V
854                           SSPILL
                                   V
                                   V
861                           RWI500
                                   .
                                   .
866                                 .      PI635
                                           .
                                           .
872                           CPI635............
                                   V
                                   V
874                           RPI635
                                   .
                                   .
879                                 .     PI621C
                                                V
                                                V
885                                 .     SPI621
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              .           .           V
              .           .           V
 890          .           .      RPI621
              .           .           .
              .           .           .
 895          .           .           .       PI633
              .           .           .           .
              .           .           .           .
 901          .           .           .           .         1.8
              .           .           .           .           V
              .           .           .           .           V
 907          .           .           .           .        S1.8
              .           .           .           .           .
              .           .           .           .           .
 913          .           .           .           .           .         1.7
              .           .           .           .           .           .
              .           .           .           .           .           .
 919          .           .           .           .           .           .        1.5A
              .           .           .           .           .           .           .
              .           .           .           .           .           .           .
 925          .           .           .           .        C1.7........................
              .           .           .           .           V
              .           .           .           .           V
 927          .           .           .           .        S1.7
              .           .           .           .           .
              .           .           .           .           .
 933          .           .           .           .           .         1.9
              .           .           .           .           .           .
              .           .           .           .           .           .
 939          .           .           .           .           .           .         1.6
              .           .           .           .           .           .           .
              .           .           .           .           .           .           .
 945          .           .           .           .        C1.6........................
              .           .           .           .           V
              .           .           .           .           V
 947          .           .           .           .        S1.6
              .           .           .           .           .
              .           .           .           .           .
 953          .           .           .           .           .        1.10
              .           .           .           .           .           V
              .           .           .           .           .           V
 959          .           .           .           .           .       R1.10
              .           .           .           .           .           .
              .           .           .           .           .           .
 964          .           .           .           .           .           .       1.13A
              .           .           .           .           .           .           .
              .           .           .           .           .           .           .
 970          .           .           .           .           .           .           .       1.14A
              .           .           .           .           .           .           .           .
              .           .           .           .           .           .           .           .
 976          .           .           .           .      C1.14A....................................
              .           .           .           .           V
              .           .           .           .           V
 978          .           .           .           .      S1.14A
              .           .           .           .           .
              .           .           .           .           .
 984          .           .           .           .           .       1.13B
              .           .           .           .           .           V
              .           .           .           .           .           V
 990          .           .           .           .           .      R1.13B
              .           .           .           .           .           .
              .           .           .           .           .           .
 995          .           .           .           .           .           .       1.14B
              .           .           .           .           .           .           .
              .           .           .           .           .           .           .
1001          .           .           .           .      C1.14B........................
              .           .           .           .           V
              .           .           .           .           V
1003          .           .           .           .      R1.14B
              .           .           .           .           .
              .           .           .           .           .
1008          .           .           .           .           .       1.16A
              .           .           .           .           .           V
              .           .           .           .           .           V
1014          .           .           .           .           .      S1.16A
              .           .           .           .           .           V
              .           .           .           .           .           V
1020          .           .           .           .           .      R1.16A
              .           .           .           .           .           .
              .           .           .           .           .           .
1025          .           .           .           .           .           .       1.15A
              .           .           .           .           .           .           V
              .           .           .           .           .           .           V
1031          .           .           .           .           .           .      S1.15A
              .           .           .           .           .           .           .
              .           .           .           .           .           .           .
1037          .           .           .           .           .           .           .       1.15B
              .           .           .           .           .           .           .           .
              .           .           .           .           .           .           .           .
1043          .           .           .           .      C1.15B....................................
              .           .           .           .           V
              .           .           .           .           V
1045          .           .           .           .      R1.15B
              .           .           .           .           .
              .           .           .           .           .
1050          .           .           .           .           .       1.16B
              .           .           .           .           .           V
              .           .           .           .           .           V
1056          .           .           .           .           .      S1.16B
              .           .           .           .           .           V
              .           .           .           .           .           V
1062          .           .           .           .           .      R1.16B
              .           .           .           .           .           .
              .           .           .           .           .           .
1067          .           .           .           .           .           .       1.17A
              .           .           .           .           .           .           V
```

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                                                PA_EX.OH1
                                                                  V
1073                                                          S1.17A
                                                                  .
1079                                                                  1.17B
                                                                      .
1085                                        C1.17B.....................
                                                  V
                                                  V
1087                                        R1.17B
                                                  .
1092                                                  1.3
                                                      V
                                                      V
1098                                                  S1.3
                                                      V
                                                      V
1104                                                  R1.3
                                                      .
1109                                                      1.2
                                                          V
                                                          V
1115                                                      S1.2
                                                          .
1121                                          C636........................
                                                  V
                                                  V
1123                                        RPI636
                                                  .
1129                                                      .<-------   D624C
1128                                                  D624C
                                                      V
                                                      V
1130                                                RD624C
                                                      .
1136                                                          .<-------   D624G
1135                                                      D624G
                                                          V
                                                          V
1137                                                    RD624G
                                                          .
1142                                                                  4B
                                                                      .
1148                                                  C4B........................
                                                      V
                                                      V
1150                                                  R4B
                                                      .
1155                                                      1.5B
                                                          V
                                                          V
1161                                                    S1.5B
                                                          .
1167                                                C1.5B............
                                                      V
                                                      V
1169                                                R1.5B
                                                      .
1174                                                      1.5C
                                                          V
                                                          V
1180                                                    S1.5C
                                                          V
                                                          V
1186                                                    R1.5C
                                                          .
1191                                                                  1.4
                                                                      V
                                                                      V
1197                                                                  S1.4
                                                                      .
1203                                                  C624........................
                                                      .
1205                                                    PI624
                                                          .
1211                                        CPI624......................
                                                  V
                                                  V
1213                                        SPI624
                                                  V
                                                  V
1219                                        RPI624
                                                  .
1224                                  CPI633.....................................
                                          V
                                          V
1226                                  RPI633
                                          .
1231                                      .       PI600
```

```
                .          .          .
                .          .          .
  1237      CPI600.......................
                V
                V
  1239      RPI600

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   23NOV10  TIME  14:01:01  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
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HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
100-YEAR 24-HOUR STORM
PREFERRED ALTERNATIVE EXISTING CONDITIONS
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
**  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY   **
**                                                                         **
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*****************************************************************************
**                                                                         **
** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS   **
** DATED OCTOBER 2004:                                                     **
**                                                                         **
**     -Diversion added after CTW480                                       **
**          -Main flow (5%) to CTW478                                      **
**          -Diverted flow (95%) to CWI584                                 **
**          -Added concentration point CWI584 combining RD480 and WI584    **
**          -Hard coding was added to CTW478                               **
**          -Route added after D480 (Diversion Recovery)                   **
**          -Route RWI584 was adjusted                                     **
**          -Storage Route SCP050 was adjusted                             **
**          -Route R508* was adjusted                                      **
**          -Hard coding for CWI510 was adjusted                           **
**                                                                         **
**     -Diversion D618 was moved from after CPI618 to before RDCP12        **
**          -Updated route RD618 information                               **
**          -Hard coding on CPI618 was adjusted                            **
**          -Hard coding on CPI615 was adjusted                            **
**                                                                         **
**     -Route RPI639 changed from following US60 to CPI636 to route        **
**      through US60/RR structures and combine with CWI506                 **
**          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
**           following R624A to follow RWI524                              **
**          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
**          -RPI639 information was changed to reflect new route           **
**          -CWI506 changed from combining 3 to combine 4:                 **
**           RWI525, RWI524, RPI639 & WI506                                **
**          -Hard coding on CWI506 was adjusted                            **
**          -Hard Coding on CWI500 was adjusted                            **
**                                                                         **
*****************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
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**                                                                         **
**    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004      **
**                                                                         **
*****************************************************************************
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PROJECT:                Wittmann ADMS Update
CLIENT:                 Flood Control District of Maricopa County
PREPARED BY:            Entellus, Inc.
PROJECT No:             FCD 2002C029              Entellus 310.032
FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
                                       MODIFIED DATE: MAY 04, 2005

STORM:
                        100-year 24-hour Storm

DEVELOPMENT CONDITIONS:
                        Existing Conditions

MODELING ASSUMPTIONS:
                        It was assumed that the US60 did not have adequate
                        storage to cause any significant attenuation.

                        The assumption was made that the CAP Canal embankment
                        would not be breached under a large flood event.

                        The assumption was made that the Beardsley Canal would
                        not fail under a large storm event (Per District
                        Instruction).  In addition, the berm north of the
                        Beardsley canal and east of US60 was assumed to fail
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(per district Instruction).

For both the CAP and Beardsley Canals, once the berm elevation was reached weir flow was assumed. It was also assumed that any weir flow over the canal that might enter the canal and be diverted out of the study area was insignificant, and thus was ignored. In other words all weir flow over the canal embankment reaches the downstream concentration point.

Typical X-sects were developed, and it was assumed that a typical x-sect could adequately represent various reaches.

Time-Area Relations were used base on the District's Hydrology Manual criteria. Two Time-Area Relation Curves were utilized:
-Urban
-Natural
The Time-Area Relation Curves were taken directly from the manual

MODELING METHODS:

This model utilizes QI cards to input the Padelford hydrographs from the 100-year 6-hour existing conditions model developed by A-N West Inc. for the Padelford Wash Floodplain Delineation Study. The hydrograph was altered from its original form (2-minute interval to 5-minute interval) through simple interpolation.

Clark Unit Hydrographs were used for all subbasins except the two subbasins directly upstream of the Bonita Dam (PD726B and PD740 use S-graphs). The UC parameters were calculated using the WMS7.0 software.

For Basins PD726B and PD740 S-Graphs were utilized per the request of the FCDMC. Limited details regarding the calculations of the S-graphs can be found in the model by the basin KK card. For full details of the S-graph calculations refer to the Appendix.

Normal Depth routing was used for all routing reaches.

Hard coding was used to account for the percentage of area associated with a diversion. Because of the use of JD cards and aereal reduction, hard coding was necessary to properly account for area. For a given diversion a percentage of the flow is routed to two different locations. The same percentage of area follows that diverted flow. In addition the area downstream of the main path is reduced or increased and is hard coded to account for the loss or gain of area. Hard coding was performed based on the 24-hour existing conditions model.

Stage-storage was developed for all the structures along the CAP Canal, as well as along the Beardsley Canal. In addition several stage-storage locations were developed for areas with significant storage along the SR74. No storage was modeled along the US60 and railroad, but the culverts were analyzed for diversion potential. Diversions were placed in the model where deemed appropriate. See appendix for details.

FLO-2D was utilized to calculate the split flows at concentration points CIW351. CIW357, CIW363 and CWI576. See appendix for modeling details.

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159 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ        1500  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      6    0  ENDING DATE
                     NDTIME        0455  ENDING TIME
                      ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL    0.08 HOURS
                      TOTAL TIME BASE  124.92 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

161 JD          INDEX STORM NO. 1
                       STRM        4.18  PRECIPITATION DEPTH
                       TRDA        0.01  TRANSPOSITION DRAINAGE AREA

162 PI            PRECIPITATION PATTERN
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
172 JD        INDEX STORM NO. 2
                STRM        3.93  PRECIPITATION DEPTH
                TRDA       10.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
173 JD        INDEX STORM NO. 3
                STRM        3.86  PRECIPITATION DEPTH
                TRDA       20.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
174 JD        INDEX STORM NO. 4
                STRM        3.72  PRECIPITATION DEPTH
                TRDA       40.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

175 JD        INDEX STORM NO. 5
                STRM        3.60  PRECIPITATION DEPTH
                TRDA       80.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

176 JD        INDEX STORM NO. 6
                STRM        3.53  PRECIPITATION DEPTH
                TRDA      120.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00

177 JD        INDEX STORM NO. 7
                STRM        3.44  PRECIPITATION DEPTH
                TRDA      200.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
          0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
178 JD  INDEX STORM NO. 8
              STRM        3.38  PRECIPITATION DEPTH
              TRDA      300.00  TRANSPOSITION DRAINAGE AREA

  0 PI      PRECIPITATION PATTERN
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
          0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
179 JD  INDEX STORM NO. 9
              STRM        3.29  PRECIPITATION DEPTH
              TRDA      500.00  TRANSPOSITION DRAINAGE AREA

  0 PI      PRECIPITATION PATTERN
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
          0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
          0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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          0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
181 BI  READ STATION   DCAP11 HYDROGRAPH FROM UNIT 22

188 BI  READ STATION   DCAP12 HYDROGRAPH FROM UNIT 22

212 BI  READ STATION   DCAP13 HYDROGRAPH FROM UNIT 22

291 BI  READ STATION   DCAP14 HYDROGRAPH FROM UNIT 22
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 317 KK     *    624ERT  *
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 318 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

 451 BI          READ STATION   RDCP15 HYDROGRAPH FROM UNIT 22
        WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

 551 BI          READ STATION   CWI504 HYDROGRAPH FROM UNIT 22

 558 BI          READ STATION   CWI508 HYDROGRAPH FROM UNIT 22

 601 BI          READ STATION   CWI525 HYDROGRAPH FROM UNIT 22

 612 BI          READ STATION   DCAP10 HYDROGRAPH FROM UNIT 22
        WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO
WARNING --- ROUTED OUTFLOW (    444.) IS GREATER THAN MAXIMUM OUTFLOW (    342.) IN STORAGE-OUTFLOW TABLE
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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	DCAP11	424.	16.08	411.	256.	88.	53.75		
+	ROUTED TO	RDCP11	424.	16.33	410.	256.	88.	53.75		
+	HYDROGRAPH AT	DCAP12	410.	16.08	394.	243.	84.	53.75		
+	DIVERSION TO	DO618	218.	16.08	209.	129.	45.	53.75		
+	HYDROGRAPH AT	D618	193.	16.08	185.	114.	40.	53.75		
+	ROUTED TO	RDCP12	193.	16.33	185.	114.	40.	53.75		
+	HYDROGRAPH AT	PI618	323.	12.33	43.	12.	4.	0.29		
+	3 COMBINED AT	CPI618	629.	16.17	605.	390.	135.	5.48		
+	ROUTED TO	RPI618	628.	16.75	604.	390.	135.	5.48		
+	HYDROGRAPH AT	DCAP13	420.	16.08	404.	248.	88.	53.75		
+	ROUTED TO	RDCP13	420.	16.67	403.	248.	88.	53.75		
+	HYDROGRAPH AT	PI615	625.	12.33	115.	31.	10.	0.84		
+	HYDROGRAPH AT	D618	218.	16.08	209.	129.	45.	53.75		
+	ROUTED TO	RD618	217.	16.42	209.	129.	45.	53.75		
	3 COMBINED AT									

+		CPI615	701.	12.33	626.	416.	146.	6.21
+	ROUTED TO	RPI615	653.	16.75	626.	416.	146.	6.21
+	HYDROGRAPH AT	PI612	458.	12.67	96.	26.	9.	0.74
+	HYDROGRAPH AT	PI624B	67.	12.42	11.	3.	1.	0.10
+	DIVERSION TO	D624B	47.	12.25	10.	3.	1.	0.10
+	HYDROGRAPH AT	DO624B	20.	12.42	1.	0.	0.	0.10
+	ROUTED TO	RX624B	15.	12.58	1.	0.	0.	0.10
+	HYDROGRAPH AT	PI624D	204.	12.58	41.	11.	4.	0.32
+	2 COMBINED AT	CP624D	217.	12.58	42.	11.	4.	0.35
+	DIVERSION TO	DO624D	217.	12.58	42.	11.	4.	0.35
+	HYDROGRAPH AT	D624D	0.	0.00	0.	0.	0.	0.35
+	ROUTED TO	RX624D	0.	0.00	0.	0.	0.	0.35
+	4 COMBINED AT	CPI612	1406.	12.67	1232.	826.	288.	12.43
+	DIVERSION TO	DO612	1055.	12.67	924.	620.	216.	12.43
+	HYDROGRAPH AT	D612	352.	12.67	308.	207.	72.	12.43
+	ROUTED TO	RPI612	335.	12.92	308.	207.	72.	12.43
+	HYDROGRAPH AT	DCAP14	362.	16.08	347.	185.	62.	53.75
+	ROUTED TO	RDCP14	362.	17.25	346.	185.	62.	53.75
+	HYDROGRAPH AT	PI609	960.	12.50	262.	71.	24.	1.94
+	HYDROGRAPH AT	D624D	217.	12.58	42.	11.	4.	0.35
+	ROUTED TO	RD624D	205.	12.67	42.	11.	4.	0.35
+	HYDROGRAPH AT	PI624E	512.	12.08	48.	15.	5.	0.26
+	DIVERSION TO	RET624	512.	12.08	35.	9.	3.	0.26
+	HYDROGRAPH AT	624ERT	229.	12.17	18.	5.	2.	0.26
+	2 COMBINED AT	CP624E	259.	12.25	59.	16.	5.	0.61
+	ROUTED TO	RD624E	226.	12.75	59.	16.	5.	0.61
+	HYDROGRAPH AT	PI624G	86.	12.25	10.	3.	1.	0.07
+	HYDROGRAPH AT	PI624F	51.	12.33	8.	2.	1.	0.06
+	HYDROGRAPH AT	D624B	47.	12.25	10.	3.	1.	0.10
+	ROUTED TO	RD624B	46.	12.83	10.	3.	1.	0.10
+	HYDROGRAPH AT	PI624C	331.	12.50	51.	13.	4.	0.37
+	2 COMBINED AT	CP624C	346.	12.50	61.	16.	5.	0.44
+	DIVERSION TO	D624C	235.	12.50	41.	11.	4.	0.44
+	HYDROGRAPH AT	DO624C	111.	12.50	20.	5.	2.	0.44
+	ROUTED TO	RD624C	107.	12.67	20.	5.	2.	0.44
+	4 COMBINED AT	CP624G	405.	12.42	95.	26.	9.	0.88

+	DIVERSION TO	D624G	60.	12.42	14.	4.	1.	0.88
+	HYDROGRAPH AT	DO624G	345.	12.42	81.	22.	7.	0.88
+	ROUTED TO	RD624G	343.	12.42	81.	22.	7.	0.88
+	HYDROGRAPH AT	PI624H	59.	12.33	10.	3.	1.	0.08
+	2 COMBINED AT	CP624H	398.	12.42	90.	24.	8.	0.95
+	ROUTED TO	RD624H	393.	12.50	90.	24.	8.	0.95
+	ROUTED TO	RD624H	376.	12.58	90.	24.	8.	0.95
+	HYDROGRAPH AT	D612	1055.	12.67	924.	620.	216.	12.43
+	ROUTED TO	RD612	1004.	13.00	924.	620.	216.	12.43
+	HYDROGRAPH AT	PI621A	137.	12.42	23.	6.	2.	0.17
+	3 COMBINED AT	CP621A	1403.	12.92	985.	649.	226.	10.31
+	ROUTED TO	RD621A	1385.	13.00	984.	649.	226.	10.31
+	HYDROGRAPH AT	PI621B	39.	12.25	5.	1.	0.	0.04
+	2 COMBINED AT	CP621B	1392.	13.00	985.	650.	227.	10.35
+	ROUTED TO	RD621B	1392.	13.00	985.	650.	227.	10.35
+	4 COMBINED AT	CPI609	2456.	12.92	1725.	1105.	382.	18.45
+	ROUTED TO	R609-1	2450.	12.92	1724.	1105.	382.	18.45
+	DIVERSION TO	DOHVC1	1729.	12.92	1217.	780.	270.	18.45
+	HYDROGRAPH AT	DHVC1	721.	12.92	507.	325.	112.	18.45
+	ROUTED TO	R609-2	702.	13.17	506.	325.	112.	18.45
+	HYDROGRAPH AT	DCAP15	248.	14.42	216.	66.	22.	39.36
+	ROUTED TO	RDCP15	246.	14.75	215.	66.	22.	39.36
+	HYDROGRAPH AT	PI606A	374.	12.50	65.	18.	6.	0.46
+	2 COMBINED AT	C606A	363.	12.50	253.	97.	32.	4.08
+	DIVERSION TO	DO606A	149.	12.50	104.	40.	13.	4.08
+	HYDROGRAPH AT	D606A	214.	12.50	149.	57.	19.	4.08
+	ROUTED TO	R606A	166.	18.25	148.	57.	19.	4.08
+	HYDROGRAPH AT	PI606	708.	12.42	147.	40.	13.	1.08
+	3 COMBINED AT	CPI606	1191.	13.08	732.	421.	145.	8.92
+	ROUTED TO	RPI606	1165.	13.25	729.	421.	145.	8.92
+	HYDROGRAPH AT	PI604	312.	12.33	63.	18.	6.	0.36
+	HYDROGRAPH AT	D606A	149.	12.50	104.	40.	13.	4.08
+	ROUTED TO	RD606A	131.	12.83	104.	40.	13.	4.08
+	2 COMBINED AT	CPI604	321.	12.67	144.	58.	19.	2.03
+	ROUTED TO	RPI604	312.	12.92	141.	58.	19.	2.03

+	HYDROGRAPH AT	PD744	531.	12.67	107.	28.	9.	0.80
+	HYDROGRAPH AT	DHVC1	1729.	12.92	1217.	780.	270.	18.45
+	ROUTED TO	RDHVC1	1685.	13.17	1213.	780.	270.	18.45
+	HYDROGRAPH AT	PI600A	769.	12.33	81.	21.	7.	0.56
+	2 COMBINED AT	C600A	1759.	13.17	1235.	803.	278.	13.58
+	HYDROGRAPH AT	PI603	418.	12.50	74.	20.	7.	0.52
+	5 COMBINED AT	CPI603	3507.	13.08	2190.	1295.	448.	25.85
+	ROUTED TO	SPI603	2769.	13.58	2101.	1292.	444.	25.85
+	DIVERSION TO	DO744	0.	0.00	0.	0.	0.	25.85
+	HYDROGRAPH AT	D744	2769.	13.58	2101.	1292.	444.	25.85
+	HYDROGRAPH AT	CWI504	17196.	16.08	15524.	5927.	2016.	164.40
+	ROUTED TO	RWI504	17161.	16.17	15515.	5927.	2016.	164.40
+	HYDROGRAPH AT	CWI508	7401.	16.33	4749.	1821.	616.	41.34
+	DIVERSION TO	DO508	1406.	16.33	902.	346.	117.	41.34
+	HYDROGRAPH AT	D508	5995.	16.33	3847.	1475.	499.	41.34
+	HYDROGRAPH AT	WI510A	937.	12.58	151.	39.	13.	1.13
+	ROUTED TO	R510A	553.	13.75	149.	39.	13.	1.13
+	HYDROGRAPH AT	WI510	563.	13.00	179.	47.	16.	1.23
+	3 COMBINED AT	CWI510	6176.	16.25	4065.	1565.	529.	35.84
+	ROUTED TO	RWI510	6035.	16.67	3938.	1565.	529.	35.84
+	HYDROGRAPH AT	WI502	669.	12.83	179.	47.	16.	1.21
+	3 COMBINED AT	CWI502	21379.	16.58	18774.	7288.	2477.	201.44
+	ROUTED TO	RWI502	21344.	16.67	18768.	7288.	2477.	201.44
+	HYDROGRAPH AT	CWI525	1614.	12.58	834.	557.	190.	8.92
+	DIVERSION TO	DO525	101.	12.58	37.	20.	7.	8.92
+	HYDROGRAPH AT	D525	1514.	12.58	797.	538.	183.	8.92
+	ROUTED TO	RWI525	1184.	13.33	781.	537.	183.	8.92
+	HYDROGRAPH AT	DCAP10	420.	16.08	404.	253.	86.	53.75
+	ROUTED TO	RDCP10	420.	16.50	404.	252.	86.	53.75
+	HYDROGRAPH AT	PI628	695.	12.33	81.	22.	7.	0.57
+	2 COMBINED AT	CPI628	750.	12.33	413.	280.	96.	4.11
+	ROUTED TO	RPI628	616.	12.75	412.	280.	96.	4.11
+	HYDROGRAPH AT	PI624A	960.	12.58	158.	41.	14.	1.31
+	2 COMBINED AT	C624A	1500.	12.67	545.	319.	109.	5.42
+	ROUTED TO	R624A	1500.	12.67	545.	319.	109.	5.42
	HYDROGRAPH AT							

+		PI639A	79.	12.42	11.	3.	1.	0.09
+	2 COMBINED AT	C639A	1550.	12.67	554.	321.	110.	5.51
+	ROUTED TO	R639A	1471.	12.83	552.	321.	110.	5.51
+	HYDROGRAPH AT	WI524A	463.	12.50	68.	17.	6.	0.60
+	HYDROGRAPH AT	D525	101.	12.58	37.	20.	7.	8.92
+	ROUTED TO	RD525	63.	13.58	36.	20.	7.	8.92
+	3 COMBINED AT	C524A	1768.	12.75	641.	357.	122.	6.67
+	ROUTED TO	R524A	1766.	12.83	640.	357.	122.	6.67
+	HYDROGRAPH AT	2.8	151.	12.08	16.	5.	2.	0.08
+	2 COMBINED AT	C2.8	1776.	12.83	646.	361.	124.	6.75
+	ROUTED TO	R2.8	1759.	12.83	645.	361.	124.	6.75
+	HYDROGRAPH AT	3A	59.	12.25	6.	1.	0.	0.05
+	ROUTED TO	R3A	54.	12.33	6.	1.	0.	0.05
+	HYDROGRAPH AT	2.11	73.	12.00	7.	2.	1.	0.04
+	2 COMBINED AT	C2.11	91.	12.08	12.	3.	1.	0.08
+	ROUTED TO	R2.11	88.	12.17	12.	3.	1.	0.08
+	HYDROGRAPH AT	2.10	107.	12.08	13.	4.	1.	0.07
+	ROUTED TO	S2.10	50.	12.42	10.	3.	1.	0.07
+	HYDROGRAPH AT	2.7	250.	12.00	22.	7.	2.	0.11
+	HYDROGRAPH AT	2.4	98.	12.08	12.	4.	1.	0.07
+	ROUTED TO	S2.4	96.	12.17	12.	4.	1.	0.07
+	ROUTED TO	R2.4	91.	12.25	12.	4.	1.	0.07
+	4 COMBINED AT	C2.7	357.	12.08	55.	16.	6.	0.32
+	ROUTED TO	S2.7	1.	12.08	1.	1.	1.	0.32
+	2 COMBINED AT	C2.6	1759.	12.83	645.	362.	125.	7.07
+	ROUTED TO	R2.6	1752.	12.92	644.	362.	124.	7.07
+	HYDROGRAPH AT	2.5	152.	12.08	18.	6.	2.	0.09
+	2 COMBINED AT	CWI524	1766.	12.92	650.	367.	126.	7.17
+	DIVERSION TO	DO524	234.	12.92	27.	7.	2.	7.17
+	HYDROGRAPH AT	D524	1532.	12.92	622.	360.	124.	7.17
+	ROUTED TO	RWI524	1418.	13.17	618.	360.	124.	7.17
+	HYDROGRAPH AT	4A	162.	12.42	22.	6.	2.	0.19
+	ROUTED TO	R4A	151.	12.50	22.	6.	2.	0.19
+	HYDROGRAPH AT	2.1	201.	12.08	26.	8.	3.	0.14
+	2 COMBINED AT	C2.1	230.	12.42	47.	13.	4.	0.32
+	ROUTED TO	S2.1	229.	12.50	47.	13.	4.	0.32

+	ROUTED TO	R2.1	224.	12.58	47.	13.	4.	0.32
+	HYDROGRAPH AT	1.11	198.	12.08	25.	8.	3.	0.13
+	HYDROGRAPH AT	D524	234.	12.92	27.	7.	2.	7.17
+	ROUTED TO	RD524	206.	13.08	27.	7.	2.	7.17
+	3 COMBINED AT	CPI639	353.	13.00	99.	28.	9.	1.34
+	ROUTED TO	RPI639	340.	13.17	99.	28.	9.	1.34
+	HYDROGRAPH AT	WI506	961.	12.50	239.	65.	22.	1.58
+	4 COMBINED AT	CWI506	3353.	13.17	1591.	971.	334.	17.54
+	HYDROGRAPH AT	D508	1406.	16.33	902.	346.	117.	41.34
+	ROUTED TO	RD508	1389.	16.58	902.	346.	117.	41.34
+	HYDROGRAPH AT	WI500	765.	12.67	154.	40.	13.	1.05
+	4 COMBINED AT	CWI500	23515.	16.75	20602.	8472.	2882.	227.89
+	ROUTED TO	SSPILL	3018.	27.08	2999.	2754.	1896.	227.89
+	ROUTED TO	RWI500	3017.	27.67	2999.	2753.	1896.	227.89
+	HYDROGRAPH AT	PI635	622.	12.50	100.	28.	9.	0.61
+	2 COMBINED AT	CPI635	3017.	27.67	2999.	2753.	1896.	228.50
+	ROUTED TO	RPI635	3016.	28.42	2998.	2752.	1896.	228.50
+	HYDROGRAPH AT	PI621C	730.	12.42	90.	24.	8.	0.66
+	ROUTED TO	SPI621	613.	12.58	51.	13.	4.	0.66
+	ROUTED TO	RPI621	367.	12.83	51.	13.	4.	0.66
+	HYDROGRAPH AT	PI633	280.	12.50	50.	13.	4.	0.34
+	HYDROGRAPH AT	1.8	37.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.8	31.	12.08	3.	1.	0.	0.02
+	HYDROGRAPH AT	1.7	122.	12.08	13.	4.	1.	0.07
+	HYDROGRAPH AT	1.5A	26.	12.08	3.	1.	0.	0.01
+	3 COMBINED AT	C1.7	177.	12.08	19.	6.	2.	0.10
+	ROUTED TO	S1.7	111.	12.25	18.	5.	2.	0.10
+	HYDROGRAPH AT	1.9	111.	12.08	14.	4.	1.	0.07
+	HYDROGRAPH AT	1.6	83.	12.08	9.	3.	1.	0.05
+	3 COMBINED AT	C1.6	275.	12.17	39.	11.	4.	0.22
+	ROUTED TO	S1.6	234.	12.25	39.	11.	4.	0.22
+	HYDROGRAPH AT	1.10	50.	12.00	4.	1.	0.	0.02
+	ROUTED TO	R1.10	41.	12.08	4.	1.	0.	0.02
+	HYDROGRAPH AT	1.13A	54.	12.00	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14A	60.	12.08	7.	2.	1.	0.04

+	4 COMBINED AT	C1.14A	341.	12.17	55.	17.	6.	0.30
+	ROUTED TO	S1.14A	171.	12.58	35.	10.	3.	0.30
+	HYDROGRAPH AT	1.13B	36.	12.08	5.	2.	1.	0.03
+	ROUTED TO	R1.13B	30.	12.33	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14B	55.	12.08	7.	2.	1.	0.03
+	3 COMBINED AT	C1.14B	204.	12.58	45.	13.	4.	0.36
+	ROUTED TO	R1.14B	200.	12.67	45.	13.	4.	0.36
+	HYDROGRAPH AT	1.16A	57.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16A	7.	12.42	2.	1.	0.	0.03
+	ROUTED TO	R1.16A	7.	12.58	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.15A	46.	12.00	5.	1.	0.	0.02
+	ROUTED TO	S1.15A	21.	12.25	2.	1.	0.	0.02
+	HYDROGRAPH AT	1.15B	33.	12.00	4.	1.	0.	0.02
+	4 COMBINED AT	C1.15B	217.	12.58	52.	15.	5.	0.43
+	ROUTED TO	R1.15B	210.	12.75	52.	15.	5.	0.43
+	HYDROGRAPH AT	1.16B	66.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16B	7.	12.33	2.	1.	0.	0.03
+	ROUTED TO	R1.16B	6.	12.83	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.17A	89.	12.08	10.	3.	1.	0.05
+	ROUTED TO	S1.17A	15.	12.58	4.	1.	0.	0.05
+	HYDROGRAPH AT	1.17B	48.	12.08	6.	2.	1.	0.03
+	4 COMBINED AT	C1.17B	236.	12.75	62.	19.	6.	0.54
+	ROUTED TO	R1.17B	233.	12.83	62.	19.	6.	0.54
+	HYDROGRAPH AT	1.3	55.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.3	2.	13.33	1.	0.	0.	0.03
+	ROUTED TO	R1.3	2.	13.92	1.	0.	0.	0.03
+	HYDROGRAPH AT	1.2	180.	12.08	20.	6.	2.	0.11
+	ROUTED TO	S1.2	5.	13.92	3.	1.	0.	0.11
+	3 COMBINED AT	C636	233.	12.83	65.	20.	7.	0.68
+	ROUTED TO	RPI636	229.	12.83	65.	20.	7.	0.68
+	HYDROGRAPH AT	D624C	235.	12.50	41.	11.	4.	0.44
+	ROUTED TO	RD624C	217.	12.75	41.	11.	4.	0.44
+	HYDROGRAPH AT	D624G	60.	12.42	14.	4.	1.	0.88
+	ROUTED TO	RD624G	56.	12.83	14.	4.	1.	0.88
+	HYDROGRAPH AT	4B	401.	12.42	47.	12.	4.	0.38
	3 COMBINED AT							

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+                    C4B      555.   12.50       102.       26.        9.      0.81
        ROUTED TO
+                    R4B      551.   12.58       101.       26.        9.      0.81
        HYDROGRAPH AT
+                   1.5B       33.   12.00         3.        1.        0.      0.02
        ROUTED TO
+                  S1.5B        3.   12.67         1.        0.        0.      0.02
        2 COMBINED AT
+                  C1.5B      552.   12.58       102.       26.        9.      0.83
        ROUTED TO
+                  R1.5B      549.   12.58       102.       26.        9.      0.83
        HYDROGRAPH AT
+                   1.5C       34.   12.00         3.        1.        0.      0.01
        ROUTED TO
+                  S1.5C        2.   12.42         1.        0.        0.      0.01
        ROUTED TO
+                  R1.5C        1.   12.75         1.        0.        0.      0.01
        HYDROGRAPH AT
+                    1.4       58.   12.00         6.        2.        1.      0.03
        ROUTED TO
+                   S1.4        0.   23.50         0.        0.        0.      0.03
        3 COMBINED AT
+                   C624      549.   12.58       102.       26.        9.      0.87
        HYDROGRAPH AT
+                  PI624      281.   12.67        56.       14.        5.      0.45
        3 COMBINED AT
+                 CPI624      989.   12.67       218.       59.       20.      2.00
        ROUTED TO
+                 SPI624      815.   13.00       138.       38.       13.      2.00
        ROUTED TO
+                 RPI624      563.   13.50       136.       38.       13.      2.00
        4 COMBINED AT
+                 CPI633     3016.   28.33      2998.     2753.     1896.    231.49
        ROUTED TO
+                 RPI633     3014.   28.92      2996.     2750.     1895.    231.49
        HYDROGRAPH AT
+                  PI600      731.   12.33        87.       23.        8.      0.61
        3 COMBINED AT
+                 CPI600     4156.   24.50      4062.     3362.     2266.    257.94
        ROUTED TO
+                 RPI600     4152.   25.00      4059.     3362.     2265.    257.94
1                 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION   SSPILL
                 (PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED  DURING BREACH FORMATION)

PLAN  1 ..............                INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                          ELEVATION       1335.00           1360.70          1360.70
                          STORAGE              0.             39849.           39849.
                          OUTFLOW              0.             99300.           99300.

              RATIO     MAXIMUM     MAXIMUM     MAXIMUM     MAXIMUM     DURATION     TIME OF      TIME OF
               OF       RESERVOIR   DEPTH       STORAGE     OUTFLOW     OVER TOP     MAX OUTFLOW  FAILURE
              PMF       W.S.ELEV    OVER DAM    AC-FT       CFS         HOURS        HOURS        HOURS

              1.00      1352.56     0.00        17661.      4092.       0.00         25.92        0.00

PLAN  2 ..............                INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                          ELEVATION       1335.00           1360.70          1360.70
                          STORAGE              0.             39849.           39849.
                          OUTFLOW              0.             99300.           99300.

              RATIO     MAXIMUM     MAXIMUM     MAXIMUM     MAXIMUM     DURATION     TIME OF      TIME OF
               OF       RESERVOIR   DEPTH       STORAGE     OUTFLOW     OVER TOP     MAX OUTFLOW  FAILURE
              PMF       W.S.ELEV    OVER DAM    AC-FT       CFS         HOURS        HOURS        HOURS

              1.00      1351.75     0.00        16294.      3751.       0.00         26.25        0.00

PLAN  3 ..............                INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                          ELEVATION       1335.00           1360.70          1360.70
                          STORAGE              0.             39849.           39849.
                          OUTFLOW              0.             99300.           99300.

              RATIO     MAXIMUM     MAXIMUM     MAXIMUM     MAXIMUM     DURATION     TIME OF      TIME OF
               OF       RESERVOIR   DEPTH       STORAGE     OUTFLOW     OVER TOP     MAX OUTFLOW  FAILURE
              PMF       W.S.ELEV    OVER DAM    AC-FT       CFS         HOURS        HOURS        HOURS

              1.00      1351.50     0.00        15899.      3643.       0.00         26.33        0.00

PLAN  4 ..............                INITIAL VALUE     SPILLWAY CREST     TOP OF DAM
                          ELEVATION       1335.00           1360.70          1360.70
```

STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.06	0.00	15198.	3452.	0.00	26.58	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.64	0.00	14526.	3269.	0.00	26.75	0.00

PLAN 6 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.42	0.00	14170.	3172.	0.00	26.92	0.00

PLAN 7 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1350.13	0.00	13704.	3045.	0.00	27.08	0.00

PLAN 8 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.93	0.00	13394.	2960.	0.00	27.17	0.00

PLAN 9 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1349.62	0.00	12889.	2823.	0.00	27.25	0.00

*** NORMAL END OF HEC-1 ***

Future Conditions 100-Year 24-Hour Storm HEC-1 Model With Preferred Alternative in Place

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   17DEC10  TIME  10:03:09  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                                    HEC-1 INPUT                                    PAGE  1

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             1          ID   HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
             2          ID   100-YEAR 24-HOUR STORM
             3          ID   PREFERRED ALTERNATIVE FUTURE CONDITIONS
             4          ID   ******************************************************************************
             5          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
             6          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
             7          ID   ******************************************************************************
             8          ID   **                                                                          **
             9          ID   **  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY    **
            10          ID   **                                                                          **
            11          ID   ******************************************************************************
            12          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            13          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            14          ID   ******************************************************************************
            15          ID   **                                                                          **
            16          ID   ** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS    **
            17          ID   ** DATED OCTOBER 2004:                                                      **
            18          ID   **                                                                          **
            19          ID   **     -Diversion added after CTW480                                        **
            20          ID   **          -Main flow (5%) to CTW478                                       **
            21          ID   **          -Diverted flow (95%) to CWI584                                  **
            22          ID   **          -Added concentration point CWI584 combining RD480 and WI584     **
            23          ID   **          -Hard coding was added to CTW478                                **
            24          ID   **          -Route added after D480 (Diversion Recovery)                    **
            25          ID   **          -Route RWI584 was adjusted                                      **
            26          ID   **          -Storage Route SCP050 was adjusted                              **
            27          ID   **          -Route R508* was adjusted                                       **
            28          ID   **          -Hard coding for CWI510 was adjusted                            **
            29          ID   **                                                                          **
            30          ID   **     -Diversion D618 was moved from after CPI618 to before RDCP12         **
            31          ID   **          -Updated route RD618 information                                **
            32          ID   **          -Hard coding on CPI618 was adjusted                             **
            33          ID   **          -Hard coding on CPI615 was adjusted                             **
            34          ID   **                                                                          **
            35          ID   **     -Route RPI639 changed from following US60 to CPI636 to route         **
            36          ID   **      through US60/RR structures and combine with CWI506                  **
            37          ID   **          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from **
            38          ID   **           following R624A to follow RWI524                               **
            39          ID   **          -CPI636 was removed-no longer needed to combine PI636 & RPI639 **
            40          ID   **          -RPI639 information was changed to reflect new route            **
            41          ID   **          -CWI506 changed from combining 3 to combine 4:                  **
            42          ID   **           RWI525, RWI524, RPI639 & WI506                                 **
            43          ID   **          -Hard coding on CWI506 was adjusted                             **
            44          ID   **          -Hard Coding on CWI500 was adjusted                             **
            45          ID   **                                                                          **
            46          ID   ******************************************************************************
            47          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            48          ID   **-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
            49          ID   ******************************************************************************
            50          ID
            51          ID
            52          ID
            53          ID   ******************************************************************************
            54          ID   ******************************************************************************
            55          ID   **                                                                          **
1                                    HEC-1 INPUT                                    PAGE  2

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

            56          ID   **    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004       **
            57          ID   **                                                                          **
            58          ID   ******************************************************************************
            59          ID   ******************************************************************************
            60          ID
            61          ID   PROJECT:                Wittmann ADMS Update
            62          ID   CLIENT:                 Flood Control District of Maricopa County
            63          ID   PREPARED BY:            Entellus, Inc.
            64          ID   PROJECT No:             FCD 2002C029              Entellus 310.032
```

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 65          ID   FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
 66          ID                                           MODIFIED DATE: MAY 04, 2005
 67          ID
 68          ID   STORM:
 69          ID                        100-year 24-hour Storm
 70          ID
 71          ID   DEVELOPMENT CONDITIONS:
 72          ID                        Existing Conditions
 73          ID
 74          ID   MODELING ASSUMPTIONS:
 75          ID                        It was assumed that the US60 did not have adequate
 76          ID                        storage to cause any significant attenuation.
 77          ID
 78          ID                        The assumption was made that the CAP Canal embankment
 79          ID                        would not be breached under a large flood event.
 80          ID
 81          ID                        The assumption was made that the Beardsley Canal would
 82          ID                        not fail under a large storm event (Per District
 83          ID                        Instruction).  In addition, the berm north of the
 84          ID                        Beardsley canal and east of US60 was assumed to fail
 85          ID                        (per district Instruction).
 86          ID
 87          ID                        For both the CAP and Beardsley Canals, once the berm
 88          ID                        elevation was reached weir flow was assumed.  It was
 89          ID                        also assumed that any weir flow over the canal that
 90          ID                        might enter the canal and be diverted out of the study
 91          ID                        area was insignificant, and thus was ignored.  In other
 92          ID                        words all weir flow over the canal embankment reaches
 93          ID                        the downstream concentration point.
 94          ID
 95          ID                        Typical X-sects were developed, and it was assumed
 96          ID                        that a typical x-sect could adequately represent
 97          ID                        various reaches.
 98          ID
 99          ID                        Time-Area Relations were used base on the District's
100          ID                        Hydrology Manual criteria.  Two Time-Area Relation
101          ID                        Curves were utilized:
102          ID                                -Urban
103          ID                                -Natural
104          ID                        The Time-Area Relation Curves were taken directly
105          ID                        from the manual
106          ID
107          ID   MODELING METHODS:
108          ID                        This model utilizes QI cards to input the Padelford
109          ID                        hydrographs from the 100-year 6-hour existing
110          ID                        conditions model developed by A-N West Inc. for the
1                                          HEC-1 INPUT                                    PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

111          ID                        Padelford Wash Floodplain Delineation Study.  The
112          ID                        hydrograph was altered from its original form
113          ID                        (2-minute interval to 5-minute interval) through
114          ID                        simple interpolation.
115          ID
116          ID                        Clark Unit Hydrographs were used for all subbasins
117          ID                        except the two subbasins directly upstream of the
118          ID                        Bonita Dam (PD726B and PD740 use S-graphs).  The UC
119          ID                        parameters were calculated using the WMS7.0 software.
120          ID
121          ID                        For Basins PD726B and PD740 S-Graphs were utilized per
122          ID                        the request of the FCDMC.  Limited details regarding
123          ID                        the calculations of the S-graphs can be found in the
124          ID                        model by the basin KK card.  For full details of the
125          ID                        S-graph calculations refer to the Appendix.
126          ID
127          ID                        Normal Depth routing was used for all routing reaches.
128          ID
129          ID                        Hard coding was used to account for the percentage of
130          ID                        area associated with a diversion.  Because of the use
131          ID                        of JD cards and aereal reduction, hard coding  was
132          ID                        necessary to properly account for area.  For a given
133          ID                        diversion a percentage of the flow is routed to two
134          ID                        different locations.  The same percentage of area
135          ID                        follows that diverted flow.  In addition the area
136          ID                        downstream of the main path is reduced or increased and
137          ID                        is hard coded to account for the loss or gain of area.
138          ID                        Hard coding was performed based on the 24-hour existing
139          ID                        conditions model.
140          ID
141          ID                        Stage-storage was developed for all the structures
142          ID                        along the CAP Canal, as well as along the Beardsley
143          ID                        Canal.  In addition several stage-storage locations
144          ID                        were developed for areas with significant storage
145          ID                        along the SR74.  No storage was modeled along the US60
146          ID                        and railroad, but the culverts were analyzed for
147          ID                        diversion potential.  Diversions were placed in the
148          ID                        model where deemed appropriate.  See appendix for
149          ID                        details.
150          ID
151          ID                        FLO-2D was utilized to calculate the split flows at
152          ID                        concentration points CIW351. CIW357, CIW363 and CWI576.
153          ID                        See appendix for modeling details.
154          ID
155          ID   ******************************************************************************
156          ID   ******************************************************************************
157          ID
             *DIAGRAM
158          IT       5                0    1500
159          IO       5
160          IN      15                0
161          JD    4.18     0.01
             * 24-hour distribution
162          PC     0.0    0.002    0.005    0.008    0.011    0.014    0.017     0.02    0.023    0.026
163          PC   0.029    0.032    0.035    0.038    0.041    0.044    0.048    0.052    0.056     0.06
1                                          HEC-1 INPUT                                    PAGE  4
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 164          PC   0.064   0.068   0.072   0.076    0.08   0.085    0.09   0.095     0.1   0.105
 165          PC    0.11   0.115    0.12   0.126   0.133    0.14   0.147   0.155   0.163   0.172
 166          PC   0.181   0.191   0.203   0.218   0.236   0.257   0.283   0.387   0.663   0.707
 167          PC   0.735   0.758   0.776   0.791   0.804   0.815   0.825   0.834   0.842   0.849
 168          PC   0.856   0.863   0.869   0.875   0.881   0.887   0.893   0.898   0.903   0.908
 169          PC   0.913   0.918   0.922   0.926    0.93   0.934   0.938   0.942   0.946    0.95
 170          PC   0.953   0.956   0.959   0.962   0.965   0.968   0.971   0.974   0.977    0.98
 171          PC   0.983   0.986   0.989   0.992   0.995   0.998     1.0
 172          JD   3.929    10.0
 173          JD   3.856    20.0
 174          JD   3.725    40.0
 175          JD   3.599    80.0
 176          JD   3.532   120.0
 177          JD   3.444   200.0
 178          JD   3.385   300.0
 179          JD   3.289   500.0
              *
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP110

 180          KK  DCAP11
 181          BI  DCAP11      22
              *
              *
              * ROUTE UPDATED 4/14/4

 182          KK  RDCP11
 183          RS       5    FLOW     0.0     0.0
 184          RC   0.043   0.035   0.043    6377  0.0094
              * PITS10_2
 185          RX       0      89     103     136     185     206     261     280
 186          RY    1612  1610.5    1610  1608.5    1610    1611  1611.8    1612
              *
              * CAP Diversion Recovery: Outflow from structure CAP120

 187          KK  DCAP12
 188          BI  DCAP12      22
              *
              *
              * Diversion Out: Flow split FS11
              * Flow Split Diversion: Main path to CPI618, Diversion to CPI615
              * 53% of flow is diverted to CPI615

 189          KK    D618
 190          DT   DO618     0.0     0.0
 191          DI       0   10000
 192          DQ       0    5300
              *
              *
              * ROUTE UPDATED 4/14/4
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 193          KK  RDCP12
 194          RS       2    FLOW     0.0     0.0
 195          RC   0.043   0.035   0.043    6159  0.0094
              * PITS30
 196          RX       0      49     199     206     222     231     299     375
 197          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *

 198          KK   PI618
 199          BA  0.2886
 200          LG     0.3    0.25   4.623   0.336    10.0
 201          UC   0.500   0.407
              * Urban Time-Area Relation
 202          UA       0       5      16      30      65      77      84      90      94      97
 203          UA     100
              *
              *
              * Combines PI618, RDCP12 and RDCP11

 204          KK  CPI618
              * Hard Coded
 205          HC       3    5.48
              *
              *
              * ROUTE UPDATED 4/14/04

 206          KK  RPI618
 207          RS       5    FLOW     0.0     0.0
 208          RC   0.043   0.035   0.043   10443  0.0075
              * PITS20
 209          RX       0      50      84      87     123     125     156     285
 210          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              * CAP Diversion Recovery: Outflow from structure CAP130

 211          KK  DCAP13
 212          BI  DCAP13      22
              *
              *
              * ROUTE UPDATED 4/14/4

 213          KK  RDCP13
 214          RS       6    FLOW     0.0     0.0
 215          RC   0.043   0.035   0.043   11034  0.0089
              * PITS30
```

```
 216          RX       0      49     199     206     222     231     299     375
 217          RY    1532    1532    1530    1528    1528    1530    1532    1532
              *
              *
1                                        HEC-1 INPUT                                                    PAGE  6

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 218          KK   PI615
 219          BA  0.8419
 220          LG   0.297    0.25   4.318   0.415  11.355
 221          UC   0.771    0.57
              * Urban Time-Area Relation
 222          UA       0       5      16      30      65      77      84      90      94      97
 223          UA     100
              *
              *
              * Diversion Recovery: Flow split FS11

 224          KK    D618
 225          DR   DO618
              *
              *
              * ROUTE UPDATED 05/04/2005

 226          KK   RD618
 227          RS       5    FLOW     0.0     0.0
 228          RC   0.043   0.035   0.043    9630  0.0091
              * PITS20
 229          RX       0      50      84      87     123     125     156     285
 230          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *
              *
              * Combines RD618, PI615 and RDCP13

 231          KK  CPI615
              * Hard Coded
 232          HC       3    6.21
              *
              *
              * ROUTE UPDATED 4/14/04

 233          KK  RPI615
 234          RS       2    FLOW     0.0     0.0
 235          RC   0.043   0.035   0.043    5109  0.0079
              * PITS20
 236          RX       0      50      84      87     123     125     156     285
 237          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 238          KK   PI612
 239          BA  0.7377
 240          LG   0.248    0.25   4.365   0.461  34.801
 241          UC   0.883   0.770
              * Urban Time-Area Relation
 242          UA       0       5      16      30      65      77      84      90      94      97
 243          UA     100
              *
              *
1                                        HEC-1 INPUT                                                    PAGE  7

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 244          KK  PI624B
 245          KM   OFFSITE SUBBASIN PI624B (North of Jomax Road, upstream of 36" culvert)
 246          BA   0.098
 247          LG    0.25    0.25   4.300   0.491    35.0
 248          UC   0.558   0.644
              * Urban Time-Area Relation
 249          UA       0       5      16      30      65      77      84      90      94      97
 250          UA     100
              *
              * Diversion to RX624B - Max Flow in 36" culvert w/4' depth = 47cfs (From DEI)
              *

 251          KK  DO624B
 252          KM   36" CONC CULVERT
 253          DT   D624B
 254          DI       0      47      87     200
 255          DQ       0      47      47      47
              *
              * ROUTE REMAINDER TO CP624D (From DEI)
              *

 256          KK  RX624B
 257          RS       3    FLOW     0.0     0.0
 258          RC   0.043   0.035   0.043    2000   0.006
 259          RX       0       4       8      12      20      24      28      32
 260          RY    1454    1453    1452    1450    1450    1452    1452    1454
              *
              *

 261          KK  PI624D
 262          KM   OFFSITE SUBBASIN PI624D (North of Jomax Road, upstream of 3-8x4 Box Culvert)
 263          BA   0.323
 264          LG   0.242   0.250   4.449   0.450   38.04
 265          UC   0.783   0.763
              * Urban Time-Area Relation
 266          UA       0       5      16      30      65      77      84      90      94      97
 267          UA     100
              * Hard Coded
```

```
268          KK  CP624D
269          HC       2    0.35
             *
             * MAIN FLOW NORTH RESTRICTION @ DESERT OASIS 3-8x4 BC CAPACITY TO DITCH
             * DIVERSION IS TO WASH 5 EAST

270          KK   D624D
271          DT  DO624D
272          DI       0     380     400
273          DQ       0     380     380
             *
             * ROUTING FROM DEI
1                                    HEC-1 INPUT                                                PAGE  8

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

274          KK  RX624D
275          RS       3    FLOW     0.0     0.0
276          RC   0.043   0.035   0.043    3854   0.006
277          RX       0       4       8      12      20      24      28      32
278          RY    1454    1453    1452    1450    1450    1452    1452    1454
             * COMBINES PI612, RPI618, RPI615, and FLOW FROM NORTH RESTRICTION @ DESERT OASIS

279          KK  CPI612
             * Hard Coded
280          HC       4   12.43
             *
             *
             * Diversion Out: Flow split FS12
             * Flow Split Diversion: Main path to CPI609, Diversion to PI621

281          KK    D612
282          DT   DO612     0.0     0.0
283          DI       0   10000
284          DQ       0    7500
             *
             *
             * ROUTE UPDATED 4/14/04

285          KK  RPI612
286          RS       3    FLOW     0.0     0.0
287          RC   0.043   0.035   0.043    5754   0.006
             * PITS20
288          RX       0      50      84      87     123     125     156     285
289          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             *
             *
             * CAP Diversion Recovery: Outflow from structure CAP140

290          KK  DCAP14
291          BI  DCAP14      22
             *
             *
             * ROUTE UPDATED 4/14/4

292          KK  RDCP14
293          RS      12    FLOW     0.0     0.0
294          RC   0.043   0.035   0.043   20386  0.0086
             * PITS30
295          RX       0      49     199     206     222     231     299     375
296          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *
1                                    HEC-1 INPUT                                                PAGE  9

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

297          KK   PI609
298          BA  1.9353
299          LG   0.275    0.25   4.529   0.391  21.889
300          UC   1.146   0.915
             * Urban Time-Area Relation
301          UA       0       5      16      30      65      77      84      90      94      97
302          UA     100
             *
             * PORTION OF TIERRA VERDE
             * RETENTION DIVERSION 80% OF REQUIRED 118.5 acres * 2.85/12 * 0.60 = 16.9 AcreFt
             * USE=13.51 AcreFt

303          KK  609RET
304          KO       0       0
305          DT  RET609   13.51
306          DI   10000
307          DQ   10000
             *
             * Diversion Recovery: WASH 5 EAST IN DESERT OASIS

308          KK   D624D
309          DR  DO624D

310          KK  RD624D
311          RS       2    FLOW     0.0     0.0
312          RC   0.043   0.035   0.043    3140   0.008
313          RX       0       4       8      12      27      31      35      39
314          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *
             * ******************************************************************************
             * DESERT OASIS DEVELOPMENT ******************************************************
             * ******************************************************************************
             *

315          KK  PI624E
316          KM   OFFSITE SUBBASIN PI624E
```

```
317          BA   0.257
318          LG    0.25    0.25    4.55   0.419      35
319          UC   0.250   0.121
             * Urban Time-Area Relation
320          UA       0       5      16      30      65      77      84      90      94      97
321          UA     100
             *
             * RETENTION DIVERSION 80% OF REQUIRED 164 acres * 2.85/12 * 0.60 = 23.4 AcreFt
             * USE=18.75 AcreFt

322          KK  624ERT
323          KO       0       0
324          DT  RET624   18.75
325          DI   10000
326          DQ   10000
             * Hard Coded
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

327          KK  CP624E
328          HC       2   0.609

329          KK  RD624E
330          RS       3    FLOW     0.0     0.0
331          RC   0.043   0.035   0.043    2793   0.007
332          RX       0       4       8      12      27      31      35      39
333          RY    1454    1453    1452    1450    1450    1452    1452    1454

334          KK  PI624G
335          KM   OFFSITE SUBBASIN PI624G (Undeveloped Desert Oasis Parcel)
336          BA   0.074
337          LG   0.250   0.250   4.550   0.419   35.00
338          UC   0.417   0.375
             * Urban Time-Area Relation
339          UA       0       5      16      30      65      77      84      90      94      97
340          UA     100
             * ASANTE PARCEL 4.3

341          KK     4.3
342          KM   ONSITE SUBBASIN 4.3
343          BA  0.1837
344          LG    0.25    0.25    4.90    0.34      35
345          UC   0.563   0.517
346          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
347          UA     100
             *
             *
             * Diversion Recovery: Flow Split D624B (36" Culvert)

348          KK   D624B
349          DR   D624B

350          KK   R624B
351          KM   404 CHANNEL TO C3.6
352          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, CHANNEL BOTTOM 2 FT,
353          KM   SLOPE @ 0.0070 FT/FT, DEPTH 1.1 FT, VELOCITY 2.6 FT/S
354          RS       2    FLOW     0.0     0.0
355          RC   0.042   0.035   0.042    2700  0.0070
356          RX       0       4       8      12      14      18      22      26
357          RY       3       2       1       0       0       1       2       3
             *

358          KK     3.7
359          KM   ONSITE SUBBASIN 3.7
360          BA   0.053
361          LG    0.27    0.25    4.55    0.40      31
362          UC   0.254   0.164
363          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
364          UA     100
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

365          KK    S3.7
366          KM   OVERFLOW WEIR ELEV. @ 3.0 FT, L=100 FT, C=2.8
367          KM   WEIR EQ'N: Q=CLH^3/2
368          RS       1    STOR       0
369          SQ     0.0     0.0     0.0     0.0    8.85   280.0
370          SE     0.0     1.0     2.0    2.99     3.0     4.0
371          SV    0.00    1.10    2.47    4.13    4.15    4.17
372          SE     0.0     1.0     2.0    2.99     3.0     4.0
             *

373          KK    R3.7
374          KM   ROUTE FLOW TO S3.6
375          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, CHANNEL BOTTOM 2 FT,
376          KM   SLOPE @ 0.0070 FT/FT, DEPTH 1.1 FT, VELOCITY 2.6 FT/S
377          RS       2    FLOW     0.0     0.0
378          RC   0.035   0.035   0.035    1280  0.0070
379          RX       0       4       8      12      14      18      22      26
380          RY       3       2       1       0       0       1       2       3
             *

381          KK     3.6
382          KM   ONSITE SUBBASIN 3.6
383          BA   0.133
384          LG    0.25    0.25    4.55    0.41      35
385          UC   0.350   0.240
386          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
387          UA     100
             *
```

```
388          KK   S3.61
389          KM   OVERFLOW WEIR ELEV. @ 3.0 FT, L=400 FT, C=2.8
390          KM   WEIR EQ'N: Q=CLH^3/2
391          RS       1    STOR       0
392          SQ     0.0     0.0     0.0     0.0   35.42  1120.0
393          SE     0.0     1.0     2.0    2.99     3.0     4.0
394          SV    0.00    1.98    4.50    7.59    7.61    7.63
395          SE     0.0     1.0     2.0    2.99     3.0     4.0
             *

396          KK    C3.6
397          KM   COMBINES 3.6 AND R3.7 AND R624B
398          HC       3    0.26
             *

399          KK    S3.6
400          KM   2-3'X12' CONCRETE BOX CULVERTS, 45 DEGREE WINGWALL FLARE
401          KM   INLET CONTROL, CULVERT BARREL SLOPE @ 0.0033 FT/FT
402          RS       1    STOR       0
403          SQ     0.0    65.9   186.4   342.2   431.3
404          SE     0.0     1.0     2.0     3.0     3.5
405          SV    0.00    0.33    0.66    1.00    1.17
406          SE     0.0     1.0     2.0     3.0     3.5
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

407          KK    R3.6
408          KM   ROUTE FLOW TO S3.10
409          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, CHANNEL BOTTOM 20 FT,
410          KM   SLOPE @ 0.0060 FT/FT, DEPTH 2.3 FT, VELOCITY 4.8 FT/S
411          RS       1    FLOW     0.0     0.0
412          RC   0.035   0.035   0.035    2000  0.0060
413          RX       0       4       8      12      32      36      40      44
414          RY       3       2       1       0       0       1       2       3
             *

415          KK    3.10
416          KM   ONSITE SUBBASIN 3.10
417          BA   0.152
418          LG    0.25    0.25    5.00    0.32      35
419          UC   0.280   0.120
420          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
421          UA     100
             *

422          KK   C3.10
423          KM   COMBINES 3.10 AND R3.6
424          HC       2       0
             *

425          KK   S3.10
426          KM   OVERFLOW WEIR ELEV. @ 3.0 FT, L=215 FT, C=2.8
427          KM   WEIR EQ'N: Q=CLH^3/2
428          RS       1    STOR       0
429          SQ     0.0     0.0     0.0     0.0    40.1   600.0
430          SE     0.0     1.0     2.0    2.99     3.0     4.0
431          SV    0.00    4.71    9.26   13.64   13.66   13.68
432          SE     0.0     1.0     2.0    2.99     3.0     4.0
             *

433          KK   R3.10
434          KM   ROUTE FLOW TO S4.9
435          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, CHANNEL BOTTOM 20 FT,
436          KM   SLOPE @ 0.0050 FT/FT, DEPTH 0.7 FT, VELOCITY 2.3 FT/S
437          RS       1    FLOW     0.0     0.0
438          RC   0.035   0.035   0.035     965  0.0050
439          RX       0       4       8      12      32      36      40      44
440          RY       3       2       1       0       0       1       2       3
             *

441          KK     4.9
442          KM   ONSITE SUBBASIN 4.9
443          BA   0.061
444          LG    0.25    0.25    5.10    0.31      35
445          UC   0.230   0.110
446          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
447          UA     100
             *
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

448          KK   S4.91
449          KM   LAKES AND RETENTION
450          RS       1    STOR       0
451          SQ     0.0     0.0     0.0     0.0    12.8   143.5   406.0
452          SE     0.0     1.0     2.0    2.99     3.0     3.5     4.0
453          SV    0.00    2.23    4.83    7.81    7.81    7.83    7.85
454          SE     0.0     1.0     2.0    2.99     3.5     3.5     4.0
             *

455          KK    C4.9
456          KM   COMBINES S4.91 AND R3.6
457          HC       2       0
             *

458          KK    S4.9
459          KM   2 - 3'X8' CONCRETE BOX CULVERT, 45 DEGREE WINGWALL FLARE
460          KM   INLET CONTROL, CULVERT BARREL SLOPE @ 0.0033 FT/FT
461          RS       1    STOR       0
462          SQ     0.0    22.0    62.1   114.1   270.0   365.0
463          SE     0.0     1.0     2.0    3.00     3.5     4.0
```

```
464          SV    0.00    0.33    0.66    1.00    1.17    1.17
465          SE     0.0     1.0     2.0     3.0     3.5     4.0
             *

466          KK    R4.9
467          KM   ROUTE FLOW TO C624F
468          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, CHANNEL BOTTOM 12 FT,
469          KM   SLOPE @ 0.0017 FT/FT, DEPTH 2.5 FT, VELOCITY 2.4 FT/S
470          RS       3    FLOW     0.0     0.0
471          RC   0.035   0.035   0.035    2320  0.0017
472          RX       0       6      10      14      18      30      34      38      42      48
473          RY       4       3       2       1       0       0       1       2       3       4
             *
             * CONCENTRATION POINT @ 163RD Ave Culvert (Wash 5 East)

474          KK  CP624G
475          HC       4

476          KK  DO624G
477          KM   163rd Ave Culvert Flow Split
478          DT   D624G
479          DI       0     409
480          DQ       0      61
             * Happy Valley Channel Cross Section 1

481          KK  RD624G
482          RS       1    FLOW     0.0     0.0
483          RC   0.035   0.035   0.035     442  0.0024
484          RX       0      15      30      38      46      54      69      84
485          RY       5     2.5       0       0       0       0     2.5       5
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

486          KK  PI624H
487          KM   OFFSITE SUBBASIN PI624H (Desert Oasis Parcel)
488          BA   0.075
489          LG   0.250   0.250   4.550   0.419   33.88
490          UC   0.521   0.663
             * Urban Time-Area Relation
491          UA       0       5      16      30      65      77      84      90      94      97
492          UA     100
             *

493          KK  CP624H
494          HC       2
             * Happy Valley Channel Cross Section 1

495          KK  RD624H
496          RS       1    FLOW     0.0     0.0
497          RC   0.035   0.035   0.035     550  0.0024
498          RX       0      15      30      38      46      54      69      84
499          RY       5     2.5       0       0       0       0     2.5       5
             * Happy Valley Channel Cross Section 2

500          KK  RD624H
501          RS       1    FLOW     0.0     0.0
502          RC   0.035   0.035   0.035     985  0.0019
503          RX       0      15      30      50      70      96     111     126
504          RY       5     2.5       0       0       0       0     2.5       5
             * Diversion Recovery: Flow split FS12

505          KK    D612
506          DR   DO612
             *
             *
             * ROUTE UPDATED 4/14/4
             * Length and Slope Updated

507          KK   RD612
508          RS       4    FLOW     0.0     0.0
509          RC   0.043   0.035   0.043    4537  0.0066
             * PITS20
510          RX       0      50      84      87     123     125     156     285
511          RY    1454    1453    1452    1450    1450    1452    1452    1454
             *

512          KK  PI621A
513          KM   OFFSITE SUBBASIN PI621A
514          BA   0.167
515          LG   0.250   0.250   4.550   0.419   30.80
516          UC   0.608   0.603
             * Urban Time-Area Relation
517          UA       0       5      16      30      65      77      84      90      94      97
518          UA     100
             *
             * Hard Coded
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

519          KK  CP621A
520          HC       3   10.31
             * Happy Valley Channel Cross Section 2

521          KK  RD621A
522          RS       1    FLOW     0.0     0.0
523          RC   0.035   0.035   0.035    1587  0.0019
524          RX       0      15      30      50      70      96     111     126
525          RY       5     2.5       0       0       0       0     2.5       5

526          KK  PI621B
527          KM   OFFSITE SUBBASIN PI621B
528          BA   0.035
```

```
529          LG   0.250   0.250   4.550   0.419   30.00
530          UC   0.362   0.427
             * Urban Time-Area Relation
531          UA       0       5      16      30      65      77      84      90      94      97
532          UA     100
             *
             *
             * PORTION OF TIERRA VERDE
             * RETENTION DIVERSION 80% OF REQUIRED 22.3 acres * 2.85/12 * 0.60 = 3.2 AcreFt
             * USE=2.55 AcreFt

533          KK  621BRT
534          KO       0       0
535          DT  RT621B    2.55
536          DI   10000
537          DQ   10000
             *

538          KK  CP621B
539          HC       2
             * Happy Valley Channel Cross Section 3

540          KK  RD621B
541          RS       1    FLOW     0.0     0.0
542          RC   0.035   0.035   0.035     342  0.0017
543          RX       0      15      30      80     100     160     175     190
544          RY       5     2.5       0       0       0       0     2.5       5
             * Combines RPI612, RDCP14, PI609, RD621B

545          KK  CPI609
             * Hard Coded
546          HC       4   18.45
             *
             *
             * Happy Valley Channel Cross Section 3
```



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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

547          KK  R609-1
548          RS       1    FLOW     0.0     0.0
549          RC   0.035   0.035   0.035     615  0.0026
550          RX       0      15      30      56      82     132     147     162
551          RY       5     2.5       0       0       0       0     2.5       5
             * Diversion Out To PI600A
             * Flow Split Diversion: Main path to CPI606, Diversion to C600A

552          KK   DHVC1
553          DT  DOHVC1     0.0     0.0
554          DI       0    2393
555          DQ       0    1689
             * Happy Valley Channel Cross Section 4

556          KK  R609-2
557          RS       3    FLOW     0.0     0.0
558          RC   0.035   0.035   0.035    4635  0.0024
559          RX       0      15      30      35      45      52      67      82
560          RY       5     2.5       0       0       0       0     2.5       5
             *

561          KK  DCAP15
562          BI  RDCP15      22
             * ROUTE UPDATED 4/14/4

563          KK  RDCP15
564          RS       6    FLOW     0.0     0.0
565          RC   0.043   0.035   0.043    9602  0.0106
             * PITS30
566          RX       0      49     199     206     222     231     299     375
567          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *

568          KK  PI606A
569          BA  0.4572
570          LG   0.300   0.250   4.449   0.379  11.709
571          UC   0.667   0.586
             * Urban Time-Area Relation
572          UA       0       5      16      30      65      77      84      90      94      97
573          UA     100
             *
             *
             * COMBINES BASIN PI606A, RDCP15

574          KK   C606A
             * Hard Coded
575          HC       2    4.08
             *
             *
             * Diversion Out: Flow split FS14
             * Flow Split Diversion: Main path to CPI606, Diversion to CPI604
             * 41% of flow is diverted to CPI604
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

576          KK   D606A
577          DT  DO606A     0.0     0.0
578          DI       0   10000
579          DQ       0    4100
             *
             *
             * ROUTE UPDATED 4/14/4
```

```
580          KK   R606A
581          RS       7    FLOW     0.0     0.0
582          RC   0.043   0.035   0.043   12583  0.0081
             * PDTS30
583          RX       0      47     318     322     356     364     463     604
584          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *

585          KK   PI606
586          BA  1.0765
587          LG   0.255    0.25   4.383   0.458  32.416
588          UC   0.879   0.635
             * Urban Time-Area Relation
589          UA       0       5      16      30      65      77      84      90      94      97
590          UA     100
             *
             *
             * PORTION OF TIERRA VERDE
             * RETENTION DIVERSION 80% OF REQUIRED 44.5 acres * 2.85/12 * 0.60 = 6.3 AcreFt
             * USE=5.07 AcreFt

591          KK  606RET
592          KO       0       0
593          DT  RET606    5.07
594          DI   10000
595          DQ   10000
             *
             *
             * COMBINES BASIN PI606, R606A, AND RPI609

596          KK  CPI606
             * Hard Coded
597          HC       3    8.92
             *
             *
             * ROUTE UPDATED 4/14/04

598          KK  RPI606
599          RS       3    FLOW     0.0     0.0
600          RC   0.043   0.035   0.043    2654  0.0055
             * TSR606
601          RX       0     241     598     949    1098    1381    2002    2039
602          RY    1354    1354    1350    1348    1348    1350    1352    1354
             *
             *
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LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

603          KK   PI604
604          BA  0.3628
605          LG   0.265    0.25    4.97   0.318  40.981
606          UC   0.688   0.579
             * Urban Time-Area Relation
607          UA       0       5      16      30      65      77      84      90      94      97
608          UA     100
             *
             *
             * Diversion Recovery: Flow split FS14

609          KK   D606A
610          DR  DO606A
             *
             *
             * ROUTE UDPATED 4/14/4

611          KK  RD606A
612          RS       6    FLOW     0.0     0.0
613          RC   0.043   0.035   0.043    7507  0.0087
             * PITS30
614          RX       0      49     199     206     222     231     299     375
615          RY    1532    1532    1530    1528    1528    1530    1532    1532
             *
             *
             * Combines RD606A and PI604

616          KK  CPI604
             * Hard Coded
617          HC       2    2.03
             *
             *
             * ROUTE UPDATED 4/14/04

618          KK  RPI604
619          RS       4    FLOW     0.0     0.0
620          RC   0.043   0.035   0.043    7442   0.007
             * PDTS30
621          RX       0      47     318     322     356     364     463     604
622          RY    1416    1414    1410    1408    1408    1410    1412    1414
             *
             *

623          KK   PD744
624          BA  0.7975
625          LG   0.298    0.25   4.427    0.36  11.172
626          UC   0.908   0.725
             * Urban Time-Area Relation
627          UA       0       5      16      30      65      77      84      90      94      97
628          UA     100
             *
             *
             * PORTION OF RANCHO MERCADO
             * RETENTION DIVERSION 80% OF REQUIRED 451.1 acres * 2.85/12 * 0.60 = 64.3 AcreFt
             * USE=51.43 AcreFt
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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 629          KK  744RET
 630          KO        0       0
 631          DT  RET744   51.43
 632          DI   10000
 633          DQ   10000
              *
              *Diversion Recovery

 634          KK  DHVC1
 635          DR  DOHVC1
              * 155TH AVE Channel Section 1

 636          KK  RDHVC1
 637          RS        3    FLOW     0.0     0.0
 638          RC    0.035   0.035   0.035    4900  0.0018
 639          RX        0      15      30      60      90     116     131     146
 640          RY        5     2.5       0       0       0       0     2.5       5
              *

 641          KK  PI600A
 642          BA     0.56
 643          LG    0.250   0.250   5.184   0.293   30.00
 644          UC    0.538   0.266
              * Urban Time-Area Relation
 645          UA        0       5      16      30      65      77      84      90      94      97
 646          UA      100
              * Hard Coded

 647          KK   C600A
 648          HC        2   13.58

 649          KK   PI603
 650          BA   0.5190
 651          LG    0.263    0.25    4.66   0.347  28.978
 652          UC    0.738   0.615
              * Urban Time-Area Relation
 653          UA        0       5      16      30      65      77      84      90      94      97
 654          UA      100
              *
              *
              * PORTION OF RANCHO MERCADO
              * RETENTION DIVERSION 80% OF REQUIRED 230.9 acres * 2.85/12 * 0.60 = 32.9 AcreFt
              * USE=26.33 AcreFt

 655          KK  603RET
 656          KO        0       0
 657          DT  RET603   26.33
 658          DI   10000
 659          DQ   10000
              *
              *
              * COMBINES RD600A, RPI606, RPI604, PD744 AND PI603
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 660          KK  CPI603
 661          HC        5
              *
              *
              *
              * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
              * *** This storage includes the storage at basins PI603, PI600A and PD744
              * *** The Discharge represents the Discharge through the Beardsley Canal
              * *** structure as well as the weir flow across PI603, PI600A and PD744,
              * *** so the SQ card can be calculated by adding the flows for basins PI603
              * *** and PD744 as found in the appendix.
              * *** The Weir flow across PD744 is diverted out on the next KK card.
              * *** The weir flow for Basin PI600A is not diverted, because both
              * *** flows (from PI600A and PI603) go to CPI600.

 662          KK  SPI603
 663          RS        1    STOR       0
 664          SQ        0     309     874    1605    2471    3453    4539   14797   33095   56636
 665          SQ    84417
 666          SE     1338    1339    1340    1341    1342    1343    1344  1344.5    1345  1345.5
 667          SE     1346
              *
              * ADDITIONAL STORAGE ON STATE LAND PROPERTY
 668          SA        0   28.57   33.69   52.61   87.31   87.33   87.35
 669          SE     1336    1338    1340    1342    1344    1345    1346
              *
              *
              * This diversion is only weir flow across the boundary of Basin PD744
              * over the Beardsley Canal to CPD720.  This Diversion is being combined
              * with CPD726 and they are routed together.
              *
              * For overtopping of the berm, the Weir equation was used.
              * Q=C*L*H^1.5
              * C was assumed to be 2.7
              * L, the length of the weir was the basin boundary along the canal = 3652 ft
              * Berm Elevation was 1344
              * *** The remaing flow goes to CPI600 ***

 670          KK    D744
 671          DT   DO744     0.0     0.0
 672          DI        0     309     874    1605    2471    3453    4539   14797   33095   56636
 673          DI    84417
 674          DQ        0       0       0       0       0       0       0    3486    9860   18115
 675          DQ    27889
```

```
                    *
 676                KK  CWI504
 677                BI  CWI504      22
                    * ROUTE UPDATED 4/14/04
1                                          HEC-1 INPUT                                                    PAGE 21

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 678                KK  RWI504
 679                RS       1    FLOW     0.0     0.0
 680                RC   0.045   0.035   0.045    1494   0.001
                    * McMicken Dam Channel
 681                RX       0      46     101     121     171     181    1421    3621
 682                RY      25      14       4       0       0       4      14      25
                    *

 683                KK  CWI508
 684                BI  CWI508      22
                    *
                    * Diversion Out: Flow split FS10
                    * Flow Split Diversion: Main path to CWI510, Diversion to CWI500
                    * 19% of flow is diverted to CWI500

 685                KK    D508
 686                DT   D0508     0.0     0.0
 687                DI       0   10000
 688                DQ       0    1900
                    *
                    *

 689                KK  WI510A
 690                BA  1.1293
 691                LG   0.250    0.25   4.622   0.398  34.980
 692                UC   0.813   0.521
                    * Urban Time-Area Relation
 693                UA       0       5      16      30      65      77      84      90      94      97
 694                UA     100
                    *
                    *
                    * ROUTE UPDATED 4/14/4

 695                KK   R510A
 696                RS       8    FLOW     0.0     0.0
 697                RC    0.04    0.04    0.04   17257  0.0051
                    * WITS70
 698                RX       0     450     700    1284    1435    1499    1745    2500
 699                RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
                    *
                    *

 700                KK   WI510
 701                BA  1.2273
 702                LG   0.258   0.250   5.732   0.237  27.923
 703                UC   1.313   1.287
                    * Urban Time-Area Relation
 704                UA       0       5      16      30      65      77      84      90      94      97
 705                UA     100
                    *
                    *
                    * COMBINES CWI508, WI510 AND R510A
1                                          HEC-1 INPUT                                                    PAGE 22

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 706                KK  CWI510
                    * Hard Coded
 707                HC       3   35.84
                    *
                    *
                    * ROUTE UPDATED 4/14/04

 708                KK  RWI510
 709                RS       2    FLOW     0.0     0.0
 710                RC    0.04    0.04    0.04    6492  0.0048
                    * WITS70
 711                RX       0     450     700    1284    1435    1499    1745    2500
 712                RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
                    *
                    *

 713                KK   WI502
 714                BA  1.2082
 715                LG   0.259    0.28   5.443   0.259  35.404
 716                UC   1.179   1.004
                    * Urban Time-Area Relation
 717                UA       0       5      16      30      65      77      84      90      94      97
 718                UA     100
                    *
                    *
                    * COMBINES WI502, RWI510 AND RWI504

 719                KK  CWI502
 720                HC       3
                    *
                    *
                    * ROUTE UPDATED 4/14/04

 721                KK  RWI502
 722                RS       1    FLOW     0.0     0.0
 723                RC   0.045   0.035   0.045    1679  0.0026
                    * McMicken Dam Channel
 724                RX       0      46     101     121     171     181    1421    3621
 725                RY      25      14       4       0       0       4      14      25
```

```
                    *

 726                KK  CWI525
 727                BI  CWI525      22
                    *
                    * Railroad Diversion: Main path to CWI506, Diversion to CWI524
                    * From Structure RR630 and RR640, See Appendix D.5 for analysis

 728                KK    D525
 729                DT   DO525     0.0     0.0
 730                DI       0     269     463     699     969
 731                DQ       0       0       9      26      48
                    *
                    *
                    * ROUTE UPDATED 4/14/04
1                                          HEC-1 INPUT                                                    PAGE 23

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 732                KK  RWI525
 733                RS       6    FLOW     0.0     0.0
 734                RC   0.043   0.035   0.043   11015  0.0064
                    * WITS130
 735                RX       0     400     456     575     620     650     660     682
 736                RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
                    *
                    * CAP Diversion Recovery: Outflow from structure CAP100

 737                KK  DCAP10
 738                BI  DCAP10      22
                    *
                    *
                    * ROUTE UPDATED 4/14/4

 739                KK  RDCP10
 740                RS       4    FLOW     0.0     0.0
 741                RC   0.043   0.035   0.043    6701  0.0081
                    * WITS120
 742                RX       0     100     292     409     492     567     718     886
 743                RY    1511    1510  1509.5  1507.5    1506    1509  1510.5    1511
                    *
                    *

 744                KK   PI628
 745                BA  0.5695
 746                LG     0.3    0.25    4.56   0.352    10.0
 747                UC   0.538   0.316
                    * urban Time-Area Relation
 748                UA       0       5      16      30      65      77      84      90      94      97
 749                UA     100
                    *
                    *
                    * Combines PI628 and RDCP10

 750                KK  CPI628
                    * Hard Coded
 751                HC       2    4.11
                    *
                    *
                    * ROUTE UPDATED 10/25/10

 752                KK  RPI628
 753                RS       6    FLOW     0.0     0.0
 754                RC   0.043   0.035   0.043    7825  0.0077
                    * PITS20
 755                RX       0      50      84      87     123     125     156     285
 756                RY    1454    1453    1452    1450    1450    1452    1452    1454
                    *
                    *
1                                          HEC-1 INPUT                                                    PAGE 24

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 757                KK  PI624A
 758                BA   1.306
 759                LG    0.26    0.25    4.55    0.40      24
 760                UC   0.861   0.562
                    * Urban Time-Area Relation
 761                UA       0       5      16      30      65      77      84      90      94      97
 762                UA     100
                    *
                    *
                    * COMBINES RPI628 AND PI624A

 763                KK   C624A
 764                HC       2
                    *
                    *
                    * Asante Channel From DEI
                    * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)

 765                KK   R624A
 766                RS       1    FLOW     0.0     0.0
 767                RC   0.035   0.035   0.035     680  0.0050
 768                RX       0       4      50      62     122     134     180     184
 769                RY       4       3       3       0       0       3       3       4
                    *

 770                KK  PI639A
 771                BA   0.095
 772                LG    0.25    0.25    4.50    0.43      30
 773                UC   0.554   0.527
                    * Urban Time-Area Relation
 774                UA       0       5      16      30      65      77      84      90      94      97
```

```
775          UA     100
             *
             * COMBINES R624A AND PI639A

776          KK   C639A
777          HC       2
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 60 ft)

778          KK   R639A
779          RS       2    FLOW     0.0     0.0
780          RC   0.043   0.035   0.043    3360  0.0050
781          RX       0       4      50      62     122     134     180     184
782          RY       4       3       3       0       0       3       3       4
             *

783          KK  WI524A
784          BA   0.599
785          LG    0.25    0.25    4.40    0.46      30
786          UC   0.758   0.517
             * Urban Time-Area Relation
787          UA       0       5      16      30      65      77      84      90      94      97
788          UA     100
             *
             *
             * Railroad Diversion Recovery: Outflow from structure RR630
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

789          KK    D525
790          DR   DO525
             *
             *
             * ROUTE UPDATED 4/14/4

791          KK   RD525
792          RS       6    FLOW     0.0     0.0
793          RC   0.043   0.035   0.043    6496  0.0065
             * WITS130
794          RX       0     400     456     575     620     650     660     682
795          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *
             *
             * Combines RD525, WI524, AND R639A

796          KK   C524A
             * Hard Coded
797          HC       3    6.67
             *
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

798          KK   R524A
799          RS       1    FLOW     0.0     0.0
800          RC   0.035   0.035   0.035    1025  0.0050
801          RX       0      12      18      24     117     123     129     141
802          RY       4       2       1       0       0       1       2       4
             *
             * ASANTE DATA OBTAINED FROM DEI DRAINAGE REPORT

803          KK     2.8
804          BA  0.0792
805          LG    0.25    0.25    5.70    0.24      35
806          UC   0.280   0.180
             * Urban Time-Area Relation
807          UA       0       5      16      30      65      77      84      90      94      97
808          UA     100

809          KK    C2.8
810          HC       2
             * Asante Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

811          KK    R2.8
812          RS       1    FLOW     0.0     0.0
813          RC   0.035   0.035   0.035    1810  0.0050
814          RX       0      12      18      24     117     123     129     141
815          RY       4       2       1       0       0       1       2       4
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

816          KK     3.1
817          BA  0.0151
818          LG    0.25    0.25    4.55    0.41      35
819          UC   0.194   0.144
820          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
821          UA     100
             *

822          KK    S3.1
823          KM   OVERFLOW WEIR ELEV. @ 2.7 FT, L=20 FT, C=2.8
824          KM   WEIR EQ'N: Q=CLH^3/2
825          RS       1    STOR       0
826          SQ     0.0     0.0     0.0     0.0     9.2
827          SE     0.0     1.0     2.0     2.7     3.0
828          SV    0.00    0.52    1.09    1.72
829          SE     0.0     1.0     2.0     3.0
             *

830          KK    R3.1
831          KM   ROUTE TO S3.2
```

```
832          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 5 FT,
833          KM   SLOPE @ 0.0070 FT/FT, DEPTH 0.5 FT, VELOCITY 1.9 FT/S
834          RS       2    FLOW     0.0     0.0
835          RC   0.035   0.035   0.035    1230  0.0070
836          RX       0       4       8      12      17      21      25      29
837          RY       3       2       1       0       0       1       2       3
             *

838          KK     3.2
839          BA  0.0936
840          LG    0.25    0.25    4.55    0.41      35
841          UC   0.419   0.332
842          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
843          UA     100
             *

844          KK    C3.2
845          KM   COMBINES 3.2 AND R3.1
846          HC       2       0
             *

847          KK    S3.2
848          KM   2-3'X8' CONCRETE BOX CULVERTS, 45 DEGREE WINGWALL FLARE
849          KM   INLET CONTROL, CULVERT BARREL SLOPE @ 0.0033 FT/FT
850          RS       1    STOR       0
851          SQ     0.0    43.9   124.2   228.2
852          SE     0.0     1.0     2.0     3.0
853          SV    0.00    0.33    0.66    1.00
854          SE     0.0     1.0     2.0     3.0
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

855          KK    R3.2
856          KM   ROUTE TO S2.11
857          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 20 FT,
858          KM   SLOPE @ 0.0050 FT/FT, DEPTH 1.9 FT, VELOCITY 3.90 FT/S
859          RS       1    FLOW     0.0     0.0
860          RC   0.035   0.035   0.035     995  0.0050
861          RX       0       4       8      12      32      36      40      44
862          RY       3       2       1       0       0       1       2       3
             *

863          KK    2.11
864          BA  0.0350
865          LG    0.25    0.25    4.65    0.38      35
866          UC   0.212   0.124
             * Urban Time-Area Relation
867          UA       0       5      16      30      65      77      84      90      94      97
868          UA     100
             * COMBINES UNDEVELOPED PARCEL 3 AND 2.11

869          KK   C2.11
870          HC       2
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 20 ft)

871          KK   R2.11
872          RS       1    FLOW     0.0     0.0
873          RC   0.035   0.035   0.035    1000  0.0070
874          RX       0       4       8      12      32      36      40      44
875          RY       3       2       1       0       0       1       2       3
             *

876          KK    2.10
877          BA  0.0675
878          LG    0.25    0.25    5.00    0.32      35
879          UC   0.309   0.254
             * Urban Time-Area Relation
880          UA       0       5      16      30      65      77      84      90      94      97
881          UA     100
             * FROM DEI

882          KK   S2.10
883          RS       1    STOR       0
884          SQ       0       0       0    14.2    92.8
885          SE       0       1     1.6       2       3
886          SV       0    1.36    3.28    5.83
887          SE       0       1       2       3
             *

888          KK     2.7
889          BA  0.1104
890          LG    0.25    0.25    5.30    0.28      35
891          UC   0.224   0.094
             * Urban Time-Area Relation
892          UA       0       5      16      30      65      77      84      90      94      97
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

893          UA     100
             *

894          KK     2.4
895          BA  0.0659
896          LG    0.25    0.25    4.55    0.41      35
897          UC   0.327   0.270
             * Urban Time-Area Relation
898          UA       0       5      16      30      65      77      84      90      94      97
899          UA     100
             * FROM DEI

900          KK    S2.4
```

```
901          RS       1    STOR       0
902          SQ       0    6.85   23.26   40.68   51.06   392.0
903          SE       0       1       2       3       4       5
904          SV       0    0.36    0.82    1.37    1.40    1.40
905          SE       0       1       2       3       4       5
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

906          KK    R2.4
907          RS       1    FLOW     0.0     0.0
908          RC   0.035   0.035   0.035     400  0.0080
909          RX       0       4       8      12      22      26      30      34
910          RY       3       2       1       0       0       1       2       3
             * COMBINES R2.4, 2.7, S2.10, AND R2.11

911          KK    C2.7
912          HC       4
             *

913          KK    S2.7
914          RS       1    STOR       0
915          SQ       0       1       1       1
916          SE       0       1     2.5       3
917          SV       0    8.63   18.42   29.32
918          SE       0       1       2       3
             * COMBINES S2.7 AND R2.8

919          KK    C2.6
920          HC       2
             * ASANTE CHANNEL FROM DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

921          KK    R2.6
922          RS       1    FLOW     0.0     0.0
923          RC   0.035   0.035   0.035    1700  0.0050
924          RX       0      12      18      24     117     123     129     141
925          RY       4       2       1       0       0       1       2       4
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

926          KK     2.5
927          BA  0.0933
928          LG    0.25    0.25    5.10    0.31      35
929          UC   0.313   0.241
             * urban Time-Area Relation
930          UA       0       5      16      30      65      77      84      90      94      97
931          UA     100
             * COMBINES 2.5 AND C2.6

932          KK  CWI524
933          HC       2
             *
             * Railroad Diversion: Main path to CWI506, Diversion to CPI639
             * From Structure RR650, See Appendix D.5 for analysis

934          KK    D524
935          DT   DO524     0.0     0.0
936          DI       0     595     906    1295    1748
937          DQ       0       0      38     119     230
             * ROUTE UPDATED 4/14/04

938          KK  RWI524
939          RS       2    FLOW     0.0     0.0
940          RC   0.043   0.035   0.043    4526  0.0062
             * WITS130
941          RX       0     400     456     575     620     650     660     682
942          RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *

943          KK    4.12
944          KM   ONSITE SUBBASIN 4.12
945          BA   0.092
946          LG    0.25    0.25    4.55    0.41      35
947          UC   0.349   0.282
948          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
949          UA     100
             *

950          KK   S4.12
951          KM   2-3'X10' CONCRETE BOX CULVERTS, 45 DEGREE WINGWALL FLARE
952          KM   INLET CONTROL, CULVERT BARREL SLOPE @ 0.0033 FT/FT
953          RS       1    STOR       0
954          SQ     0.0    54.9   155.3   285.2   314.1
955          SE     0.0     1.0     2.0     3.0     3.2
956          SV    0.00    0.33    0.66    1.00    1.07
957          SE     0.0     1.0     2.0     3.0     3.2
             *

958          KK   R4.12
959          KM   ROUTE TO S2.1
960          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 20 FT,
961          KM   SLOPE @ 0.0055 FT/FT, DEPTH 2.3 FT, VELOCITY 4.5 FT/S
962          RS       2    FLOW     0.0     0.0
963          RC   0.035   0.035   0.035    2160  0.0055
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

964          RX       0       4       8      12      32      36      40      44
965          RY       3       2       1       0       0       1       2       3
             *
```

```
966          KK     2.1
967          BA  0.1365
968          LG    0.25    0.25    4.55    0.41      35
969          UC   0.352   0.259
             * Urban Time-Area Relation
970          UA       0       5      16      30      65      77      84      90      94      97
971          UA     100
             * COMBINES UNDEVELOPED 4A AND 2.1

972          KK    C2.1
973          HC       2
             *

974          KK    S2.1
975          RS       1    STOR       0
976          SQ       0    98.9   279.5   513.3   592.2
977          SE       0       1       2       3     3.3
978          SV       0    0.33    0.66    1.00    1.10
979          SE       0       1       2       3     3.3
             *
             * Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 40 ft)

980          KK    R2.1
981          RS       2    FLOW     0.0     0.0
982          RC   0.035   0.035   0.035    2310  0.0035
983          RX       0       4       8      12      52      56      60      64
984          RY       3       2       1       0       0       1       2       3
             *

985          KK    1.11
986          BA  0.1290
987          LG    0.25    0.25    4.90    0.34      35
988          UC   0.369   0.244
             * Urban Time-Area Relation
989          UA       0       5      16      30      65      77      84      90      94      97
990          UA     100
             *

991          KK    D524
992          DR   DO524
             * ASANTE Channel From DEI
             * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

993          KK   RD524
994          RS       1    FLOW     0.0     0.0
995          RC   0.035   0.035   0.035    2040  0.0050
996          RX       0      12      18      24     117     123     129     141
997          RY       4       2       1       0       0       1       2       4
             * COMBINES RD524, 1.11, AND R2.1
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

998          KK  CPI639
999          HC       3    1.34
             *
             * ROUTE UPDATED 05/04/2005

1000         KK  RPI639
1001         RS       2    FLOW     0.0     0.0
1002         RC   0.043   0.035   0.043    2635  0.0061
             * WITS130
1003         RX       0     400     456     575     620     650     660     682
1004         RY  1396.5    1394  1393.5    1393    1392    1394    1395  1396.5
             *

1005         KK   WI506
1006         BA  1.5757
1007         LG    0.27   0.253   5.331   0.266  28.348
1008         UC   1.083   0.781
             * Urban Time-Area Relation
1009         UA       0       5      16      30      65      77      84      90      94      97
1010         UA     100
             *

1011         KK  CWI506
1012         HC       4   17.54
             *
             * Diversion Recovery: Flow split FS10

1013         KK    D508
1014         DR   DO508
             *
             *
             * ROUTE UPDATED 4/14/4

1015         KK   RD508
1016         RS       2    FLOW     0.0     0.0
1017         RC    0.04    0.04    0.04    5200  0.0065
             * WITS70
1018         RX       0     450     700    1284    1435    1499    1745    2500
1019         RY  1401.5  1399.5    1396  1395.5    1390    1396    1399    1400
             *
             *

1020         KK   WI500
1021         BA  1.0487
1022         LG   0.292     0.3   5.521   0.245   24.91
1023         UC   0.979   0.695
             * Urban Time-Area Relation
1024         UA       0       5      16      30      65      77      84      90      94      97
1025         UA     100
             *
             *
```

```
                    * COMBINES WI500, RD508, RWI506 AND RWI502
1                                        HEC-1 INPUT                                                          PAGE 32
LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1026                KK  CWI500
                    * Hard Coded
1027                HC       4  227.89
                    *
                    *
                    * STORAGE AT MCMICKEN DAM SPILLWAY
                    *
                    *

1028                KK  SSPILL
1029                KM   MCMICKEN DAM OUTLET AND SPILLWAY RATING CURVES USED HERE
1030                RS       1    STOR       0       0
1031                SV       0    1370    5505   17501   20816   25623   30850   36661   38754   39849
1032                SQ       0     675     810    4080    4325   21150   47400   81650   93160   99300
1033                SE    1335    1340    1345  1352.5 1353.65 1355.65 1357.65 1359.65 1360.35  1360.7
1034                ST  1360.7   12775    3.05     1.5
                    *
                    *
                    * ROUTE UPDATED 4/14/04

1035                KK  RWI500
1036                RS       3    FLOW     0.0     0.0
1037                RC   0.045   0.035   0.045    5659   0.001
                    * McMicken Dam Channel
1038                RX       0      46     101     121     171     181    1421    3621
1039                RY      25      14       4       0       0       4      14      25
                    *

1040                KK   PI635
1041                BA  0.6106
1042                LG    0.29    0.27   5.391   0.237  15.959
1043                UC   0.683   0.465
                    * Natural Time-Area Relation
1044                UA       0       3       5       8      12      20      43      75      90      96
1045                UA     100
                    *
                    *
                    * COMBINES PI635 AND RWI500

1046                KK  CPI635
1047                HC       2
                    *
                    * ROUTE UPDATED 4/14/04

1048                KK  RPI635
1049                RS       6    FLOW     0.0     0.0
1050                RC   0.045   0.035   0.045    7557   0.001
                    * McMicken Dam Channel
1051                RX       0      46     101     121     171     181    1421    3621
1052                RY      25      14       4       0       0       4      14      25
                    *
                    *
1                                        HEC-1 INPUT                                                          PAGE 33
LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1053                KK  PI621C
1054                BA    0.66
1055                LG   0.245   0.250   4.650   0.393  32.371
1056                UC   0.638   0.351
                    * Urban Time-Area Relation
1057                UA       0       5      16      30      65      77      84      90      94      97
1058                UA     100
                    *
                    * PORTION OF VERDUGO AND ALTA MIRA
                    * RETENTION DIVERSION 80% OF REQUIRED 255.5 acres * 2.85/12 * 0.60 = 36.4 AcreFt
                    * USE=29.13 AcreFt

1059                KK  621CRT
1060                KO       0       0
1061                DT  RT621C   29.13
1062                DI   10000
1063                DQ   10000
                    *
                    * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
                    * Berm Elevation = 1342
                    * The storage behind this basin is contained, and does not flow to a siphon
                    * For overtopping of the berm, the Weir equation was used.
                    * Q=C*L*H^1.5
                    * C was assumed to be 2.7
                    * L, the length of the weir was the basin boundary along the canal = 3107 ft

1064                KK  SPI621
1065                RS       1    STOR       0
1066                SQ       0       0       0       0    2966    8389   15411   23727
1067                SA       0    0.10    1.69   21.17   21.18   21.19   21.20   12.21
1068                SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
                    *
                    *
                    * ROUTE UPDATED 4/14/04

1069                KK  RPI621
1070                RS       1    FLOW     0.0     0.0
1071                RC   0.043   0.035   0.043    2775  0.0079
                    * TSR621
1072                RX       0      20      32      79     118     139     374     400
1073                RY    1344    1343    1342    1342    1340    1342    1344    1344
                    *
```

```
1074          KK   PI633
1075          BA  0.3359
1076          LG   0.227   0.250   5.231   0.312  48.412
1077          UC   0.708   0.635
              * Urban Time-Area Relation
1078          UA       0       5      16      30      65      77      84      90      94      97
1079          UA     100
              *
              *
              *
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1080          KK     1.8
1081          BA  0.0176
1082          LG    0.25    0.25    4.55    0.41      35
1083          UC   0.178   0.136
              * Urban Time-Area Relation
1084          UA       0       5      16      30      65      77      84      90      94      97
1085          UA     100
              *

1086          KK    S1.8
1087          RS       1    STOR       0
1088          SQ       0       0       0    47.8
1089          SE  1369.0  1370.0  1371.1  1372.0
1090          SV       0    0.20    0.50    0.93
1091          SE  1369.0  1370.0  1371.0  1372.0
              *

1092          KK     1.7
1093          BA  0.0677
1094          LG    0.25    0.25    5.20    0.29      35
1095          UC   0.306   0.198
              * Urban Time-Area Relation
1096          UA       0       5      16      30      65      77      84      90      94      97
1097          UA     100
              *

1098          KK    1.5A
1099          BA  0.0138
1100          LG    0.25    0.25    5.00    0.32      35
1101          UC   0.211   0.182
              * Urban Time-Area Relation
1102          UA       0       5      16      30      65      77      84      90      94      97
1103          UA     100
              * COMBINES 1.7, 1.5A, AND S1.8

1104          KK    C1.7
1105          HC       3
              *

1106          KK    S1.7
1107          RS       1    STOR       0
1108          SQ       0       0    61.6   174.2
1109          SE  1366.0  1367.0  1368.0  1369.0
1110          SV       0    1.81    3.78    6.09
1111          SE  1366.0  1367.0  1368.0  1369.0
              *

1112          KK     1.9
1113          BA  0.0723
1114          LG    0.25    0.25    4.55    0.41      35
1115          UC   0.330   0.251
              * Urban Time-Area Relation
1116          UA       0       5      16      30      65      77      84      90      94      97
1117          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1118          KK     1.6
1119          BA  0.0450
1120          LG    0.25    0.25    4.55    0.41      35
1121          UC   0.279   0.173
              * Urban Time-Area Relation
1122          UA       0       5      16      30      65      77      84      90      94      97
1123          UA     100
              * COMBINES 1.9, 1.6, AND S1.7

1124          KK    C1.6
1125          HC       3
              *

1126          KK    S1.6
1127          RS       1    STOR       0
1128          SQ       0    65.9   186.4   342.2   431.3
1129          SE  1366.0  1367.0  1368.0  1369.0  1369.5
1130          SV       0    1.27    2.73    4.41    4.41
1131          SE  1366.0  1367.0  1368.0  1369.0  1369.5
              *
              *

1132          KK    4.11
1133          KM   ONSITE SUBBASIN 4.11
1134          BA  0.0556
1135          LG    0.25    0.25    5.00    0.32      35
1136          UC   0.366   0.398
1137          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1138          UA     100
              *
```

```
1139        KK   S4.11
1140        KM   CATCH BASIN TYPE "G" DOUBLE, RIM=2.0 FT, C=0.67
1141        KM   ORIFICE EQUATION: Q=CA(2GD)^1/2
1142        RS       1    STOR       0
1143        SQ     0.0     0.0     0.0    17.2
1144        SE     0.0     1.0     2.0     3.0
1145        SV    0.00    3.06    6.25    9.59
1146        SE     0.0     1.0     2.0     3.0
            *

1147        KK    1.10
1148        KM   ONSITE SUBBASIN 1.10
1149        BA  0.0224
1150        LG    0.25    0.25    4.55    0.41      35
1151        UC   0.161   0.113
1152        UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1153        UA     100
            *
```



```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1154        KK   C1.10
1155        KM   COMBINES 1.10 AND S4.11
1156        HC       2       0
            *

1157        KK   R1.10
1158        KM   ROUTE TO S1.14A
1159        KM   STREET SECTION, SLOPE @ 0.0053 FT/FT,
1160        KM   DEPTH 0.7 FT, VELOCITY 3.4 FT/S
1161        RS       2    FLOW     0.0     0.0
1162        RC   0.015   0.015   0.015    1700  0.0053
1163        RX    0.00    0.10   38.94   39.04   64.20   64.30  103.24  103.34
1164        RY    2.00    0.00    0.78    1.28    1.28    0.78    0.00    2.00
            *

1165        KK   1.13A
1166        BA  0.0279
1167        LG    0.25    0.25    4.55    0.41      35
1168        UC   0.213   0.152
            * Urban Time-Area Relation
1169        UA       0       5      16      30      65      77      84      90      94      97
1170        UA     100
            *

1171        KK   1.14A
1172        BA  0.0381
1173        LG    0.25    0.25    4.50    0.42      35
1174        UC   0.306   0.244
            * Urban Time-Area Relation
1175        UA       0       5      16      30      65      77      84      90      94      97
1176        UA     100
            * COMBINES 1.14A, 1.13A, R1.10, AND S4.11

1177        KK  C1.14A
1178        HC       4
            *

1179        KK  S1.14A
1180        RS       1    STOR       0
1181        SQ       0       0       0   316.8
1182        SE       0     1.0     2.5     3.0
1183        SV       0    6.64   13.49   20.53
1184        SE       0     1.0     2.5     3.0
            *

1185        KK   1.13B
1186        BA  0.0252
1187        LG    0.25    0.25    5.10    0.31      35
1188        UC   0.308   0.329
            * Urban Time-Area Relation
1189        UA       0       5      16      30      65      77      84      90      94      97
1190        UA     100
            * ASANTE Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)
```



```
LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1191        KK  R1.13B
1192        RS       2    FLOW     0.0     0.0
1193        RC   0.035   0.035   0.035    1200  0.0050
1194        RX       0       6      12      18     111     117     123     129
1195        RY       3       2       1       0       0       1       2       3
            *

1196        KK   1.14B
1197        BA  0.0315
1198        LG    0.25    0.23    6.20    0.20      35
1199        UC   0.274   0.239
            * Urban Time-Area Relation
1200        UA       0       5      16      30      65      77      84      90      94      97
1201        UA     100
            * COMBINES 1.14B, R1.13B, AND S1.14A

1202        KK  C1.14B
1203        HC       3
            * ASANTE Channel From DEI
            * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1204        KK  R1.14B
1205        RS       1    FLOW     0.0     0.0
1206        RC   0.035   0.035   0.035     820  0.0050
```

```
1207    RX       0       6      12      18     111     117     123     129
1208    RY       3       2       1       0       0       1       2       3
        *

1209    KK   1.16A
1210    BA  0.0265
1211    LG    0.25    0.25    4.50    0.42      35
1212    UC   0.181   0.120
        * Urban Time-Area Relation
1213    UA       0       5      16      30      65      77      84      90      94      97
1214    UA     100
        *

1215    KK  S1.16A
1216    RS       1    STOR       0
1217    SQ       0       0       0    17.2
1218    SE       0     1.0     2.0     3.0
1219    SV       0    0.92    1.91    2.98
1220    SE       0     1.0     2.0     3.0
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1221    KK  R1.16A
1222    RS       2    FLOW     0.0     0.0
1223    RC   0.035   0.035   0.035     590  0.0014
1224    RX       0       4       8      12      22      26      30      34
1225    RY       3       2       1       0       0       1       2       3
        *
```



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LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1226    KK   1.15A
1227    BA  0.0243
1228    LG    0.25    0.25    4.40    0.45      35
1229    UC   0.195   0.161
        * Urban Time-Area Relation
1230    UA       0       5      16      30      65      77      84      90      94      97
1231    UA     100
        *

1232    KK  S1.15A
1233    RS       1    STOR       0
1234    SQ       0       0       0    56.0
1235    SE       0     1.0     2.0     3.0
1236    SV       0    0.70    1.46    2.28
1237    SE       0     1.0     2.0     3.0
        *

1238    KK   1.15B
1239    BA  0.0156
1240    LG    0.25    0.15    7.30    0.13      35
1241    UC   0.207   0.157
        * Urban Time-Area Relation
1242    UA       0       5      16      30      65      77      84      90      94      97
1243    UA     100
        * COMBINES 1.15B, S1.15A, R1.16A, AND R1.14B

1244    KK  C1.15B
1245    HC       4
        *
        * ASANTE Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 93 ft)

1246    KK  R1.15B
1247    RS       2    FLOW     0.0     0.0
1248    RC   0.035   0.035   0.035    1760  0.0050
1249    RX       0       6      12      18     111     117     123     129
1250    RY       3       2       1       0       0       1       2       3
        *

1251    KK   1.16B
1252    BA  0.0268
1253    LG    0.25    0.25    4.55    0.41      35
1254    UC   0.137   0.077
        * Urban Time-Area Relation
1255    UA       0       5      16      30      65      77      84      90      94      97
1256    UA     100
        *

1257    KK  S1.16B
1258    RS       1    STOR       0
1259    SQ       0       0       0    17.2
1260    SE       0     1.0     2.0     3.0
1261    SV       0    0.93    1.93    3.01
1262    SE       0     1.0     2.0     3.0
        * Channel From DEI
        * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)
```



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LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1263    KK  R1.16B
1264    RS       4    FLOW     0.0     0.0
1265    RC   0.035   0.035   0.035    1630  0.0012
1266    RX       0       4       8      12      22      26      30      34
1267    RY       3       2       1       0       0       1       2       3
        *

1268    KK   1.17A
1269    BA  0.0521
1270    LG    0.25    0.25    4.20    0.50      35
1271    UC   0.282   0.197
        * Urban Time-Area Relation
```

```
1272          UA        0        5       16       30       65       77       84       90       94       97
1273          UA      100
              *

1274          KK   S1.17A
1275          RS        1     STOR        0
1276          SQ        0        0        0     56.0
1277          SE        0      1.0      2.0      3.0
1278          SV        0     1.84     3.78     5.84
1279          SE        0      1.0      2.0      3.0
              *

1280          KK    1.17B
1281          BA   0.0332
1282          LG     0.25     0.25     4.20     0.50       35
1283          UC    0.299    0.279
              * Urban Time-Area Relation
1284          UA        0        5       16       30       65       77       84       90       94       97
1285          UA      100
              * COMBINES 1.17B, S1.17A, R1.16B, AND R1.15B

1286          KK   C1.17B
1287          HC        4
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 6:1, Channel Bottom 40 ft)

1288          KK   R1.17B
1289          RS        1     FLOW      0.0      0.0
1290          RC    0.035    0.035    0.035      990   0.0050
1291          RX        0        6       12       18       58       64       70       76
1292          RY        3        2        1        0        0        1        2        3
              *

1293          KK      1.3
1294          BA   0.0285
1295          LG     0.25     0.25     4.55     0.41       35
1296          UC    0.204    0.152
              * Urban Time-Area Relation
1297          UA        0        5       16       30       65       77       84       90       94       97
1298          UA      100
              *
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1299          KK     S1.3
1300          RS        1     STOR        0
1301          SQ        0        0        0     17.2
1302          SE        0      1.0      2.0      3.0
1303          SV        0     1.27     2.62     4.07
1304          SE        0      1.0      2.0      3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1305          KK     R1.3
1306          RS        4     FLOW      0.0      0.0
1307          RC    0.035    0.035    0.035     2450   0.0050
1308          RX        0        4        8       12       22       26       30       34
1309          RY        3        2        1        0        0        1        2        3
              *

1310          KK      1.2
1311          BA   0.1074
1312          LG     0.25     0.25     4.50     0.42       35
1313          UC    0.358    0.195
              * Urban Time-Area Relation
1314          UA        0        5       16       30       65       77       84       90       94       97
1315          UA      100
              *

1316          KK     S1.2
1317          RS        1     STOR        0
1318          SQ        0        0        0     56.0
1319          SE        0      1.0      2.0      3.0
1320          SV        0     4.92    10.01    15.28
1321          SE        0      1.0      2.0      3.0
              * COMBINES S1.2, R1.3, AND R1.17B

1322          KK     C636
1323          HC        3
              *
              * ROUTE UPDATED 4/14/04

1324          KK   RPI636
1325          RS        1     FLOW      0.0      0.0
1326          RC    0.043    0.035    0.043      730   0.0137
              * WITS130
1327          RX        0      400      456      575      620      650      660      682
1328          RY   1396.5     1394   1393.5     1393     1392     1394     1395   1396.5
              *

1329          KK      4.7
1330          KM    ONSITE SUBBASIN 4.7
1331          BA   0.0496
1332          LG     0.25     0.25     5.70     0.24       35
1333          UC    0.249    0.157
1334          UA        0      5.0     16.0     30.0     65.0     77.0     84.0     90.0     94.0     97.0
1335          UA      100
              *
```



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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1336          KK      4.4
```

```
1337          KM   ONSITE SUBBASIN 4.4
1338          BA  0.0438
1339          LG    0.25    0.25    4.60    0.39      35
1340          UC   0.289   0.200
1341          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1342          UA     100
              *

1343          KK    C4.4
1344          KM   COMBINES 4.4 AND 4.7
1345          HC       2
              *

1346          KK    S4.4
1347          KM   OVERFLOW WEIR ELEV. @ 2.2 FT, L=20 FT, C=2.8
1348          KM   WEIR EQ'N: Q=CLH^3/2
1349          RS       1    STOR       0
1350          SQ     0.0     0.0     0.0     0.0    40.1
1351          SE     0.0     1.0     2.0     2.2     3.0
1352          SV    0.00    3.35    6.84   10.48
1353          SE     0.0     1.0     2.0     3.0
              *

1354          KK    R4.4
1355          KM   ROUTE TO S4.5A
1356          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 20 FT,
1357          KM   SLOPE @ 0.0050 FT/FT, DEPTH 0.7 FT, VELOCITY 2.3 FT/S
1358          RS       2    FLOW     0.0     0.0
1359          RC   0.035   0.035   0.035    1210  0.0050
1360          RX       0       4       8      12      32      36      40      44
1361          RY       3       2       1       0       0       1       2       3
              *

1362          KK     4.6
1363          KM   ONSITE SUBBASIN 4.6
1364          BA  0.0494
1365          LG    0.25    0.25    5.80    0.22      35
1366          UC   0.247   0.169
1367          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1368          UA     100
              *

1369          KK    4.5A
1370          KM   ONSITE SUBBASIN 4.5A
1371          BA  0.0151
1372          LG    0.25    0.25    4.70    0.36      35
1373          UC   0.230   0.164
1374          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1375          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1376          KK   C4.5A
1377          KM   COMBINES 4.5A, 4.6, AND R4.4
1378          HC       3       0
              *

1379          KK   S4.5A
1380          KM   OVERFLOW WEIR ELEV. @ 2.0 FT, L=20 FT, C=2.8
1381          KM   WEIR EQ'N: Q=CLH^3/2
1382          RS       1    STOR       0
1383          SQ     0.0     0.0     0.0    56.0
1384          SE     0.0     1.0     2.0     3.0
1385          SV    0.00    2.44    5.00    7.69
1386          SE     0.0     1.0     2.0     3.0
              *

1387          KK   R4.5A
1388          KM   ROUTE TO S4.5B
1389          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 20 FT,
1390          KM   SLOPE @ 0.0050 FT/FT, DEPTH 0.9 FT, VELOCITY 2.5 FT/S
1391          RS       2    FLOW     0.0     0.0
1392          RC   0.035   0.035   0.035    1060  0.0050
1393          RX       0       4       8      12      32      36      40      44
1394          RY       3       2       1       0       0       1       2       3
              *
              * Diversion Recovery: 163rd Ave Culvert Flow Split

1395          KK   D624G
1396          DR   D624G

1397          KK  RD624G
1398          RS       3    FLOW     0.0     0.0
1399          RC   0.043   0.035   0.043    3000  0.0063
              * PDTS40_1
1400          RX       0      86     158     492     543     560     776    1208
1401          RY    1330  1326.5    1326    1324    1320    1326    1328    1330
              *

1402          KK    4.5B
1403          KM   ONSITE SUBBASIN 4.5B
1404          BA  0.0489
1405          LG    0.25    0.25    4.70    0.36      35
1406          UC   0.216   0.116
1407          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1408          UA     100
              * HARD CODED

1409          KK   C4.5B
1410          HC       3    0.41
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
1411          KK   S4.5B
1412          KM   OVERFLOW WEIR ELEV. @ 2.0 FT, L=20 FT, C=2.8
1413          KM   WEIR EQ'N: Q=CLH^3/2
1414          RS       1    STOR       0
1415          SQ     0.0     0.0     0.0    56.0   100.0
1416          SE     0.0     1.0     2.0     3.0     4.0
1417          SV    0.00    1.13    2.35    3.65    3.66
1418          SE     0.0     1.0     2.0     3.0     4.0
              *

1419          KK   R4.5B
1420          KM   ROUTE TO C1.5B
1421          KM   TRAPEZOIDAL CHANNEL, SIDE SLOPES (H:V) 4:1, BOTTOM 10 FT,
1422          KM   SLOPE @ 0.0050 FT/FT, DEPTH 1.3 FT, VELOCITY 2.9 FT/S
1423          RS       2    FLOW     0.0     0.0
1424          RC   0.035   0.035   0.035    1410  0.0050
1425          RX       0       4       8      12      22      26      30      34
1426          RY       3       2       1       0       0       1       2       3
              *
              *

1427          KK    1.5B
1428          BA  0.0167
1429          LG    0.25    0.25    5.70    0.24      35
1430          UC   0.206   0.173
              * Urban Time-Area Relation
1431          UA       0       5      16      30      65      77      84      90      94      97
1432          UA     100
              *

1433          KK   S1.5B
1434          RS       1    STOR       0
1435          SQ       0       0       0    14.2
1436          SE       0     1.0     2.6     3.0
1437          SV       0    0.57    1.19    1.88
1438          SE       0     1.0     2.0     3.0
              * COMBINES S1.5B AND UNDEVELOPED PARCEL 4

1439          KK   C1.5B
1440          HC       2
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1441          KK   R1.5B
1442          RS       1    FLOW     0.0     0.0
1443          RC   0.035   0.035   0.035     800  0.0050
1444          RX       0       4       8      12      22      26      30      34
1445          RY       3       2       1       0       0       1       2       3
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1446          KK    1.5C
1447          BA  0.0133
1448          LG    0.25    0.25    5.20    0.29      35
1449          UC   0.133   0.080
              * Urban Time-Area Relation
1450          UA       0       5      16      30      65      77      84      90      94      97
1451          UA     100
              *

1452          KK   S1.5C
1453          RS       1    STOR       0
1454          SQ       0       0       0    14.2
1455          SE       0     1.0     2.6     3.0
1456          SV       0    0.45    0.95    1.51
1457          SE       0     1.0     2.0     3.0
              * Channel From DEI
              * (Trapezoidal Channel, Side Slopes H:V 4:1, Channel Bottom 10 ft)

1458          KK   R1.5C
1459          RS       2    FLOW     0.0     0.0
1460          RC   0.035   0.035   0.035     845  0.0050
1461          RX       0       4       8      12      22      26      30      34
1462          RY       3       2       1       0       0       1       2       3
              *

1463          KK     1.4
1464          BA  0.0284
1465          LG    0.25    0.25    5.70    0.24      35
1466          UC   0.204   0.155
              * Urban Time-Area Relation
1467          UA       0       5      16      30      65      77      84      90      94      97
1468          UA     100
              *

1469          KK    S1.4
1470          RS       1    STOR       0
1471          SQ       0       0       0    14.2
1472          SE       0     1.0     2.6     3.0
1473          SV       0    1.26    2.60    4.04
1474          SE       0     1.0     2.0     3.0
              * COMBINES S1.4, R1.5C, AND R1.5B

1475          KK    C624
1476          HC       3
              *

1477          KK   PI624
1478          BA   0.452
1479          LG    0.19    0.25    4.80    0.38      44
1480          UC   0.915   0.764
```

```
                 * Urban Time-Area Relation
1481             UA       0       5      16      30      65      77      84      90      94      97
1482             UA     100
                 *
                 *
                 * PORTION OF VERDUGO
                 * RETENTION DIVERSION 80% OF REQUIRED 108.8 acres * 2.85/12 * 0.60 = 15.5 AcreFt
                 * USE=12.40 AcreFt
1                                          HEC-1 INPUT                                          PAGE 45

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1483             KK  621RET
1484             KO       0       0
1485             DT  RET621   12.40
1486             DI   10000
1487             DQ   10000
                 *

1488             KK  CPI624
1489             HC       3
                 *
                 * *** STAGE DISCHARGE / STORAGE BEHIND Beardsley Canal
                 * It was assumed that this basin is isolated, and can only overtop the canal.
                 * Berm Elevation = 1342
                 * For Overtopping of the berm, the Weir equation was used.
                 * Q=C*B*H^1.5
                 * C was assumed to be 2.7
                 * B, the length of the weir was the basin boundary along the canal = 4305 ft

1490             KK  SPI624
1491             RS       1    STOR       0
1492             SQ       0       0       0       0    4110   11624   21354   32876
1493             SE    1336    1338    1340    1342  1342.5    1343  1343.5    1344
1494             SA       0    0.19    5.86   36.95   36.96   36.97
1495             SE    1336    1338    1340    1342    1343    1344
                 *
                 *
                 * ROUTE UPDATED 4/14/04

1496             KK  RPI624
1497             RS       3    FLOW     0.0     0.0
1498             RC   0.043   0.035   0.043    5060  0.0043
                 * TSR621-modified X-sect
1499             RX       0      40      52      99     138     159     394   511.5
1500             RY    1345    1343    1342    1342    1340    1342    1344    1345
                 *
                 *
                 * Combines RPI635, D600A, RPI621, RPI624 and PI633

1501             KK  CPI633
1502             HC       4
                 *
                 * ROUTE UPDATED 4/14/04

1503             KK  RPI633
1504             RS       4    FLOW     0.0     0.0
1505             RC   0.045   0.035   0.045    5834   0.001
                 * McMicken Dam Channel
1506             RX       0      46     101     121     171     181    1421    3621
1507             RY      25      14       4       0       0       4      14      25
                 *
                 *
1                                          HEC-1 INPUT                                          PAGE 46

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1508             KK   PI600
1509             BA  0.6050
1510             LG   0.275   0.250   5.047   0.303  23.868
1511             UC   0.542   0.341
                 * Urban Time-Area Relation
1512             UA       0       5      16      30      65      77      84      90      94      97
1513             UA     100
                 *
                 *
                 * PORTION OF RANCHO MERCADO
                 * RETENTION DIVERSION 80% OF REQUIRED 88.3 acres * 2.85/12 * 0.60 = 12.6 AcreFt
                 * USE=10.07 AcreFt

1514             KK  600RET
1515             KO       0       0
1516             DT  RET600   10.07
1517             DI   10000
1518             DQ   10000
                 *
                 *
                 * COMBINES BASIN RPI633, RPI603 and  PI600

1519             KK  CPI600
1520             HC       3
                 *
                 * ROUTE UPDATED 4/14/04

1521             KK  RPI600
1522             RS       2    FLOW     0.0     0.0
1523             RC   0.045   0.035   0.045    4937   0.001
                 * McMicken Dam Channel
1524             RX       0      46     101     121     171     181    1421    3621
1525             RY      25      14       4       0       0       4      14      25
                 *
1526             ZZ
1
        SCHEMATIC DIAGRAM OF STREAM NETWORK
```

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  180      DCAP11
                V
                V
  182      RDCP11
                .
                .
  187           .      DCAP12
                .           .
                .           .
  190           .           .-------->   DO618
  189           .        D618
                .           V
                .           V
  193           .      RDCP12
                .           .
                .           .
  198           .           .       PI618
                .           .           .
                .           .           .
  204      CPI618.......................
                V
                V
  206      RPI618
                .
                .
  211           .      DCAP13
                .           V
                .           V
  213           .      RDCP13
                .           .
                .           .
  218           .           .       PI615
                .           .           .
                .           .           .
  225           .           .           .           .<-------   DO618
  224           .           .           .        D618
                .           .           .           V
                .           .           .           V
  226           .           .           .       RD618
                .           .           .           .
                .           .           .           .
  231           .      CPI615.......................
                .           V
                .           V
  233           .      RPI615
                .           .
                .           .
  238           .           .       PI612
                .           .           .
                .           .           .
  244           .           .           .      PI624B
                .           .           .           .
                .           .           .           .
  253           .           .           .           .-------->   D624B
  251           .           .           .      DO624B
                .           .           .           V
                .           .           .           V
  256           .           .           .      RX624B
                .           .           .           .
                .           .           .           .
  261           .           .           .           .      PI624D
                .           .           .           .           .
                .           .           .           .           .
  268           .           .           .      CP624D............
                .           .           .           .
                .           .           .           .
  271           .           .           .           .-------->  DO624D
  270           .           .           .       D624D
                .           .           .           V
                .           .           .           V
  274           .           .           .      RX624D
                .           .           .           .
                .           .           .           .
  279      CPI612.................................
                .
                .
  282           .-------->   DO612
  281        D612
                V
                V
  285      RPI612
                .
                .
  290           .      DCAP14
                .           V
                .           V
  292           .      RDCP14
                .           .
                .           .
  297           .           .       PI609
                .           .           .
                .           .           .
  305           .           .           .-------->  RET609
  303           .           .      609RET
                .           .           .
                .           .           .
  309           .           .           .           .<-------  DO624D
  308           .           .           .       D624D
                .           .           .           V
                .           .           .           V
  310           .           .           .      RD624D
```

```
315                 PI624E
                          .
324                       .-------> RET624
322                 624ERT
                          .
327           CP624E............
                    V
                    V
329           RD624E
                          .
334                 PI624G
                          .
341                       .        4.3
                          .          .
349                       .          .      .<-------   D624B
348                       .          .   D624B
                          .          .      V
                          .          .      V
350                       .          .   R624B
                          .          .      .
358                       .          .      .        3.7
                          .          .      .         V
                          .          .      .         V
365                       .          .      .       S3.7
                          .          .      .         V
                          .          .      .         V
373                       .          .      .       R3.7
                          .          .      .         .
381                       .          .      .         .        3.6
                          .          .      .         .         V
                          .          .      .         .         V
388                       .          .      .         .      S3.61
                          .          .      .         .         .
                          .          .      .         .         .
396                       .          .      .    C3.6.......................
                          .          .      .      V
                          .          .      .      V
399                       .          .      .    S3.6
                          .          .      .      V
                          .          .      .      V
407                       .          .      .    R3.6
                          .          .      .      .
415                       .          .      .      .       3.10
                          .          .      .      .         .
422                       .          .      .   C3.10...........
                          .          .      .      V
                          .          .      .      V
425                       .          .      .   S3.10
                          .          .      .      V
                          .          .      .      V
433                       .          .      .   R3.10
                          .          .      .      .
441                       .          .      .      .        4.9
                          .          .      .      .         V
                          .          .      .      .         V
448                       .          .      .      .      S4.91
                          .          .      .      .         .
455                       .          .      .    C4.9...........
                          .          .      .      V
                          .          .      .      V
458                       .          .      .    S4.9
                          .          .      .      V
                          .          .      .      V
466                       .          .      .    R4.9
                          .          .      .      .
474           CP624G...................................
                          .
478                       .-------> D624G
476           DO624G
                    V
                    V
481           RD624G
                          .
486                 PI624H
                          .
493           CP624H............
                    V
                    V
495           RD624H
                    V
                    V
500           RD624H
                          .
506                       .<-------   DO612
505                       .       D612
                          .         V
                          .         V
507                       .      RD612
```

```
                                                        PA_FC.OH1
512                                                        PI621A
519                                   CP621A.......................
                                           V
                                           V
521                                   RD621A
526                                                 PI621B
535                                                        .-------> RT621B
533                                                 621BRT
538                                   CP621B............
                                           V
                                           V
540                                   RD621B
545                CPI609.................................
                       V
                       V
547                R609-1
553                       .-------> DOHVC1
552                 DHVC1
                       V
                       V
556                R609-2
561                       DCAP15
                                V
                                V
563                       RDCP15
568                                     PI606A
574                        C606A............
577                                     .-------> DO606A
576                        D606A
                                V
                                V
580                        R606A
585                                      PI606
593                                                .-------> RET606
591                                     606RET
596                CPI606......................
                       V
                       V
598                RPI606
603                        PI604
610                                     .<-------  DO606A
609                                      D606A
                                             V
                                             V
611                                     RD606A
616                       CPI604............
                                V
                                V
618                       RPI604
623                                      PD744
631                                                .-------> RET744
629                                     744RET
635                                                        .<-------  DOHVC1
634                                                 DHVC1
                                                        V
                                                        V
636                                                 RDHVC1
641                                                         PI600A
647                                                  C600A............
649                                                          PI603
```

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                                                          .
                                                          .
657                                                       .-------> RET603
655                                                 603RET
                                                          .
660     CPI603.............................................
             V
             V
662     SPI603
             .
             .
671          .-------> DO744
670       D744
             .
             .
676          .     CWI504
             .          V
             .          V
678          .     RWI504
             .          .
             .          .
683          .          .     CWI508
             .          .          .
             .          .          .
686          .          .          .-------> DO508
685          .          .       D508
             .          .          .
             .          .          .
689          .          .          .     WI510A
             .          .          .          V
             .          .          .          V
695          .          .          .      R510A
             .          .          .          .
             .          .          .          .
700          .          .          .          .      WI510
             .          .          .          .          .
             .          .          .          .          .
706          .          .     CWI510.......................
             .          .          V
             .          .          V
708          .          .     RWI510
             .          .          .
             .          .          .
713          .          .          .      WI502
             .          .          .          .
             .          .          .          .
719          .     CWI502.......................
             .          V
             .          V
721          .     RWI502
             .          .
             .          .
726          .          .     CWI525
             .          .          .
             .          .          .
729          .          .          .-------> DO525
728          .          .       D525
             .          .          V
             .          .          V
732          .          .     RWI525
             .          .          .
             .          .          .
737          .          .          .     DCAP10
             .          .          .          V
             .          .          .          V
739          .          .          .     RDCP10
             .          .          .          .
             .          .          .          .
744          .          .          .          .      PI628
             .          .          .          .          .
             .          .          .          .          .
750          .          .          .     CPI628............
             .          .          .          V
             .          .          .          V
752          .          .          .     RPI628
             .          .          .          .
             .          .          .          .
757          .          .          .          .     PI624A
             .          .          .          .          .
             .          .          .          .          .
763          .          .          .      C624A............
             .          .          .          V
             .          .          .          V
765          .          .          .      R624A
             .          .          .          .
             .          .          .          .
770          .          .          .          .     PI639A
             .          .          .          .          .
             .          .          .          .          .
776          .          .          .      C639A............
             .          .          .          V
             .          .          .          V
778          .          .          .      R639A
             .          .          .          .
             .          .          .          .
783          .          .          .          .     WI524A
             .          .          .          .          .
             .          .          .          .          .
790          .          .          .          .          .<-------  DO525
789          .          .          .          .       D525
             .          .          .          .          V
             .          .          .          .          V
791          .          .          .          .      RD525
             .          .          .          .          .
             .          .          .          .          .
```

```
796                 C524A.......................
                       V
                       V
798                 R524A
                       .
                       .
803                    .         2.8
                       .          .
                       .          .
809                 C2.8............
                       V
                       V
811                 R2.8
                       .
                       .
816                    .         3.1
                       .          V
                       .          V
822                    .        S3.1
                       .          V
                       .          V
830                    .        R3.1
                       .          .
                       .          .
838                    .           .         3.2
                       .           .          .
                       .           .          .
844                    .        C3.2............
                       .          V
                       .          V
847                    .        S3.2
                       .          V
                       .          V
855                    .        R3.2
                       .          .
                       .          .
863                    .           .        2.11
                       .           .          .
                       .           .          .
869                    .       C2.11............
                       .          V
                       .          V
871                    .       R2.11
                       .          .
                       .          .
876                    .           .        2.10
                       .           .          V
                       .           .          V
882                    .           .       S2.10
                       .           .          .
                       .           .          .
888                    .           .          .         2.7
                       .           .          .          .
                       .           .          .          .
894                    .           .          .          .         2.4
                       .           .          .          .          V
                       .           .          .          .          V
900                    .           .          .          .        S2.4
                       .           .          .          .          V
                       .           .          .          .          V
906                    .           .          .          .        R2.4
                       .           .          .          .          .
                       .           .          .          .          .
911                    .        C2.7.................................
                       .          V
                       .          V
913                    .        S2.7
                       .          .
                       .          .
919                 C2.6............
                       V
                       V
921                 R2.6
                       .
                       .
926                    .         2.5
                       .          .
                       .          .
932              CWI524............
                       .
                       .
935                    .-------->   DO524
934                 D524
                       V
                       V
938              RWI524
                       .
                       .
943                    .        4.12
                       .          V
                       .          V
950                    .       S4.12
                       .          V
                       .          V
958                    .       R4.12
                       .          .
                       .          .
966                    .           .         2.1
                       .           .          .
                       .           .          .
972                    .        C2.1............
                       .          V
                       .          V
974                    .        S2.1
                       .          V
                       .          V
```

```
                                                   PA_FC.OH1
 980                                            R2.1
                                                  .
 985                                                  1.11
                                                        .
 992                                                    .<-------   DO524
 991                                                  D524
                                                        V
                                                        V
 993                                                 RD524
                                                        .
                                                        .
 998                                            CPI639.......................
                                                     V
                                                     V
1000                                            RPI639
                                                  .
1005                                                 WI506
                                                        .
                                                        .
1011                                      CWI506.................................
                                                  .
1014                                                  .<-------   DO508
1013                                            D508
                                                     V
                                                     V
1015                                            RD508
                                                  .
1020                                                  .      WI500
                                                  .
1026                                      CWI500.................................
                                                V
                                                V
1028                                      SSPILL
                                                V
                                                V
1035                                      RWI500
                                                .
1040                                            .      PI635
                                                .
1046                                      CPI635............
                                                V
                                                V
1048                                      RPI635
                                                .
1053                                            .      PI621C
                                                .
1061                                            .-------> RT621C
1059                                            .      621CRT
                                                     V
                                                     V
1064                                            .      SPI621
                                                     V
                                                     V
1069                                            .      RPI621
                                                .
1074                                            .      PI633
                                                .
1080                                            .        1.8
                                                .         V
                                                .         V
1086                                            .       S1.8
                                                .
1092                                            .            1.7
                                                .
1098                                            .            .       1.5A
                                                .
1104                                            .       C1.7........................
                                                .         V
                                                .         V
1106                                            .       S1.7
                                                .
1112                                            .            1.9
                                                .
1118                                            .            .         1.6
                                                .
1124                                            .       C1.6........................
                                                .         V
                                                .         V
1126                                            .       S1.6
                                                .
1132                                            .            4.11
                                                .              V
                                                .              V
1139                                            .           S4.11
                                                .
1147                                            .            .       1.10
```

```
1154                  C1.10.............
                        V
                        V
1157                  R1.10
                        .
1165                    .         1.13A
                        .           .
1171                    .           .          1.14A
                        .           .            .
1177            C1.14A...............................
                  V                                 .
                  V                                 .
1179            S1.14A                              .
                  .                                 .
1185                  1.13B                         .
                        V                           .
                        V                           .
1191                  R1.13B                        .
                        .                           .
1196                    .         1.14B             .
                        .           .               .
1202            C1.14B...........................   .
                  V                                 .
                  V                                 .
1204            R1.14B                              .
                  .                                 .
1209                  1.16A                         .
                        V                           .
                        V                           .
1215                  S1.16A                        .
                        V                           .
                        V                           .
1221                  R1.16A                        .
                        .                           .
1226                    .         1.15A             .
                        .           V               .
                        .           V               .
1232                    .       S1.15A              .
                        .           .               .
1238                    .           .          1.15B
                        .           .            .
1244            C1.15B...............................
                  V                                 .
                  V                                 .
1246            R1.15B                              .
                  .                                 .
1251                  1.16B                         .
                        V                           .
                        V                           .
1257                  S1.16B                        .
                        V                           .
                        V                           .
1263                  R1.16B                        .
                        .                           .
1268                    .         1.17A             .
                        .           V               .
                        .           V               .
1274                    .       S1.17A              .
                        .           .               .
1280                    .           .          1.17B
                        .           .            .
1286            C1.17B...............................
                  V                                 .
                  V                                 .
1288            R1.17B                              .
                  .                                 .
1293                    1.3                         .
                        V                           .
                        V                           .
1299                  S1.3                          .
                        V                           .
                        V                           .
1305                  R1.3                          .
                        .                           .
1310                    .           1.2             .
                        .           V               .
                        .           V               .
1316                    .         S1.2              .
                        .           .               .
1322              C636...........................   .
                  V                                 .
                  V                                 .
1324            RPI636                              .
                  .                                 .
1329                    4.7                         .
                        .
```

```
1336                                                  4.4
                                                       .
1343                                            C4.4...........
                                                   V
                                                   V
1346                                            S4.4
                                                   V
                                                   V
1354                                            R4.4
                                                       .
1362                                                  4.6
                                                       .
                                                       .
1369                                                   .        4.5A
                                                       .          .
                                                       .          .
1376                                        C4.5A......................
                                                   V
                                                   V
1379                                        S4.5A
                                                   V
                                                   V
1387                                        R4.5A
                                                       .
                                                       .
1396                                                   .<-------   D624G
1395                                                D624G
                                                       V
                                                       V
1397                                                RD624G
                                                       .
                                                       .
1402                                                   .        4.5B
                                                       .          .
                                                       .          .
1409                                        C4.5B......................
                                                   V
                                                   V
1411                                        S4.5B
                                                   V
                                                   V
1419                                        R4.5B
                                                       .
                                                       .
1427                                                  1.5B
                                                       V
                                                       V
1433                                                S1.5B
                                                       .
                                                       .
1439                                        C1.5B...........
                                                   V
                                                   V
1441                                        R1.5B
                                                       .
                                                       .
1446                                                  1.5C
                                                       V
                                                       V
1452                                                S1.5C
                                                       V
                                                       V
1458                                                R1.5C
                                                       .
                                                       .
1463                                                   .         1.4
                                                       .          V
                                                       .          V
1469                                                   .        S1.4
                                                       .          .
                                                       .          .
1475                                         C624......................
                                                       .
                                                       .
1477                                                PI624
                                                       .
                                                       .
1485                                                   .-------> RET621
1483                                                621RET
                                                       .
                                                       .
1488                                     CPI624......................
                                                   V
                                                   V
1490                                     SPI624
                                                   V
                                                   V
1496                                     RPI624
                                                       .
                                                       .
1501                        CPI633.................................
                                 V
                                 V
1503                        RPI633
                                 .
1508                                 PI600
                                 .
1516                                 .-------> RET600
1514                                 600RET
                                 .
```

```
 1519      CPI600.......................
                 V
                 V
 1521      RPI600

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   17DEC10  TIME  10:03:09  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104              *
*                                      *
****************************************
```

```
HAPPY VALLEY CHANNEL DESIGN CONCEPT REPORT
100-YEAR 24-HOUR STORM
PREFERRED ALTERNATIVE FUTURE CONDITIONS
*******************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*******************************************************************************
**                                                                           **
**  ADDENDUM TO THE WITTMANN AREA DRAINAGE MASTER STUDY UPDATE HYDROLOGY     **
**                                                                           **
*******************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*******************************************************************************
**                                                                           **
** THE FOLLOWING CHANGES HAVE BEEN MADE TO THE WITTMANN HYDROLOGY MODELS     **
** DATED OCTOBER 2004:                                                       **
**                                                                           **
**     -Diversion added after CTW480                                         **
**          -Main flow (5%) to CTW478                                        **
**          -Diverted flow (95%) to CWI584                                   **
**          -Added concentration point CWI584 combining RD480 and WI584      **
**          -Hard coding was added to CTW478                                 **
**          -Route added after D480 (Diversion Recovery)                     **
**          -Route RWI584 was adjusted                                       **
**          -Storage Route SCP050 was adjusted                               **
**          -Route R508* was adjusted                                        **
**          -Hard coding for CWI510 was adjusted                             **
**                                                                           **
**     -Diversion D618 was moved from after CPI618 to before RDCP12          **
**          -Updated route RD618 information                                 **
**          -Hard coding on CPI618 was adjusted                              **
**          -Hard coding on CPI615 was adjusted                              **
**                                                                           **
**     -Route RPI639 changed from following US60 to CPI636 to route          **
**      through US60/RR structures and combine with CWI506                   **
**          -Cards PI639, D524, RD524, CPI639 and RPI639 were changed from   **
**           following R624A to follow RWI524                                **
**          -CPI636 was removed-no longer needed to combine PI636 & RPI639   **
**          -RPI639 information was changed to reflect new route             **
**          -CWI506 changed from combining 3 to combine 4:                   **
**           RWI525, RWI524, RPI639 & WI506                                  **
**          -Hard coding on CWI506 was adjusted                              **
**          -Hard Coding on CWI500 was adjusted                              **
**                                                                           **
*******************************************************************************
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
**-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-ADDENDUM-**
*******************************************************************************


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*******************************************************************************
**                                                                           **
**    WITTMANN AREA DRAINAGE MASTER STUDY UPDATE-HYDROLOGY MODEL 2004        **
**                                                                           **
*******************************************************************************
*******************************************************************************

PROJECT:                Wittmann ADMS Update
CLIENT:                 Flood Control District of Maricopa County
PREPARED BY:            Entellus, Inc.
PROJECT No:             FCD 2002C029              Entellus 310.032
FILE NAME: WTEC24-addendum.hc1          CREATED DATE: FEB 01, 2004
                                       MODIFIED DATE: MAY 04, 2005

STORM:
                    100-year 24-hour Storm

DEVELOPMENT CONDITIONS:
                    Existing Conditions

MODELING ASSUMPTIONS:
                    It was assumed that the US60 did not have adequate
                    storage to cause any significant attenuation.

                    The assumption was made that the CAP Canal embankment
                    would not be breached under a large flood event.

                    The assumption was made that the Beardsley Canal would
                    not fail under a large storm event (Per District
                    Instruction).  In addition, the berm north of the
                    Beardsley canal and east of US60 was assumed to fail
                    (per district Instruction).
```

For both the CAP and Beardsley Canals, once the berm elevation was reached weir flow was assumed. It was also assumed that any weir flow over the canal that might enter the canal and be diverted out of the study area was insignificant, and thus was ignored. In other words all weir flow over the canal embankment reaches the downstream concentration point.

Typical X-sects were developed, and it was assumed that a typical X-sect could adequately represent various reaches.

Time-Area Relations were used base on the District's Hydrology Manual criteria. Two Time-Area Relation Curves were utilized:

-Urban
-Natural

The Time-Area Relation Curves were taken directly from the manual

MODELING METHODS:

This model utilizes QI cards to input the Padelford hydrographs from the 100-year 6-hour existing conditions model developed by A-N West Inc. for the Padelford Wash Floodplain Delineation Study. The hydrograph was altered from its original form (2-minute interval to 5-minute interval) through simple interpolation.

Clark Unit Hydrographs were used for all subbasins except the two subbasins directly upstream of the Bonita Dam (PD726B and PD740 use S-graphs). The UC parameters were calculated using the WMS7.0 software.

For Basins PD726B and PD740 S-Graphs were utilized per the request of the FCDMC. Limited details regarding the calculations of the S-graphs can be found in the model by the basin KK card. For full details of the S-graph calculations refer to the Appendix.

Normal Depth routing was used for all routing reaches.

Hard coding was used to account for the percentage of area associated with a diversion. Because of the use of JD cards and aereal reduction, hard coding was necessary to properly account for area. For a given diversion a percentage of the flow is routed to two different locations. The same percentage of area follows that diverted flow. In addition the area downstream of the main path is reduced or increased and is hard coded to account for the loss or gain of area. Hard coding was performed based on the 24-hour existing conditions model.

Stage-storage was developed for all the structures along the CAP Canal, as well as along the Beardsley Canal. In addition several stage-storage locations were developed for areas with significant storage along the SR74. No storage was modeled along the US60 and railroad, but the culverts were analyzed for diversion potential. Diversions were placed in the model where deemed appropriate. See appendix for details.

FLO-2D was utilized to calculate the split flows at concentration points CIW351. CIW357, CIW363 and CWI576. See appendix for modeling details.

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```
159 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN          5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ       1500  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      6   0  ENDING DATE
                     NDTIME       0455  ENDING TIME
                      ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL    0.08 HOURS
                      TOTAL TIME BASE  124.92 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

161 JD          INDEX STORM NO. 1
                       STRM       4.18  PRECIPITATION DEPTH
                       TRDA       0.01  TRANSPOSITION DRAINAGE AREA

162 PI            PRECIPITATION PATTERN
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                    0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
```

```
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
172 JD        INDEX STORM NO. 2
                STRM        3.93  PRECIPITATION DEPTH
                TRDA       10.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
173 JD        INDEX STORM NO. 3
                STRM        3.86  PRECIPITATION DEPTH
                TRDA       20.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
174 JD        INDEX STORM NO. 4
                STRM        3.72  PRECIPITATION DEPTH
                TRDA       40.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
175 JD        INDEX STORM NO. 5
                STRM        3.60  PRECIPITATION DEPTH
                TRDA       80.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
176 JD        INDEX STORM NO. 6
                STRM        3.53  PRECIPITATION DEPTH
                TRDA      120.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.01      0.00      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.01      0.03      0.03
                0.03      0.09      0.09      0.09      0.01      0.01      0.01      0.01      0.01      0.01
                0.01      0.01      0.01      0.01      0.01      0.01      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
177 JD        INDEX STORM NO. 7
                STRM        3.44  PRECIPITATION DEPTH
                TRDA      200.00  TRANSPOSITION DRAINAGE AREA

  0 PI          PRECIPITATION PATTERN
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
                0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00      0.00
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0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

178 JD INDEX STORM NO. 8
STRM 3.38 PRECIPITATION DEPTH
TRDA 300.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

179 JD INDEX STORM NO. 9
STRM 3.29 PRECIPITATION DEPTH
TRDA 500.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03
0.03	0.09	0.09	0.09	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		

181 BI READ STATION DCAP11 HYDROGRAPH FROM UNIT 22

188 BI READ STATION DCAP12 HYDROGRAPH FROM UNIT 22

212 BI READ STATION DCAP13 HYDROGRAPH FROM UNIT 22

291 BI READ STATION DCAP14 HYDROGRAPH FROM UNIT 22

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              **************
              *            *
 303 KK       *    609RET  *
              *            *
              **************

 304 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 322 KK       *    624ERT  *
              *            *
              **************

 323 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 533 KK       *    621BRT  *
              *            *
              **************

 534 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

 562 BI            READ STATION   RDCP15 HYDROGRAPH FROM UNIT 22

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 591 KK       *    606RET  *
              *            *
              **************

 592 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 629 KK       *    744RET  *
              *            *
              **************

 630 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

              **************
              *            *
 655 KK       *    603RET  *
              *            *
              **************

 656 KO            OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

 677 BI            READ STATION   CWI504 HYDROGRAPH FROM UNIT 22

 684 BI            READ STATION   CWI508 HYDROGRAPH FROM UNIT 22

 727 BI            READ STATION   CWI525 HYDROGRAPH FROM UNIT 22

 738 BI            READ STATION   DCAP10 HYDROGRAPH FROM UNIT 22

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                **************
                *            *
1059 KK         *    621CRT  *
                *            *
                **************

1060 KO            OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE

WARNING --- ROUTED OUTFLOW (    133.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    127.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    116.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    133.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    119.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    124.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    107.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    107.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    100.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    101.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    107.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE

WARNING --- ROUTED OUTFLOW (    102.) IS GREATER THAN MAXIMUM OUTFLOW (    100.) IN STORAGE-OUTFLOW TABLE


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                **************
                *            *
1483 KK         *    621RET  *
                *            *
                **************

1484 KO            OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


                **************
                *            *
1514 KK         *    600RET  *
                *            *
                **************

1515 KO            OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          0  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
1
                                                RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                       TIME IN HOURS,  AREA IN SQUARE MILES

                                      PEAK   TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN     MAXIMUM     TIME OF
          OPERATION       STATION     FLOW    PEAK                                          AREA      STAGE     MAX STAGE
+                                                          6-HOUR     24-HOUR     72-HOUR
          HYDROGRAPH AT
+                         DCAP11      433.   15.75         418.        282.         99.     53.75
          ROUTED TO
+                         RDCP11      433.   16.08         418.        282.         99.     53.75
          HYDROGRAPH AT
+                         DCAP12      422.   15.75         403.        269.         95.     53.75
          DIVERSION TO
+                          D0618      223.   15.75         214.        142.         50.     53.75
          HYDROGRAPH AT
+                           D618      198.   15.75         189.        126.         45.     53.75
          ROUTED TO
+                         RDCP12      198.   16.00         189.        126.         45.     53.75
          HYDROGRAPH AT
+                          PI618      300.   12.17          42.         11.          4.      0.29
          3 COMBINED AT
+                         CPI618      656.   15.58         618.        428.        151.      5.48
          ROUTED TO
+                         RPI618      650.   16.25         617.        428.        151.      5.48
          HYDROGRAPH AT
+                         DCAP13      432.   15.75         413.        273.         98.     53.75
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+	ROUTED TO	RDCP13	431.	16.42	413.	273.	98.	53.75
+	HYDROGRAPH AT	PI615	628.	12.33	117.	32.	11.	0.84
+	HYDROGRAPH AT	D618	223.	15.75	214.	142.	50.	53.75
+	ROUTED TO	RD618	223.	16.08	214.	142.	50.	53.75
+	3 COMBINED AT	CPI615	798.	12.33	656.	455.	163.	6.21
+	ROUTED TO	RPI615	735.	12.75	652.	455.	163.	6.21
+	HYDROGRAPH AT	PI612	492.	12.42	133.	41.	14.	0.74
+	HYDROGRAPH AT	PI624B	81.	12.25	18.	6.	2.	0.10
+	DIVERSION TO	D624B	47.	12.08	15.	5.	2.	0.10
+	HYDROGRAPH AT	DO624B	34.	12.25	3.	1.	0.	0.10
+	ROUTED TO	RX624B	32.	12.42	3.	1.	0.	0.10
+	HYDROGRAPH AT	PI624D	229.	12.33	61.	19.	6.	0.32
+	2 COMBINED AT	CP624D	258.	12.42	63.	20.	7.	0.35
+	DIVERSION TO	DO624D	258.	12.42	63.	20.	7.	0.35
+	HYDROGRAPH AT	D624D	0.	0.00	0.	0.	0.	0.35
+	ROUTED TO	RX624D	0.	0.00	0.	0.	0.	0.35
+	4 COMBINED AT	CPI612	1586.	12.67	1312.	916.	326.	12.43
+	DIVERSION TO	DO612	1190.	12.67	984.	687.	244.	12.43
+	HYDROGRAPH AT	D612	397.	12.67	328.	229.	81.	12.43
+	ROUTED TO	RPI612	384.	12.92	327.	229.	81.	12.43
+	HYDROGRAPH AT	DCAP14	372.	15.75	356.	207.	70.	53.75
+	ROUTED TO	RDCP14	371.	16.92	355.	207.	70.	53.75
+	HYDROGRAPH AT	PI609	1030.	12.50	306.	90.	30.	1.94
+	DIVERSION TO	RET609	31.	10.08	21.	7.	2.	1.94
+	HYDROGRAPH AT	609RET	1030.	12.50	306.	83.	28.	1.94
+	HYDROGRAPH AT	D624D	258.	12.42	63.	20.	7.	0.35
+	ROUTED TO	RD624D	250.	12.50	63.	20.	7.	0.35
+	HYDROGRAPH AT	PI624E	512.	12.08	48.	15.	5.	0.26
+	DIVERSION TO	RET624	512.	12.08	35.	9.	3.	0.26
+	HYDROGRAPH AT	624ERT	229.	12.17	18.	5.	2.	0.26
+	2 COMBINED AT	CP624E	380.	12.25	80.	25.	8.	0.61
+	ROUTED TO	RD624E	348.	12.42	80.	25.	8.	0.61
+	HYDROGRAPH AT	PI624G	90.	12.17	14.	4.	1.	0.07
+	HYDROGRAPH AT	4.3	182.	12.25	35.	11.	4.	0.18
+	HYDROGRAPH AT	D624B	47.	12.08	15.	5.	2.	0.10

+	ROUTED TO	R624B	47.	12.75	15.	5.	2.	0.10
+	HYDROGRAPH AT	3.7	99.	12.08	10.	3.	1.	0.05
+	ROUTED TO	S3.7	55.	12.33	3.	1.	0.	0.05
+	ROUTED TO	R3.7	26.	12.42	3.	1.	0.	0.05
+	HYDROGRAPH AT	3.6	204.	12.08	25.	8.	3.	0.13
+	ROUTED TO	S3.61	287.	12.25	14.	4.	1.	0.13
+	3 COMBINED AT	C3.6	320.	12.25	31.	10.	3.	0.26
+	ROUTED TO	S3.6	201.	12.25	31.	10.	3.	0.26
+	ROUTED TO	R3.6	162.	12.42	31.	10.	3.	0.26
+	HYDROGRAPH AT	3.10	316.	12.08	30.	9.	3.	0.15
+	2 COMBINED AT	C3.10	323.	12.08	59.	18.	6.	0.41
+	ROUTED TO	S3.10	244.	12.25	40.	12.	4.	0.41
+	ROUTED TO	R3.10	221.	12.42	40.	12.	4.	0.41
+	HYDROGRAPH AT	4.9	131.	12.00	12.	4.	1.	0.06
+	ROUTED TO	S4.91	0.	0.00	0.	0.	0.	0.06
+	2 COMBINED AT	C4.9	221.	12.42	40.	12.	4.	0.47
+	ROUTED TO	S4.9	235.	12.50	40.	12.	4.	0.47
+	ROUTED TO	R4.9	187.	12.67	39.	12.	4.	0.47
+	4 COMBINED AT	CP624G	605.	12.67	162.	50.	17.	1.34
+	DIVERSION TO	D624G	90.	12.67	24.	8.	3.	1.34
+	HYDROGRAPH AT	DO624G	515.	12.67	138.	43.	14.	1.34
+	ROUTED TO	RD624G	515.	12.67	138.	43.	14.	1.34
+	HYDROGRAPH AT	PI624H	63.	12.25	14.	4.	1.	0.08
+	2 COMBINED AT	CP624H	555.	12.67	151.	47.	16.	1.41
+	ROUTED TO	RD624H	550.	12.67	151.	47.	16.	1.41
+	ROUTED TO	RD624H	544.	12.75	151.	47.	16.	1.41
+	HYDROGRAPH AT	D612	1190.	12.67	984.	687.	244.	12.43
+	ROUTED TO	RD612	1165.	12.92	982.	687.	244.	12.43
+	HYDROGRAPH AT	PI621A	142.	12.25	30.	9.	3.	0.17
+	3 COMBINED AT	CP621A	1734.	12.83	1130.	739.	263.	10.31
+	ROUTED TO	RD621A	1717.	12.92	1129.	739.	263.	10.31
+	HYDROGRAPH AT	PI621B	40.	12.17	6.	2.	1.	0.04
+	DIVERSION TO	RT621B	40.	12.17	5.	1.	0.	0.04
+	HYDROGRAPH AT	621BRT	14.	12.67	2.	1.	0.	0.04
+	2 COMBINED AT	CP621B	1726.	12.92	1131.	740.	263.	10.35
	ROUTED TO							

+	RD621B	1728.	12.92	1131.	740.	263.	10.35
+ 4 COMBINED AT	CPI609	2982.	12.83	1981.	1253.	440.	18.45
+ ROUTED TO	R609-1	2984.	12.92	1981.	1253.	440.	18.45
+ DIVERSION TO	DOHVC1	2106.	12.92	1398.	884.	311.	18.45
+ HYDROGRAPH AT	DHVC1	878.	12.92	583.	369.	129.	18.45
+ ROUTED TO	R609-2	861.	13.08	581.	369.	129.	18.45
+ HYDROGRAPH AT	DCAP15	341.	17.42	312.	110.	37.	39.36
+ ROUTED TO	RDCP15	341.	17.83	312.	110.	37.	39.36
+ HYDROGRAPH AT	PI606A	353.	12.25	66.	18.	6.	0.46
+ 2 COMBINED AT	C606A	375.	18.00	342.	142.	47.	4.08
+ DIVERSION TO	DO606A	154.	18.00	140.	58.	19.	4.08
+ HYDROGRAPH AT	D606A	221.	18.00	202.	84.	28.	4.08
+ ROUTED TO	R606A	221.	18.50	201.	84.	28.	4.08
+ HYDROGRAPH AT	PI606	790.	12.42	189.	58.	19.	1.08
+ DIVERSION TO	RET606	14.	6.00	10.	3.	1.	1.08
+ HYDROGRAPH AT	606RET	790.	12.42	189.	56.	19.	1.08
+ 3 COMBINED AT	CPI606	1490.	12.92	886.	506.	176.	8.92
+ ROUTED TO	RPI606	1463.	13.08	883.	506.	176.	8.92
+ HYDROGRAPH AT	PI604	329.	12.33	73.	23.	8.	0.36
+ HYDROGRAPH AT	D606A	154.	18.00	140.	58.	19.	4.08
+ ROUTED TO	RD606A	153.	18.33	140.	58.	19.	4.08
+ 2 COMBINED AT	CPI604	384.	12.58	175.	81.	27.	2.03
+ ROUTED TO	RPI604	367.	12.83	172.	81.	27.	2.03
+ HYDROGRAPH AT	PD744	508.	12.42	115.	32.	11.	0.80
+ DIVERSION TO	RET744	508.	12.42	100.	26.	9.	0.80
+ HYDROGRAPH AT	744RET	89.	14.00	20.	6.	2.	0.80
+ HYDROGRAPH AT	DHVC1	2106.	12.92	1398.	884.	311.	18.45
+ ROUTED TO	RDHVC1	2069.	13.08	1393.	884.	311.	18.45
+ HYDROGRAPH AT	PI600A	769.	12.17	103.	31.	10.	0.56
+ 2 COMBINED AT	C600A	2176.	13.08	1436.	915.	322.	13.58
+ HYDROGRAPH AT	PI603	423.	12.33	93.	28.	9.	0.52
+ DIVERSION TO	RET603	423.	12.33	48.	13.	4.	0.52
+ HYDROGRAPH AT	603RET	330.	12.67	53.	15.	5.	0.52
+ 5 COMBINED AT	CPI603	3959.	13.00	2486.	1486.	520.	25.85
+ ROUTED TO	SPI603	3096.	13.67	2410.	1482.	517.	25.85
+ DIVERSION TO	DO744	0.	0.00	0.	0.	0.	25.85

+	HYDROGRAPH AT	D744	3096.	13.67	2410.	1482.	517.	25.85
+	HYDROGRAPH AT	CWI504	21107.	15.83	18575.	7376.	2536.	164.40
+	ROUTED TO	RWI504	21072.	15.92	18563.	7376.	2536.	164.40
+	HYDROGRAPH AT	CWI508	7988.	15.92	5306.	2126.	731.	41.34
+	DIVERSION TO	DO508	1518.	15.92	1008.	404.	139.	41.34
+	HYDROGRAPH AT	D508	6470.	15.92	4298.	1722.	592.	41.34
+	HYDROGRAPH AT	WI510A	988.	12.33	207.	64.	21.	1.13
+	ROUTED TO	R510A	672.	13.50	206.	64.	21.	1.13
+	HYDROGRAPH AT	WI510	573.	12.67	220.	67.	22.	1.23
+	3 COMBINED AT	CWI510	6728.	15.83	4640.	1850.	637.	35.84
+	ROUTED TO	RWI510	6600.	16.25	4548.	1850.	637.	35.84
+	HYDROGRAPH AT	WI502	687.	12.58	230.	71.	24.	1.21
+	3 COMBINED AT	CWI502	26281.	16.17	22413.	9020.	3104.	201.44
+	ROUTED TO	RWI502	26242.	16.25	22407.	9020.	3104.	201.44
+	HYDROGRAPH AT	CWI525	1802.	12.42	984.	647.	227.	8.92
+	DIVERSION TO	DO525	116.	12.42	49.	25.	8.	8.92
+	HYDROGRAPH AT	D525	1686.	12.42	934.	622.	219.	8.92
+	ROUTED TO	RWI525	1453.	13.08	921.	621.	219.	8.92
+	HYDROGRAPH AT	DCAP10	432.	15.75	413.	278.	98.	53.75
+	ROUTED TO	RDCP10	431.	16.17	413.	278.	98.	53.75
+	HYDROGRAPH AT	PI628	655.	12.17	82.	22.	7.	0.57
+	2 COMBINED AT	CPI628	763.	12.17	435.	307.	108.	4.11
+	ROUTED TO	RPI628	657.	12.67	434.	307.	108.	4.11
+	HYDROGRAPH AT	PI624A	1018.	12.33	213.	63.	21.	1.31
+	2 COMBINED AT	C624A	1545.	12.50	622.	364.	128.	5.42
+	ROUTED TO	R624A	1541.	12.50	622.	364.	128.	5.42
+	HYDROGRAPH AT	PI639A	89.	12.25	17.	5.	2.	0.09
+	2 COMBINED AT	C639A	1608.	12.50	636.	368.	130.	5.51
+	ROUTED TO	R639A	1564.	12.67	634.	368.	130.	5.51
+	HYDROGRAPH AT	WI524A	512.	12.33	103.	31.	10.	0.60
+	HYDROGRAPH AT	D525	116.	12.42	49.	25.	8.	8.92
+	ROUTED TO	RD525	83.	13.42	48.	25.	8.	8.92
+	3 COMBINED AT	C524A	1954.	12.67	767.	421.	148.	6.67
+	ROUTED TO	R524A	1957.	12.67	766.	421.	148.	6.67
+	HYDROGRAPH AT	2.8	151.	12.08	16.	5.	2.	0.08

+	2 COMBINED AT	C2.8	1973.	12.67	777.	425.	150.	6.75
+	ROUTED TO	R2.8	1958.	12.67	776.	425.	150.	6.75
+	HYDROGRAPH AT	3.1	30.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S3.1	1.	13.83	0.	0.	0.	0.02
+	ROUTED TO	R3.1	1.	14.33	0.	0.	0.	0.02
+	HYDROGRAPH AT	3.2	121.	12.17	18.	5.	2.	0.09
+	2 COMBINED AT	C3.2	121.	12.17	18.	6.	2.	0.11
+	ROUTED TO	S3.2	116.	12.17	18.	6.	2.	0.11
+	ROUTED TO	R3.2	114.	12.25	18.	6.	2.	0.11
+	HYDROGRAPH AT	2.11	73.	12.00	7.	2.	1.	0.04
+	2 COMBINED AT	C2.11	148.	12.17	24.	8.	3.	0.14
+	ROUTED TO	R2.11	144.	12.25	24.	8.	3.	0.14
+	HYDROGRAPH AT	2.10	107.	12.08	13.	4.	1.	0.07
+	ROUTED TO	S2.10	50.	12.42	10.	3.	1.	0.07
+	HYDROGRAPH AT	2.7	250.	12.00	22.	7.	2.	0.11
+	HYDROGRAPH AT	2.4	98.	12.08	12.	4.	1.	0.07
+	ROUTED TO	S2.4	96.	12.17	12.	4.	1.	0.07
+	ROUTED TO	R2.4	91.	12.25	12.	4.	1.	0.07
+	4 COMBINED AT	C2.7	398.	12.08	67.	21.	7.	0.39
+	ROUTED TO	S2.7	1.	12.00	1.	1.	1.	0.39
+	2 COMBINED AT	C2.6	1958.	12.67	776.	426.	151.	7.14
+	ROUTED TO	R2.6	1954.	12.75	775.	426.	151.	7.14
+	HYDROGRAPH AT	2.5	152.	12.08	18.	6.	2.	0.09
+	2 COMBINED AT	CWI524	1976.	12.75	786.	431.	152.	7.23
+	DIVERSION TO	DO524	286.	12.75	44.	11.	4.	7.23
+	HYDROGRAPH AT	D524	1690.	12.75	742.	420.	149.	7.23
+	ROUTED TO	RWI524	1611.	13.00	737.	419.	149.	7.23
+	HYDROGRAPH AT	4.12	131.	12.08	17.	5.	2.	0.09
+	ROUTED TO	S4.12	131.	12.17	17.	5.	2.	0.09
+	ROUTED TO	R4.12	119.	12.33	17.	5.	2.	0.09
+	HYDROGRAPH AT	2.1	201.	12.08	26.	8.	3.	0.14
+	2 COMBINED AT	C2.1	293.	12.17	43.	13.	4.	0.23
+	ROUTED TO	S2.1	288.	12.25	43.	13.	4.	0.23
+	ROUTED TO	R2.1	271.	12.33	43.	13.	4.	0.23
+	HYDROGRAPH AT	1.11	198.	12.08	25.	8.	3.	0.13
	HYDROGRAPH AT							

+		D524	286.	12.75	44.	11.	4.	7.23
+	ROUTED TO	RD524	269.	12.92	44.	11.	4.	7.23
+	3 COMBINED AT	CPI639	420.	12.75	112.	32.	11.	1.34
+	ROUTED TO	RPI639	414.	12.83	112.	32.	11.	1.34
+	HYDROGRAPH AT	WI506	1036.	12.50	285.	85.	28.	1.58
+	4 COMBINED AT	CWI506	4116.	13.00	1954.	1135.	401.	17.54
+	HYDROGRAPH AT	D508	1518.	15.92	1008.	404.	139.	41.34
+	ROUTED TO	RD508	1502.	16.17	1006.	404.	139.	41.34
+	HYDROGRAPH AT	WI500	745.	12.42	183.	54.	18.	1.05
+	4 COMBINED AT	CWI500	28677.	16.25	24535.	10421.	3598.	227.89
+	ROUTED TO	SSPILL	3866.	26.67	3843.	3536.	2443.	227.89
+	ROUTED TO	RWI500	3865.	27.25	3842.	3535.	2443.	227.89
+	HYDROGRAPH AT	PI635	622.	12.50	100.	28.	9.	0.61
+	2 COMBINED AT	CPI635	3865.	27.25	3842.	3536.	2443.	228.50
+	ROUTED TO	RPI635	3863.	28.00	3841.	3534.	2442.	228.50
+	HYDROGRAPH AT	PI621C	745.	12.25	119.	36.	12.	0.66
+	DIVERSION TO	RT621C	710.	12.17	52.	15.	5.	0.66
+	HYDROGRAPH AT	621CRT	695.	12.33	79.	22.	7.	0.66
+	ROUTED TO	SPI621	277.	12.83	38.	11.	4.	0.66
+	ROUTED TO	RPI621	173.	13.08	37.	11.	4.	0.66
+	HYDROGRAPH AT	PI633	297.	12.33	72.	23.	8.	0.34
+	HYDROGRAPH AT	1.8	37.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.8	31.	12.08	3.	1.	0.	0.02
+	HYDROGRAPH AT	1.7	122.	12.08	13.	4.	1.	0.07
+	HYDROGRAPH AT	1.5A	26.	12.08	3.	1.	0.	0.01
+	3 COMBINED AT	C1.7	177.	12.08	19.	6.	2.	0.10
+	ROUTED TO	S1.7	111.	12.25	18.	5.	2.	0.10
+	HYDROGRAPH AT	1.9	111.	12.08	14.	4.	1.	0.07
+	HYDROGRAPH AT	1.6	83.	12.08	9.	3.	1.	0.05
+	3 COMBINED AT	C1.6	275.	12.17	39.	11.	4.	0.22
+	ROUTED TO	S1.6	234.	12.25	39.	11.	4.	0.22
+	HYDROGRAPH AT	4.11	70.	12.17	11.	3.	1.	0.06
+	ROUTED TO	S4.11	1.	20.08	1.	0.	0.	0.06
+	HYDROGRAPH AT	1.10	50.	12.00	4.	1.	0.	0.02
+	2 COMBINED AT	C1.10	50.	12.00	4.	1.	0.	0.08
+	ROUTED TO	R1.10	41.	12.17	4.	1.	0.	0.08

+	HYDROGRAPH AT	1.13A	54.	12.00	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14A	60.	12.08	7.	2.	1.	0.04
+	4 COMBINED AT	C1.14A	341.	12.17	55.	17.	6.	0.36
+	ROUTED TO	S1.14A	170.	12.58	35.	10.	3.	0.36
+	HYDROGRAPH AT	1.13B	36.	12.08	5.	2.	1.	0.03
+	ROUTED TO	R1.13B	30.	12.33	5.	2.	1.	0.03
+	HYDROGRAPH AT	1.14B	55.	12.08	7.	2.	1.	0.03
+	3 COMBINED AT	C1.14B	203.	12.58	45.	13.	4.	0.42
+	ROUTED TO	R1.14B	199.	12.67	45.	13.	4.	0.42
+	HYDROGRAPH AT	1.16A	57.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16A	7.	12.42	2.	1.	0.	0.03
+	ROUTED TO	R1.16A	7.	12.58	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.15A	46.	12.00	5.	1.	0.	0.02
+	ROUTED TO	S1.15A	21.	12.25	2.	1.	0.	0.02
+	HYDROGRAPH AT	1.15B	33.	12.00	4.	1.	0.	0.02
+	4 COMBINED AT	C1.15B	217.	12.58	52.	15.	5.	0.48
+	ROUTED TO	R1.15B	210.	12.75	51.	15.	5.	0.48
+	HYDROGRAPH AT	1.16B	66.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.16B	7.	12.33	2.	1.	0.	0.03
+	ROUTED TO	R1.16B	6.	12.83	2.	1.	0.	0.03
+	HYDROGRAPH AT	1.17A	89.	12.08	10.	3.	1.	0.05
+	ROUTED TO	S1.17A	15.	12.58	4.	1.	0.	0.05
+	HYDROGRAPH AT	1.17B	48.	12.08	6.	2.	1.	0.03
+	4 COMBINED AT	C1.17B	235.	12.75	62.	19.	6.	0.60
+	ROUTED TO	R1.17B	232.	12.83	62.	19.	6.	0.60
+	HYDROGRAPH AT	1.3	55.	12.00	5.	2.	1.	0.03
+	ROUTED TO	S1.3	2.	13.33	1.	0.	0.	0.03
+	ROUTED TO	R1.3	2.	13.92	1.	0.	0.	0.03
+	HYDROGRAPH AT	1.2	180.	12.08	20.	6.	2.	0.11
+	ROUTED TO	S1.2	5.	13.92	3.	1.	0.	0.11
+	3 COMBINED AT	C636	232.	12.83	65.	20.	7.	0.73
+	ROUTED TO	RPI636	228.	12.83	65.	20.	7.	0.73
+	HYDROGRAPH AT	4.7	100.	12.08	10.	3.	1.	0.05
+	HYDROGRAPH AT	4.4	77.	12.08	8.	3.	1.	0.04
+	2 COMBINED AT	C4.4	175.	12.08	18.	6.	2.	0.09

+	ROUTED TO	S4.4	16.	12.75	6.	2.	1.	0.09
+	ROUTED TO	R4.4	15.	12.92	6.	2.	1.	0.09
+	HYDROGRAPH AT	4.6	98.	12.08	10.	3.	1.	0.05
+	HYDROGRAPH AT	4.5A	29.	12.08	3.	1.	0.	0.02
+	3 COMBINED AT	C4.5A	125.	12.08	18.	6.	2.	0.16
+	ROUTED TO	S4.5A	20.	12.92	10.	3.	1.	0.16
+	ROUTED TO	R4.5A	20.	13.08	10.	3.	1.	0.16
+	HYDROGRAPH AT	D624G	90.	12.67	24.	8.	3.	1.34
+	ROUTED TO	RD624G	86.	12.83	24.	7.	3.	1.34
+	HYDROGRAPH AT	4.5B	104.	12.00	9.	3.	1.	0.05
+	3 COMBINED AT	C4.5B	112.	12.75	43.	14.	5.	0.41
+	ROUTED TO	S4.5B	116.	12.75	42.	12.	4.	0.41
+	ROUTED TO	R4.5B	112.	12.83	42.	12.	4.	0.41
+	HYDROGRAPH AT	1.5B	33.	12.00	3.	1.	0.	0.02
+	ROUTED TO	S1.5B	3.	12.67	1.	0.	0.	0.02
+	2 COMBINED AT	C1.5B	113.	12.83	42.	13.	4.	0.43
+	ROUTED TO	R1.5B	113.	12.92	42.	13.	4.	0.43
+	HYDROGRAPH AT	1.5C	34.	12.00	3.	1.	0.	0.01
+	ROUTED TO	S1.5C	2.	12.42	1.	0.	0.	0.01
+	ROUTED TO	R1.5C	1.	12.75	1.	0.	0.	0.01
+	HYDROGRAPH AT	1.4	58.	12.00	6.	2.	1.	0.03
+	ROUTED TO	S1.4	0.	23.50	0.	0.	0.	0.03
+	3 COMBINED AT	C624	113.	12.92	43.	13.	4.	0.47
+	HYDROGRAPH AT	PI624	326.	12.42	92.	29.	10.	0.45
+	DIVERSION TO	RET621	124.	12.00	19.	6.	2.	0.45
+	HYDROGRAPH AT	621RET	326.	12.42	84.	23.	8.	0.45
+	3 COMBINED AT	CPI624	590.	12.75	187.	55.	18.	1.65
+	ROUTED TO	SPI624	430.	13.25	108.	33.	11.	1.65
+	ROUTED TO	RPI624	297.	13.92	105.	33.	11.	1.65
+	4 COMBINED AT	CPI633	3864.	27.83	3842.	3537.	2445.	231.15
+	ROUTED TO	RPI633	3863.	28.42	3842.	3536.	2445.	231.15
+	HYDROGRAPH AT	PI600	718.	12.25	104.	31.	10.	0.61
+	DIVERSION TO	RET600	158.	11.83	16.	5.	2.	0.61
+	HYDROGRAPH AT	600RET	718.	12.25	97.	26.	9.	0.61
+	3 COMBINED AT	CPI600	5157.	24.58	5069.	4271.	2873.	257.60
	ROUTED TO							

+
1

RPI600 5154. 25.00 5066. 4269. 2872. 257.60

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION SSPILL
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1353.82	0.00	21228.	5768.	0.00	25.08	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1353.30	0.00	19806.	4250.	0.00	26.50	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1353.14	0.00	19337.	4216.	0.00	26.50	0.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.85	0.00	18505.	4154.	0.00	26.50	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.58	0.00	17726.	4097.	0.00	26.42	0.00

PLAN 6 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.39	0.00	17328.	4033.	0.00	26.50	0.00

PLAN 7 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1352.08	0.00	16824.	3895.	0.00	26.58	0.00

PLAN 8 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS

				PA_FC.OH1			
1.00	1351.86	0.00	16484.	3803.	0.00	26.67	0.00

PLAN 9 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1335.00	1360.70	1360.70
STORAGE	0.	39849.	39849.
OUTFLOW	0.	99300.	99300.

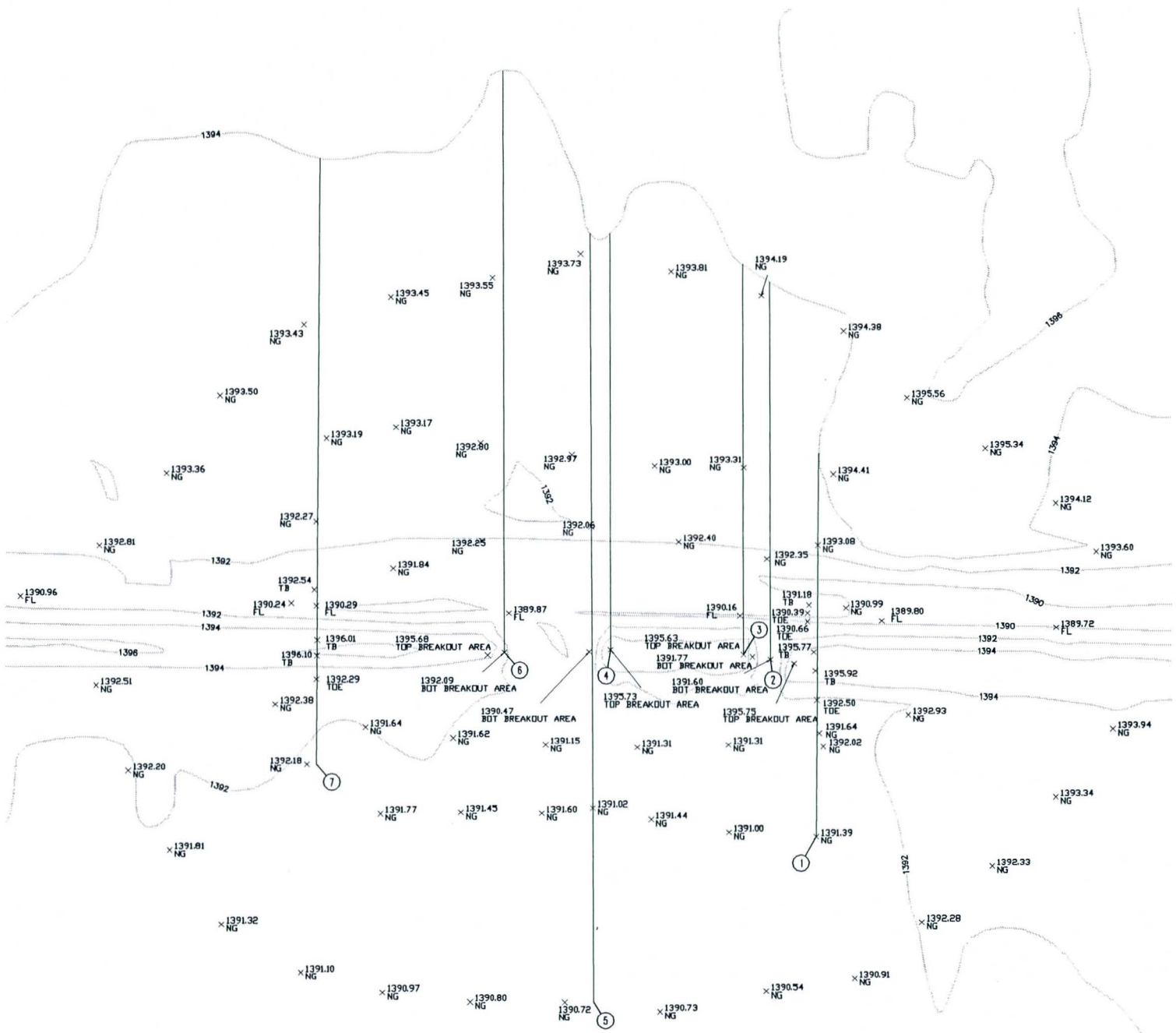
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1351.52	0.00	15934.	3653.	0.00	26.83	0.00

*** NORMAL END OF HEC-1 ***

A.4 Flow Split Analysis Results

Asante Happy Valley Berm Breach

ASANTE HAPPY VALLEY BERM BREACH



SCALE: 1"=80'

LEGEND

CROSS SECTION

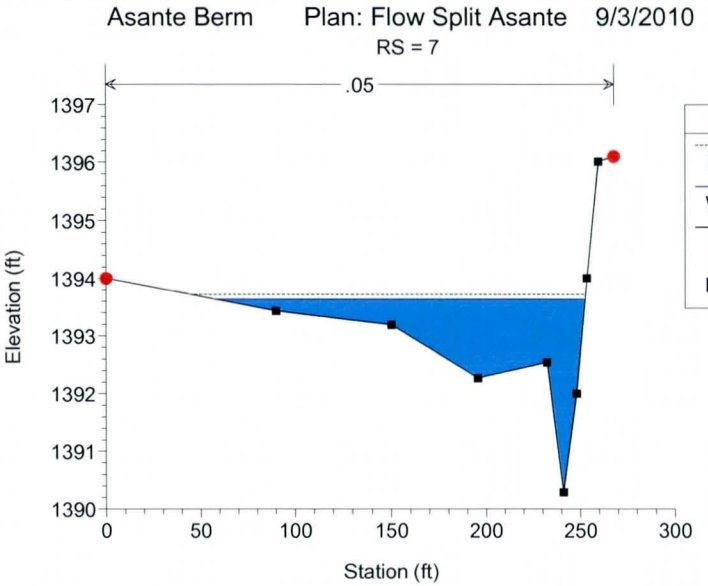
(1) CROSS SECTION NUMBER

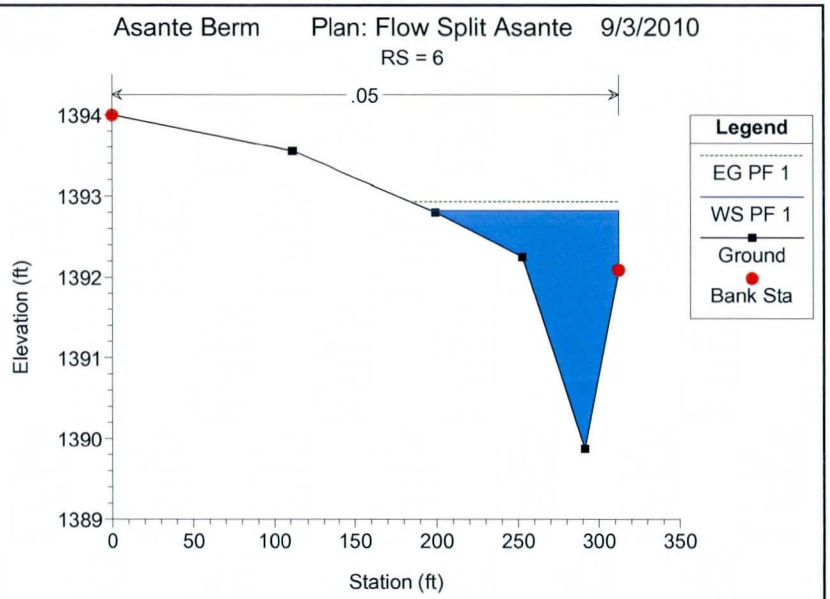
RBF CONSULTING

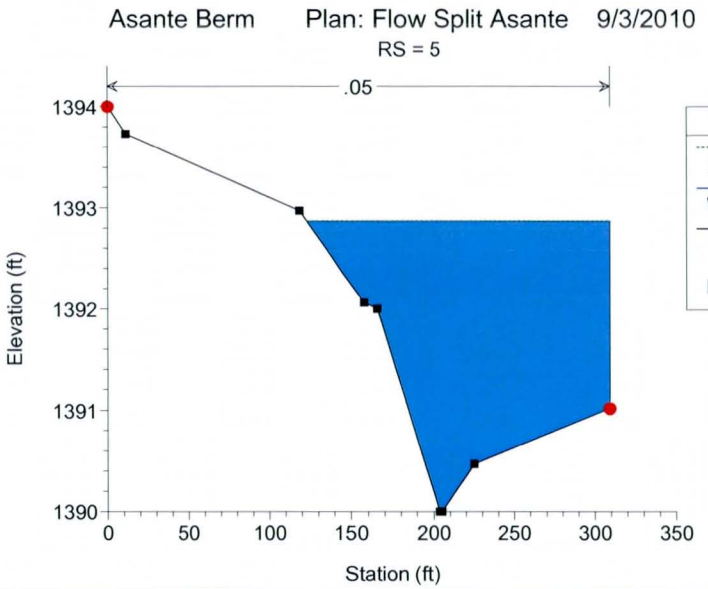
PLANNING
DESIGN
CONSTRUCTION

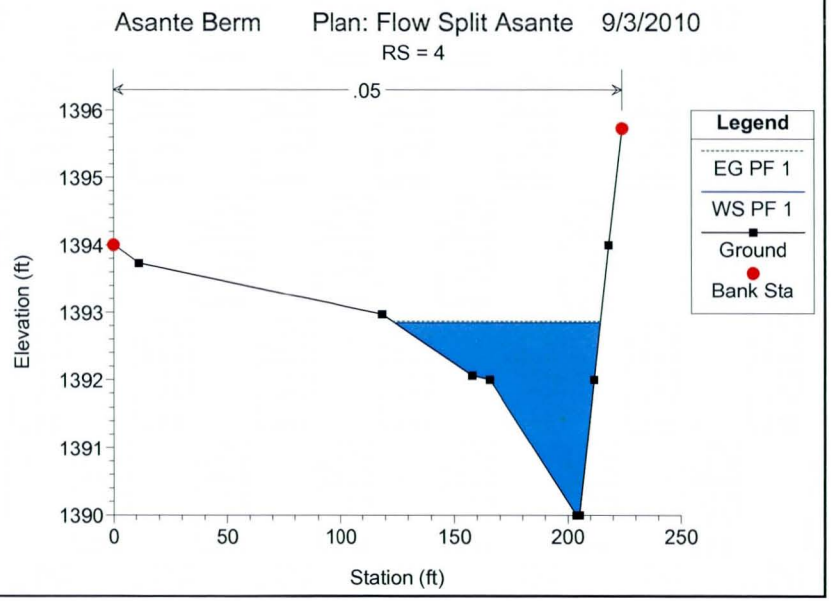
HEC-RAS Plan: Flow Split River: Happy Valley Was Reach: Asante Profile: PF 1

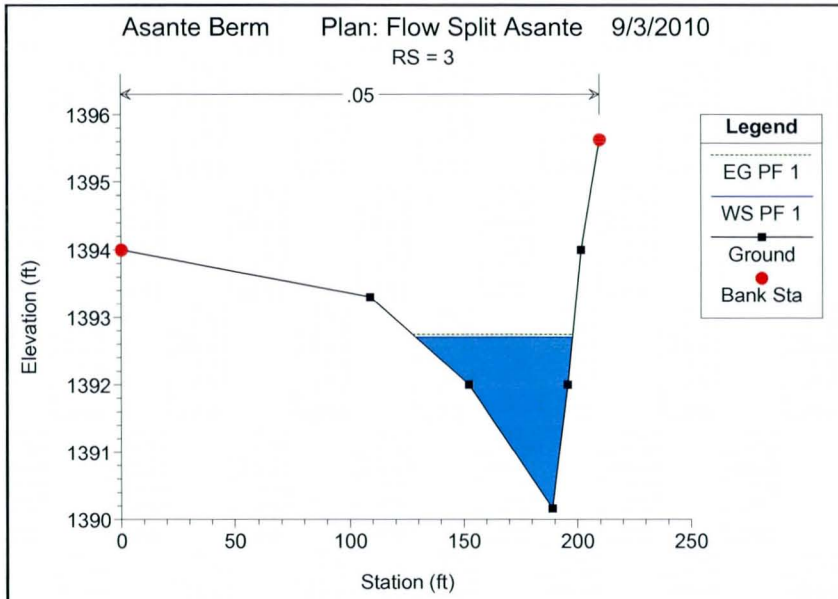
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Asante	7	PF 1	346.00	1390.29	1393.64		1393.72	0.008473	2.29	150.91	195.86	0.46
Asante	6.9		Lat Struct									
Asante	6	PF 1	325.65	1389.87	1392.83		1392.93	0.007293	2.63	123.81	116.43	0.45
Asante	5	PF 1	136.60	1390.00	1392.87		1392.87	0.000095	0.42	327.03	186.24	0.06
Asante	4	PF 1	125.79	1390.00	1392.85		1392.87	0.001248	1.17	107.33	90.51	0.19
Asante	3	PF 1	125.79	1390.16	1392.71		1392.75	0.002344	1.58	79.81	69.20	0.26
Asante	2	PF 1	120.03	1390.00	1392.71		1392.73	0.000572	0.99	121.57	72.75	0.13
Asante	1	PF 1	110.71	1390.39	1392.64	1391.91	1392.69	0.003304	1.91	58.10	48.93	0.31

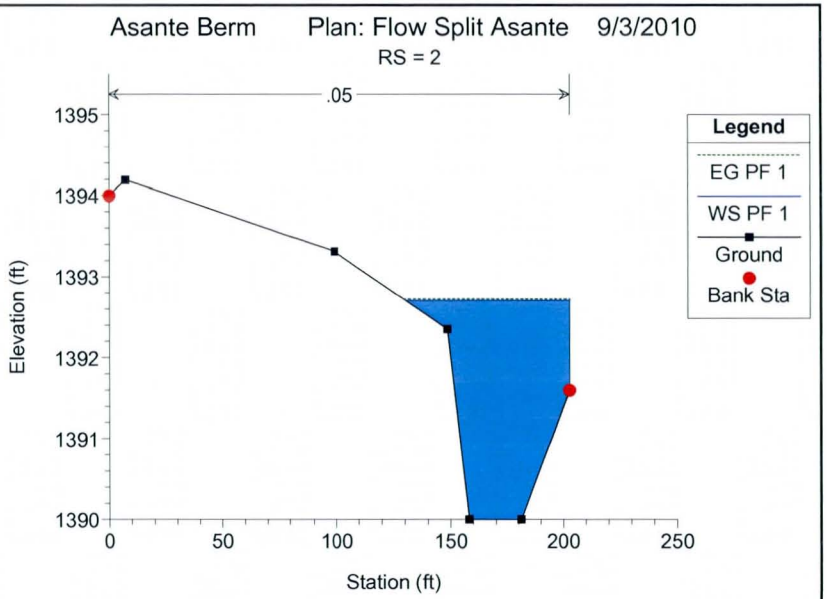

Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 7
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

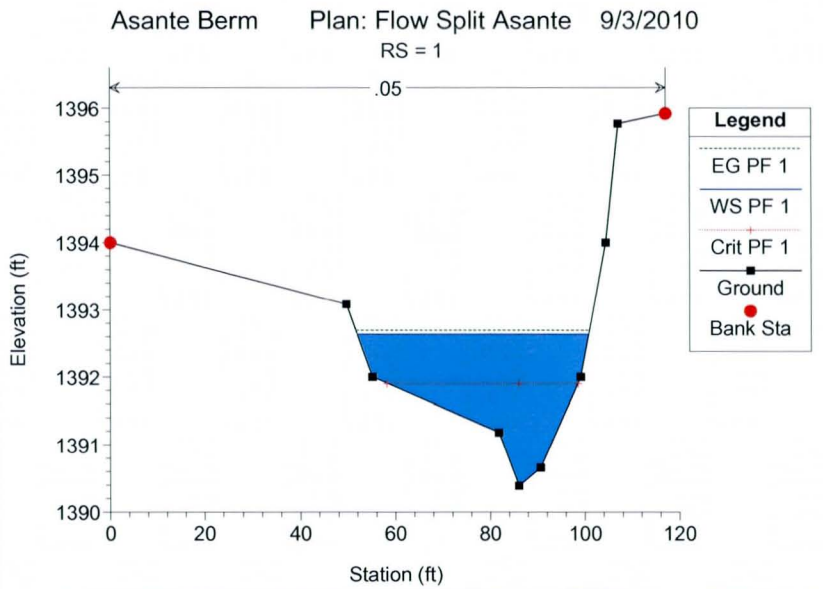

Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 6
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 5
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 4
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

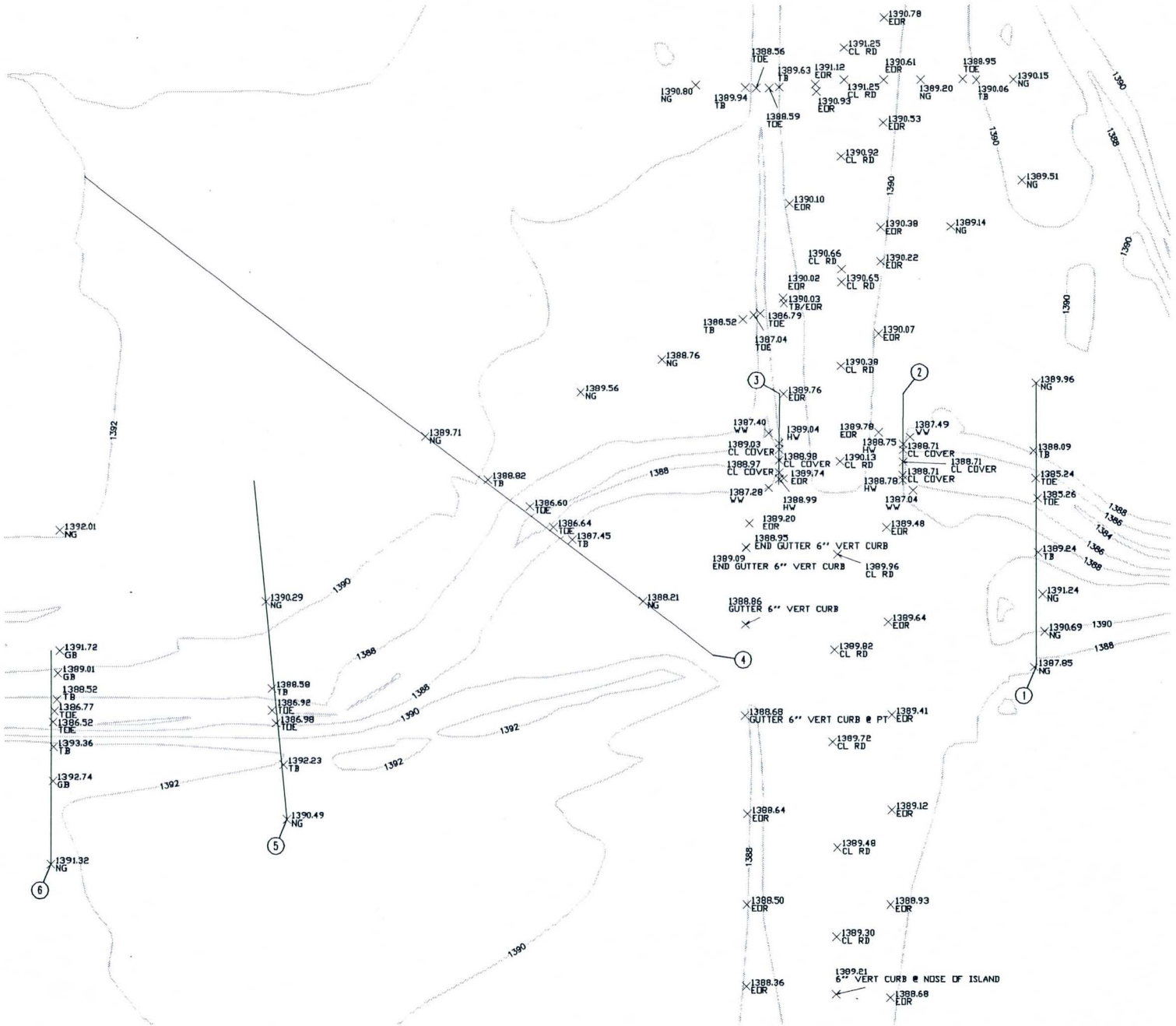

Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 3
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 2
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


Asante Berm Plan: Flow Split Asante 9/3/2010
RS = 1
.05
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

163rd Avenue / Happy Valley Road Alignment Culvert

163RD AVE / HAPPY VALLEY ROAD ALIGNMENT CULVERT



SCALE 1"=80'

LEGEND

CROSS SECTION

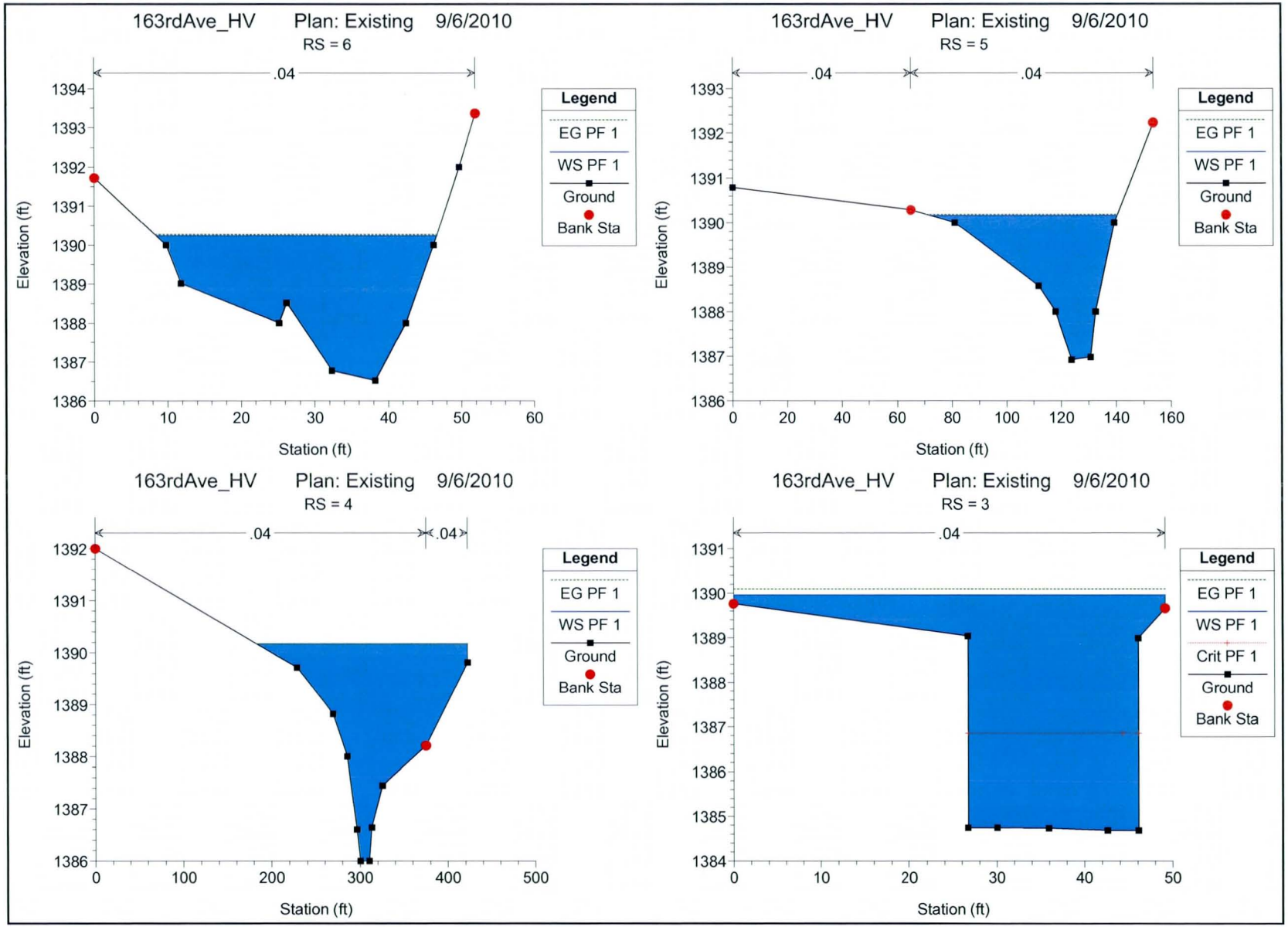
(1) CROSS SECTION NUMBER

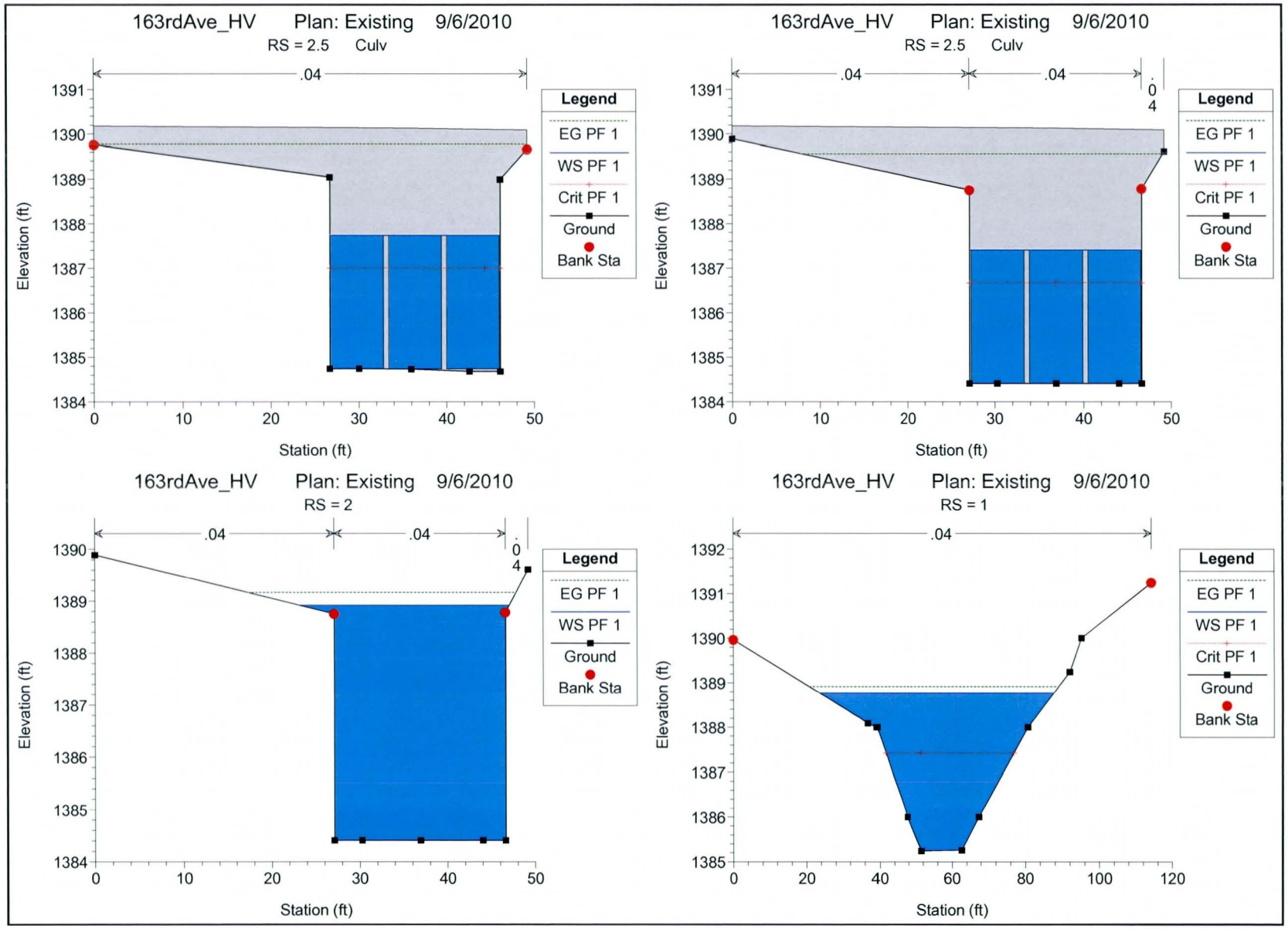
RBF CONSULTING

PLANNING
DESIGN
CONSTRUCTION

HEC-RAS Plan: Existing River: HappyValleyWash Reach: 163rd Profile: PF 1

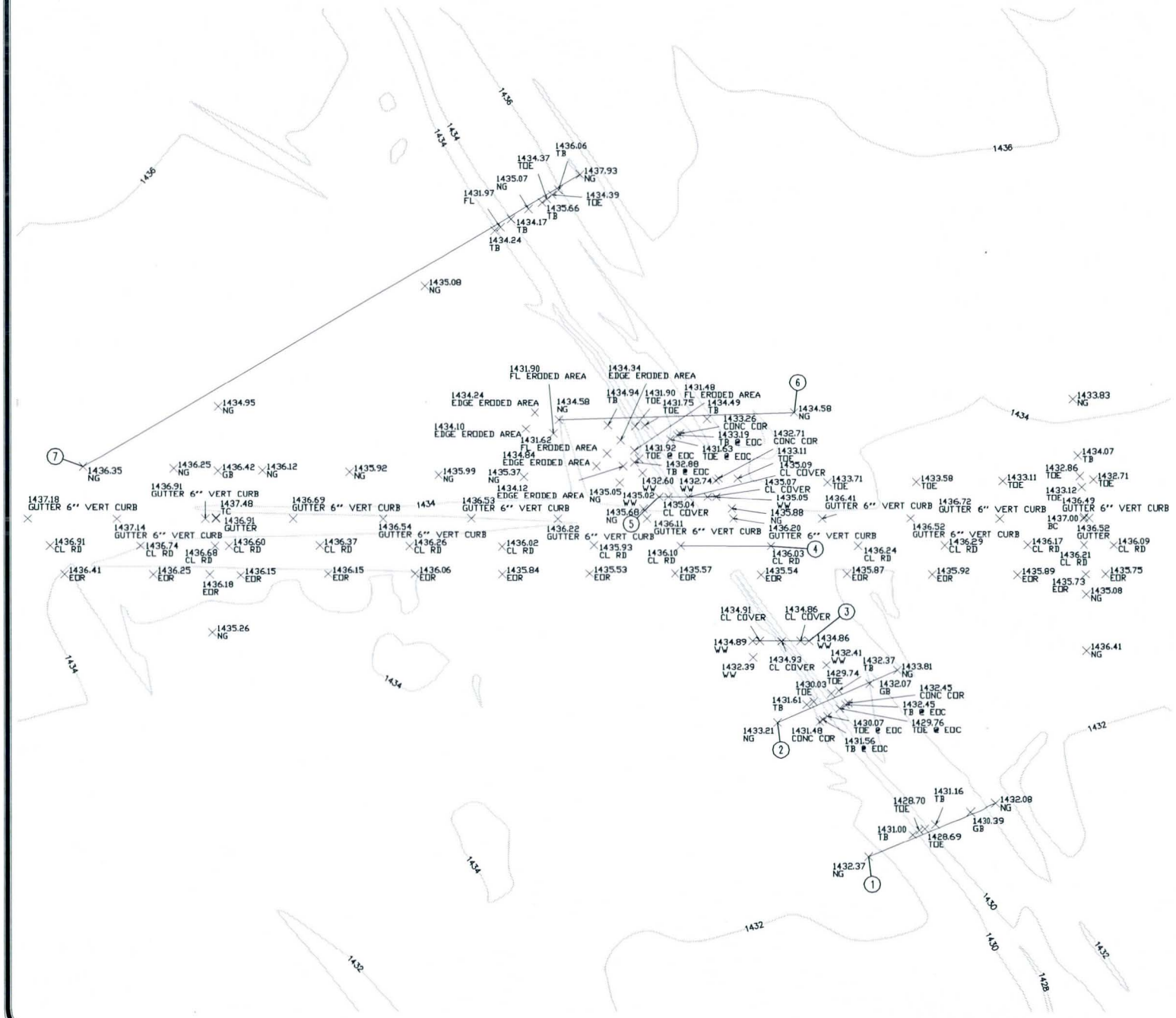
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
163rd	6	PF 1	111.00	1386.52	1390.24		1390.27	0.000520	1.37	81.25	38.20	0.17
163rd	5	PF 1	111.00	1386.92	1390.17		1390.19	0.000767	1.23	90.44	68.68	0.19
163rd	4.9		Lat Struct									
163rd	4	PF 1	102.71	1386.00	1390.17		1390.17	0.000027	0.28	384.81	240.02	0.04
163rd	3	PF 1	347.79	1384.68	1389.96	1386.86	1390.09	0.002415	2.93	118.72	49.20	0.33
163rd	2.5		Culvert									
163rd	2	PF 1	347.79	1384.41	1388.92		1389.16	0.002483	3.95	88.37	24.04	0.33
163rd	1	PF 1	347.79	1385.24	1388.77	1387.42	1388.91	0.003205	3.06	113.69	64.24	0.41


163rdAve_HV Plan: Existing 9/6/2010
RS = 6
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
163rdAve_HV Plan: Existing 9/6/2010
RS = 5
.04
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
163rdAve_HV Plan: Existing 9/6/2010
RS = 4
.04
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
163rdAve_HV Plan: Existing 9/6/2010
RS = 3
.04
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


163rdAve_HV Plan: Existing 9/6/2010
RS = 2.5 Culv
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
163rdAve_HV Plan: Existing 9/6/2010
RS = 2.5 Culv
.04
.04
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
163rdAve_HV Plan: Existing 9/6/2010
RS = 2
.04
.04
.04
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
163rdAve_HV Plan: Existing 9/6/2010
RS = 1
.04
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

Jomax / Desert Oasis Blvd Culvert

JOMAX / DESERT OASIS BLVD CULVERT



SCALE: 1"=80'

LEGEND

CROSS SECTION

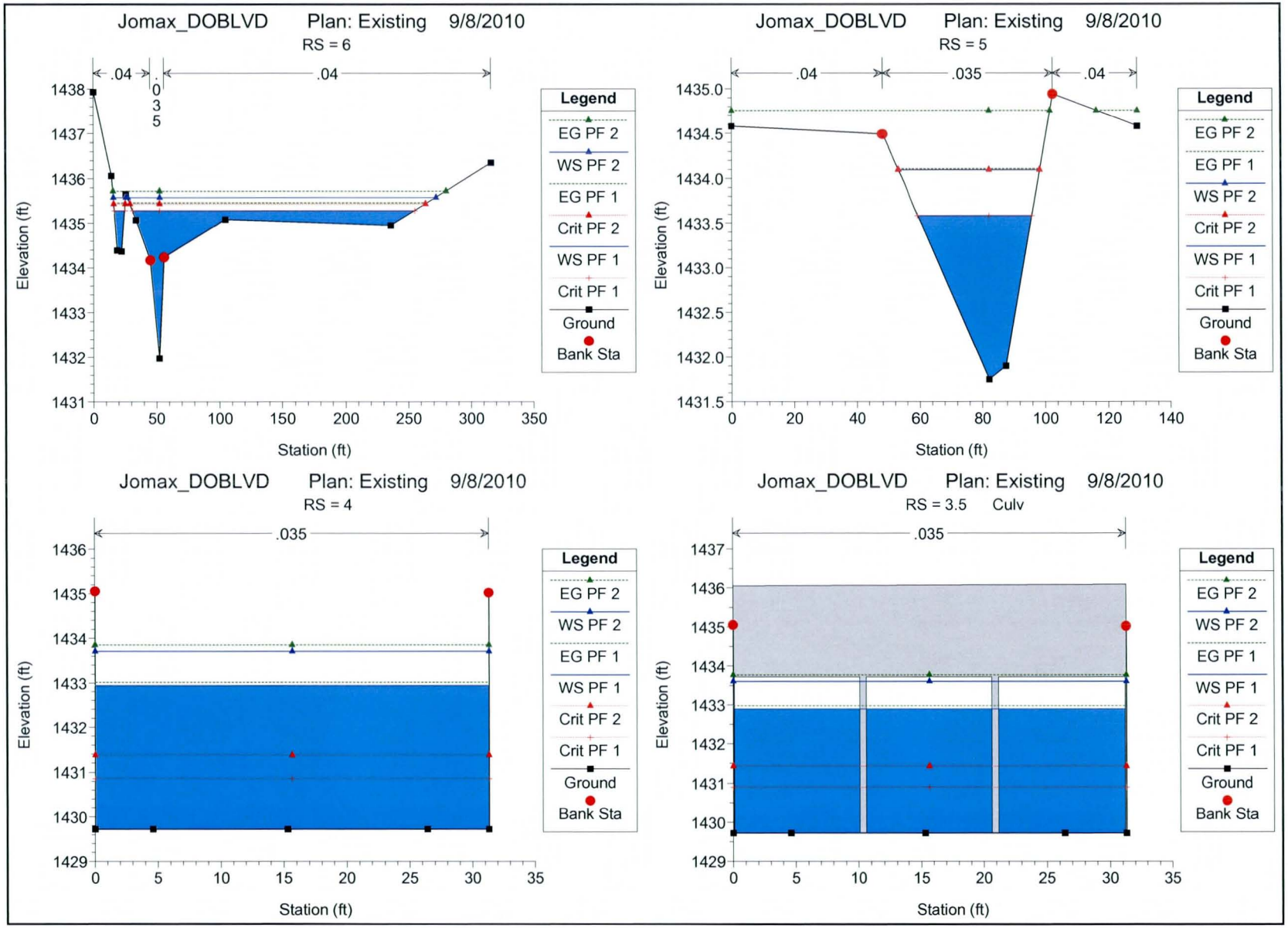
(1) CROSS SECTION NUMBER

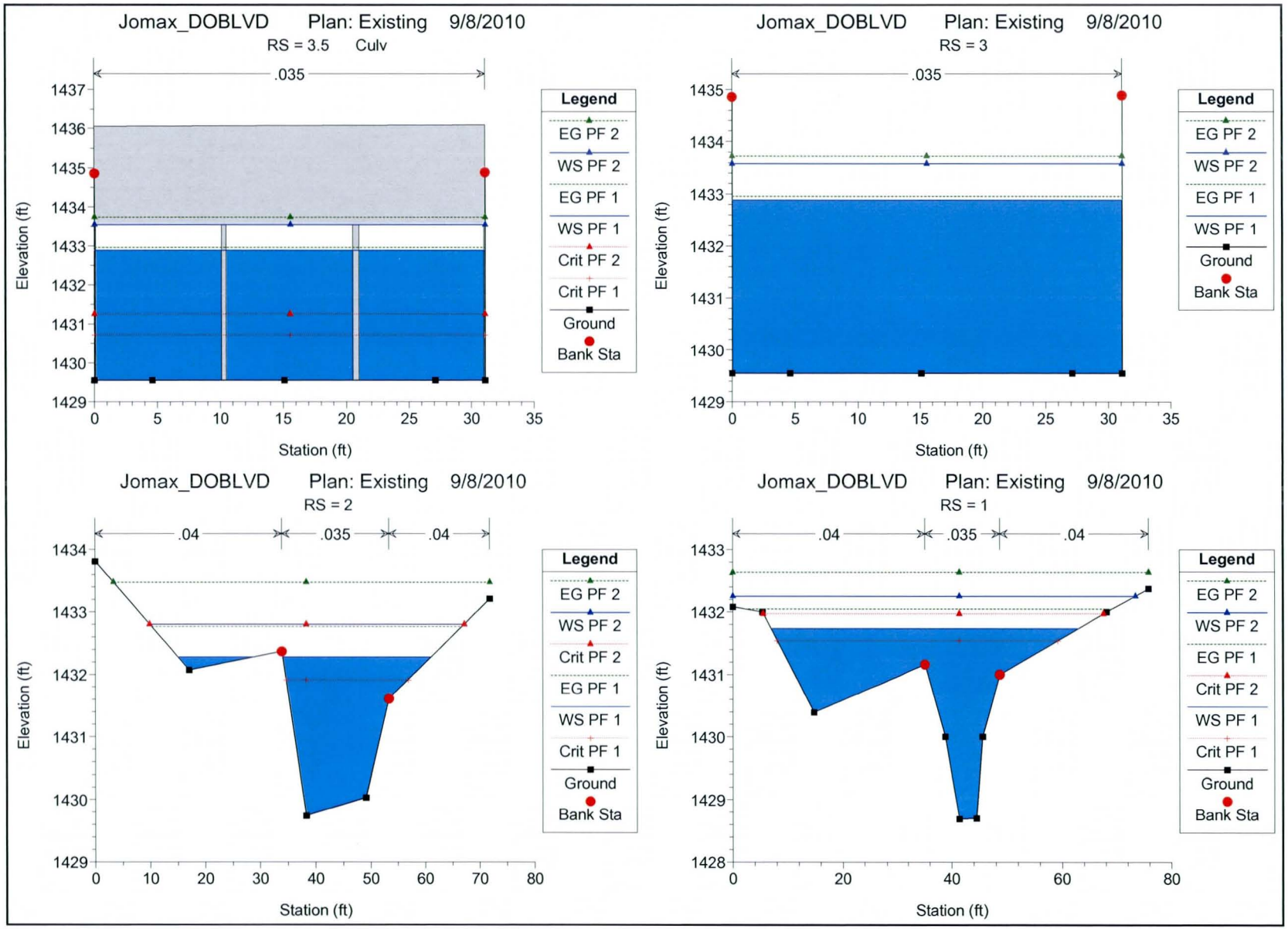
RBF CONSULTING

PLANNING
DESIGN
CONSTRUCTION

HEC-RAS Plan: Exist River: Wash5East Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	6	PF 1	217.00	1431.97	1435.28	1435.28	1435.46	0.004551	4.58	105.67	232.27	0.54
1	6	PF 2	380.00	1431.97	1435.58	1435.44	1435.72	0.003931	4.63	177.64	254.83	0.52
1	5	PF 1	217.00	1431.75	1433.58	1433.58	1434.11	0.018261	5.80	37.38	36.49	1.01
1	5	PF 2	380.00	1431.75	1434.10	1434.10	1434.76	0.016934	6.51	58.41	45.40	1.01
1	4	PF 1	217.00	1429.72	1432.94	1430.86	1433.01	0.000693	2.15	100.83	31.30	0.21
1	4	PF 2	380.00	1429.72	1433.71	1431.38	1433.85	0.001100	3.04	124.85	31.30	0.27
1	3.5		Culvert									
1	3	PF 1	217.00	1429.55	1432.89		1432.95	0.000631	2.09	103.76	31.10	0.20
1	3	PF 2	380.00	1429.55	1433.59		1433.73	0.001077	3.03	125.48	31.10	0.27
1	2	PF 1	217.00	1429.74	1432.28	1431.91	1432.77	0.007858	5.67	41.43	40.85	0.72
1	2	PF 2	380.00	1429.74	1432.80	1432.80	1433.47	0.008739	6.97	68.32	57.28	0.78
1	1	PF 1	217.00	1428.69	1431.74	1431.54	1432.05	0.007002	5.21	56.56	56.09	0.66
1	1	PF 2	380.00	1428.69	1432.25	1431.97	1432.64	0.007002	6.10	89.91	73.39	0.69


Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 6
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
Crit PF 2
WS PF 1
Crit PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 5
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
EG PF 1
WS PF 2
Crit PF 2
WS PF 1
Crit PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 4
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Crit PF 2
Crit PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 3.5 Culv
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Crit PF 2
Crit PF 1
Ground
Bank Sta

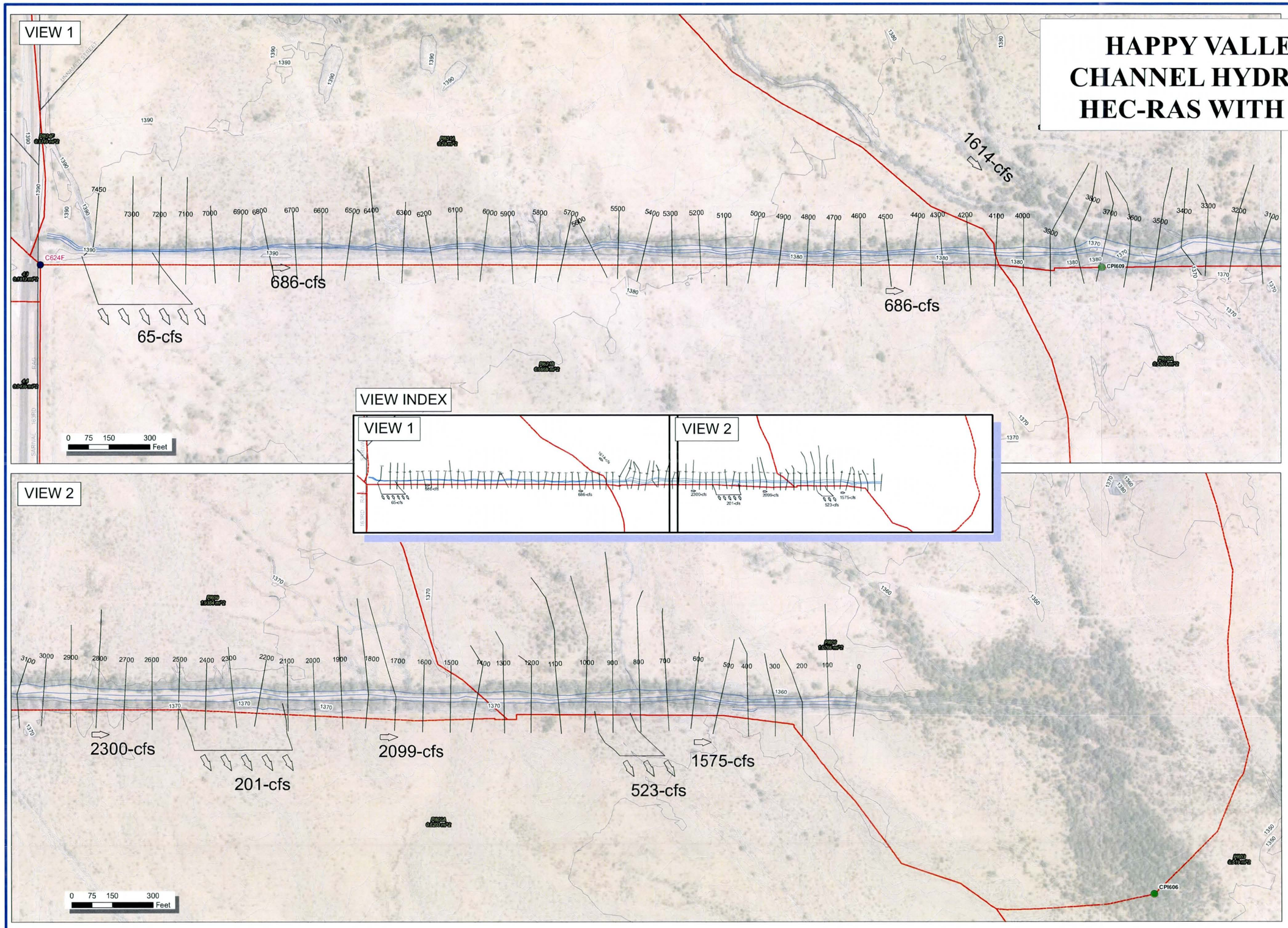

Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 3.5 Culv
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Crit PF 2
Crit PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 3
.035
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
WS PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 2
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
Crit PF 2
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Jomax_DOBLVD Plan: Existing 9/8/2010
RS = 1
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG PF 2
WS PF 2
EG PF 1
Crit PF 2
WS PF 1
Crit PF 1
Ground
Bank Sta

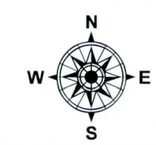
DEI Flow Splits Analysis Results For Reference

HAPPY VALLEY RD CHANNEL HYDRAULICS HEC-RAS WITH LEVEE

EXHIBIT E

WITH LEVEE EXISTING CONDITIONS





Legend

- ASANTE CPs
- WITTMAN CPs
- SUB-BASINS

DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

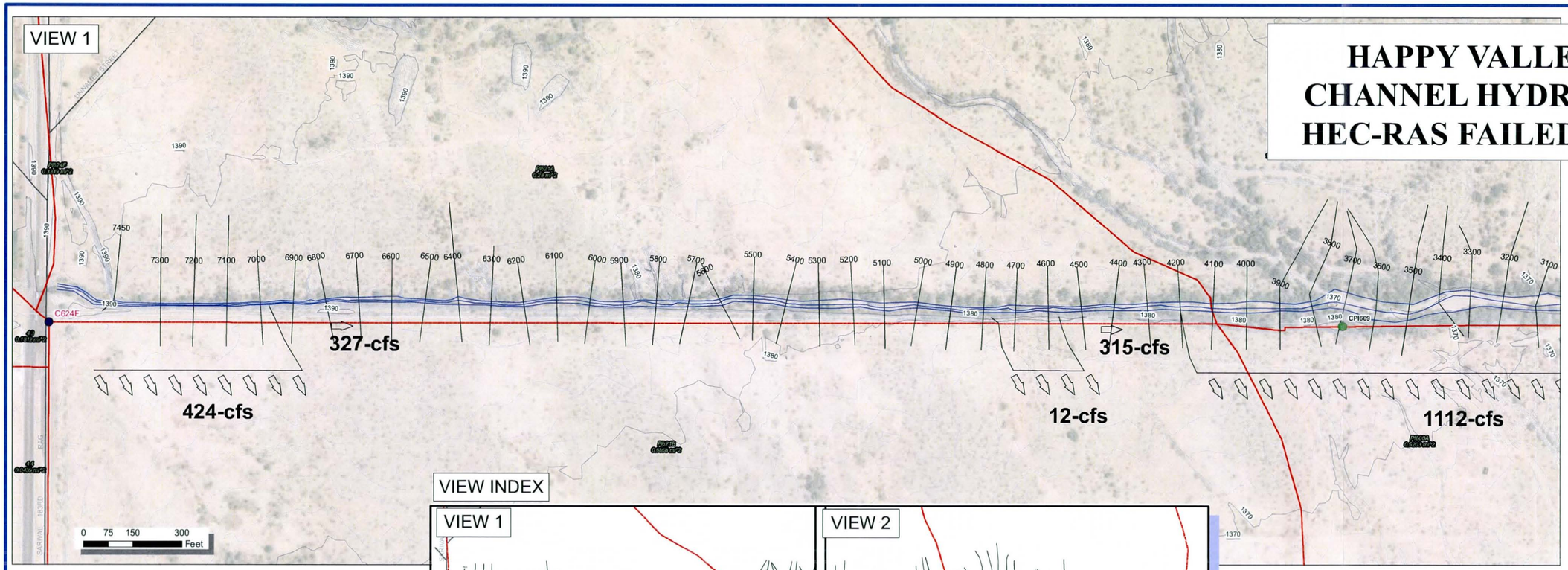
1982 – 2008
26 YEARS OF EXCELLENCE
DEI Professional Services, L.L.C.

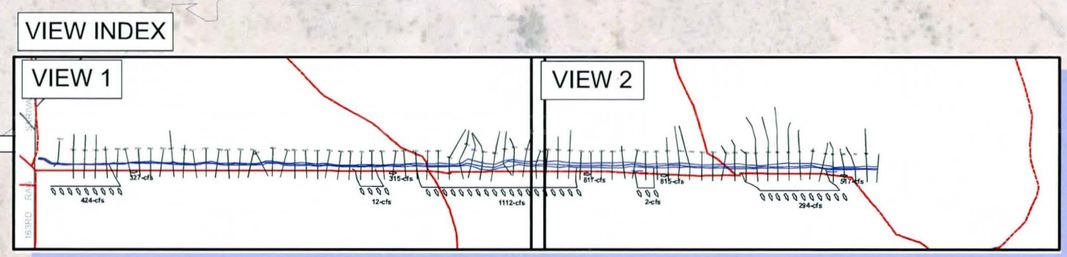
REVISED: JUNE 13, 2008

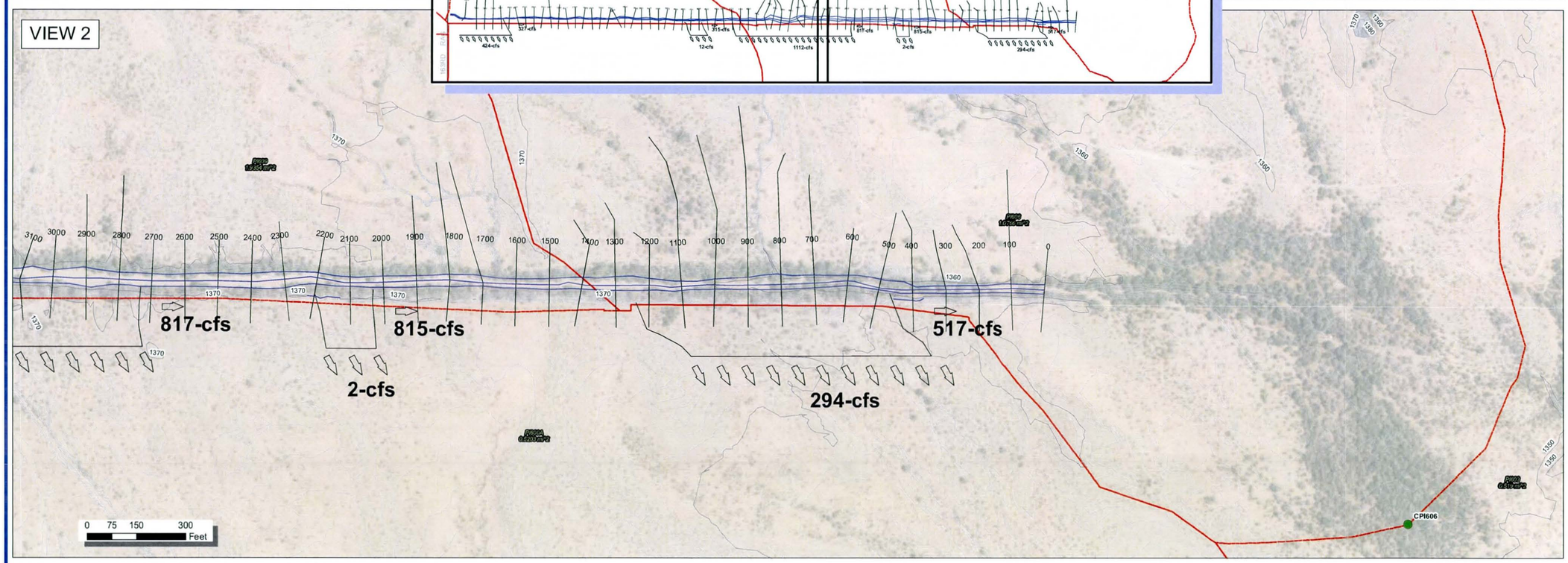
HAPPY VALLEY RD CHANNEL HYDRAULICS HEC-RAS FAILED LEVEE

EXHIBIT F

LEVEE FAILED EXISTING CONDITIONS







N
W E
S

Legend

- ASANTE CPs
- WITTMAN CPs
- SUB-BASINS

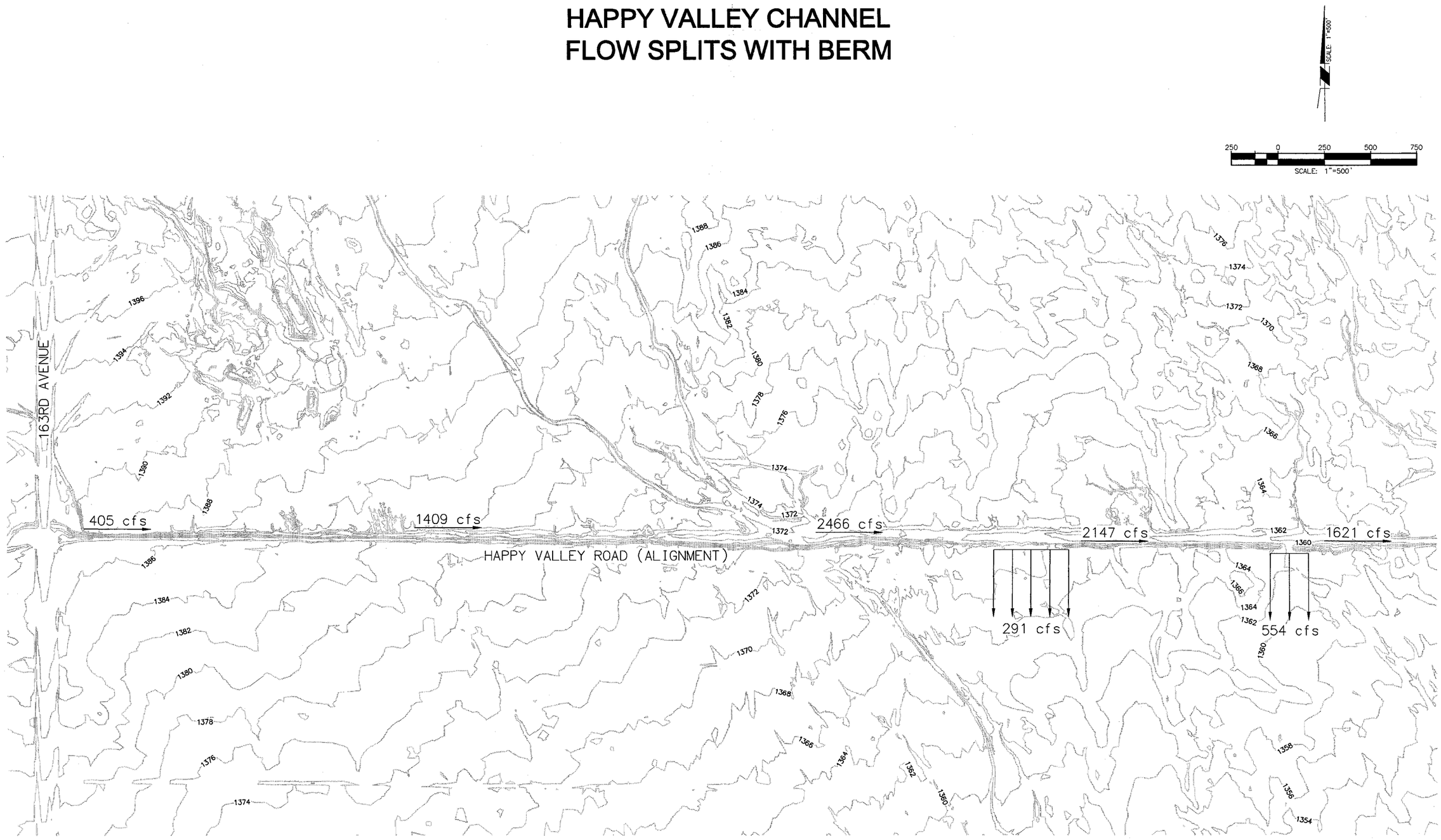
DEI Professional Services, LLC
6225 N. 24th St., Ste. 200
Phoenix, AZ 85016
Phone: (602)954-0038
Fax: (602)944-8605

1982 - 2008
26 YEARS OF EXCELLENCE
DEI Professional Services, L.L.C.

REVISED: JUNE 6, 2008

Flow Split Analysis With Berm

HAPPY VALLEY CHANNEL
FLOW SPLITS WITH BERM



RBF CONSULTING

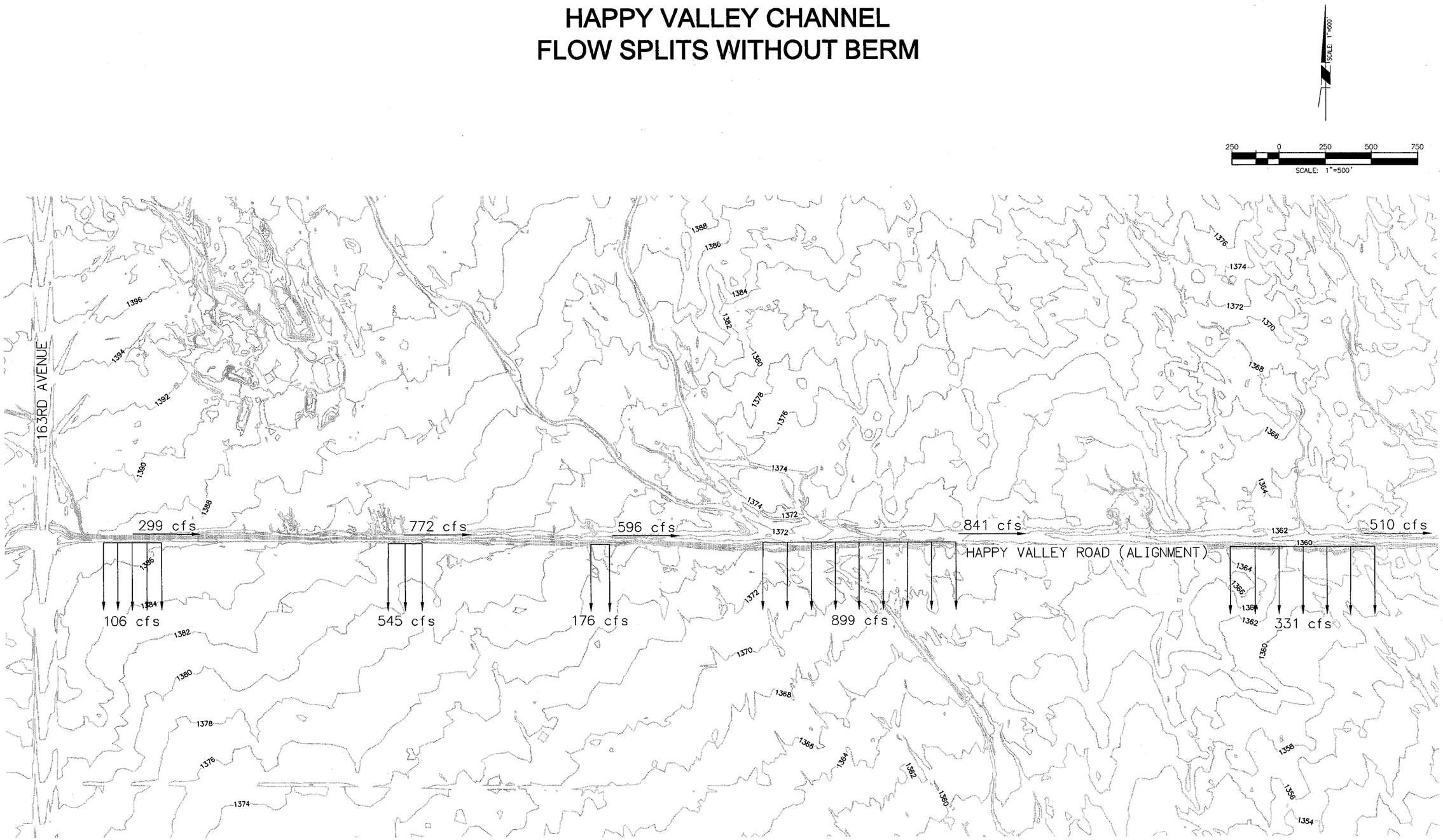
PLANNING ■ DESIGN ■ CONSTRUCTION

16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
602.467.2200 ▪ FAX 602.467.2201 ▪ www.RBF.com

H:\PDATA\45104030\CADD\STORMWATER\EXHIBITS\4030-SW-FLOWSPLITSWBERM-091109.DWG NFORD 12/8/10 11:02 am

Flow Split Analysis Without Berm

HAPPY VALLEY CHANNEL
FLOW SPLITS WITHOUT BERM



RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
602.467.2200 ▪ FAX 602.467.2201 ▪ www.RBF.com

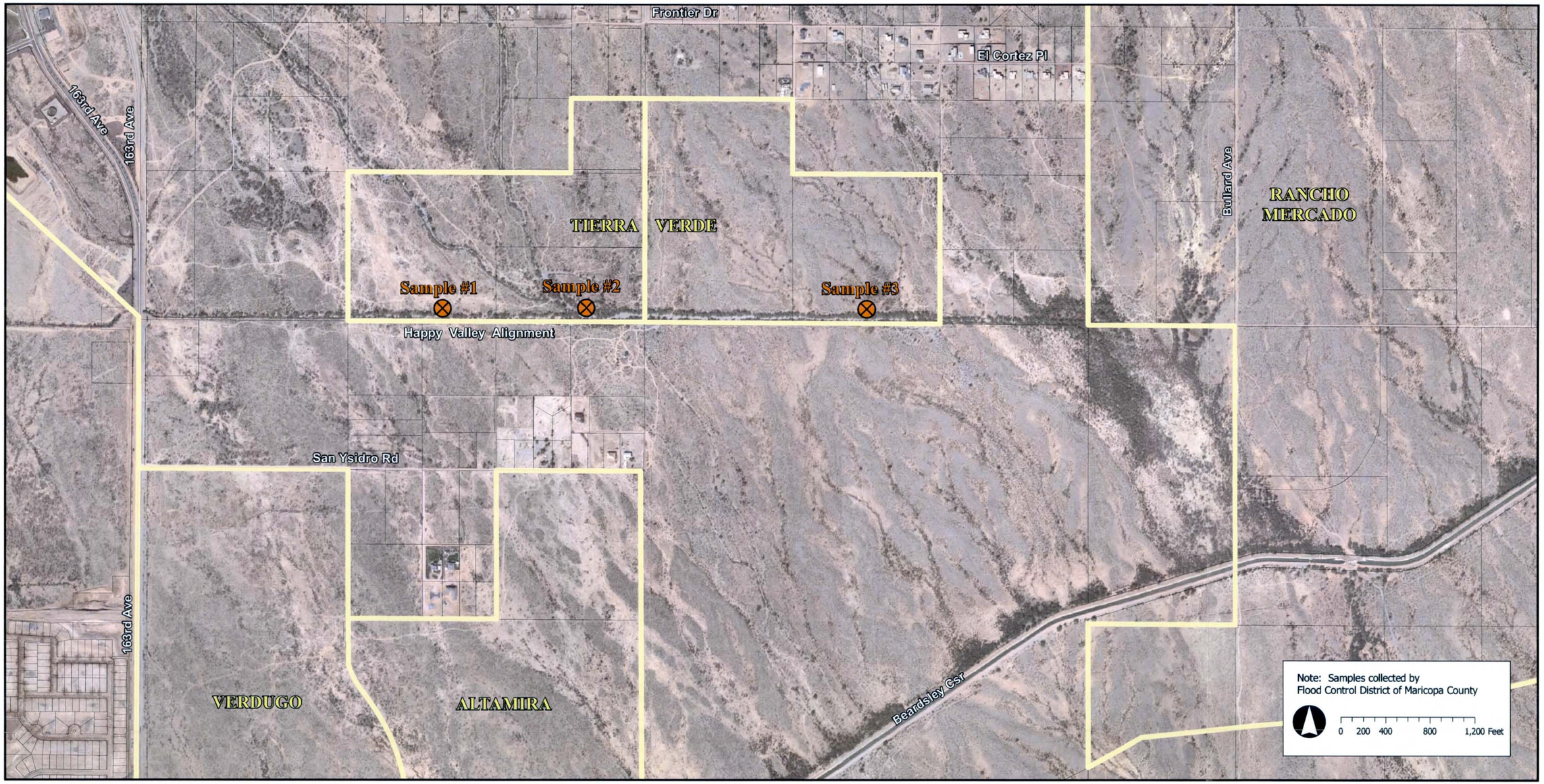
H:\PDATA\25104030\CADD\STORMWATER\EXHIBITS\4030-SW-FLOWSPLITSWOBERM-091109.DWG NFORD 12/8/10 11:05 am

APPENDIX B SOIL COLLECTION SUPPORTING DOCUMENTATION

Soil Sample Location Map

Happy Valley Design Concept Report

Soil Sample Location



2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

Soil Sample Tabular Data

MARICOPA COUNTY DEPARMENT OF TRANSPORTATION
CONSTRUCTION MATERIALS LABORATORY
2919 WEST DURANGO ST PHOENIX AZ 85009

FINE AND COARSE AGGREGATES (ASTM C136/C117)

PROJECT:	Happy Valley Rd Alignment	JOB NO:	
LOCATION:	Sample #1	LAB NO:	L11-0037
MATERIAL:	Native Subgrade	SAMPLE DATE:	10/19/10
SAMPLE SOURCE:	Roadway Alignment	TODAY'S DATE:	10/20/10
SUPPLIER:			
TESTS REQUIRED:	SA		
SAMPLED BY:	FCD	TESTED BY:	

				IN-SITU MOISTURE:		FRACTURED FACES:	
RETAINED #4:		WBW: (Wet)		WW:		TOTAL:	
PASS #4 W:		WBW: (Dry)	427.2	DW:		FF:	
PASS #4 D:		WAW	388.3	MOISTURE %:		%FF:	
TOTAL:	3567.8	ELUTRIATION:	38.9	F. FACTOR			

SIEVE NO.	RET.	%RET.	%PASS.	SPECS	PASS (Y/N)?
6 in / 152mm					
4 in / 100mm					
3 in 75 mm					
2 in / 50 mm			100		
1 1/2 in / 37.5 mm	171.1	4.8	95.2		
1 1/4 in / 31.2 mm	58.1	1.6	93.6		
1 in / 25 mm	134.6	3.8	89.8		
3/4 in / 19 mm	153.1	4.3	85.5		
1/2 in / 12.5 mm	226	6.3	79.2		
3/8 in / 9.5 mm	198.8	5.6	73.6		
1/4 in / 6.3 mm	301.8	8.5	65.1		
#4	184.6	4.9	60		
#8	75.8	10.6	49.4		
#10	22.2	4.6	44.8		
#16	44.8	6.3	38.5		
#30	54.9	7.7	30.8		
#40	83.5	11.7	19.1		
#50	33.2	4.7	14.4		
#100	28.9	4	10.4		
#200	35	4.9	5.5		
WAW					
ELUTR.				Sand Equivalent	

Soils Classification: Plasticity Index:

MARICOPA COUNTY DEPARMENT OF TRANSPORTATION
CONSTRUCTION MATERIALS LABORATORY
2919 WEST DURANGO ST PHOENIX AZ 85009

FINE AND COARSE AGGREGATES (ASTM C136/C117)

PROJECT:	Happy Valley Rd Alignment	JOB NO:	
LOCATION:	Sample #2	LAB NO:	L11-0038
MATERIAL:	Native Subgrade	SAMPLE DATE:	10/19/10
SAMPLE SOURCE:	Roadway Alignment	TODAY'S DATE:	10/20/10
SUPPLIER:			
TESTS REQUIRED:	SA		
SAMPLED BY:	FCD	TESTED BY:	

				IN-SITU MOISTURE:		FRACTURED FACES:	
RETAINED #4:		WBW: (Wet)		WW:	322.3	TOTAL:	
PASS #4 W:		WBW: (Dry)	430.8	DW:	318.9	FF:	
PASS #4 D:		WAW	392.3	MOISTURE %:	1.1	%FF:	
TOTAL:	3614.5	ELUTRIATION:	38.3	F. FACTOR			

SIEVE NO.	RET.	%RET.	%PASS.	SPECS	PASS (Y/N)?
6 in / 152mm					
4 in / 100mm					
3 in 75 mm					
2 in / 50 mm			100		
1 1/2 in / 37.5 mm	84.1	2.3	97.7		
1 1/4 in / 31.2 mm	0	0	97.7		
1 in / 25 mm	33.4	1.0	96.7		
3/4 in / 19 mm	74.2	2.1	94.6		
1/2 in / 12.5 mm	248.9	6.8	87.8		
3/8 in / 9.5 mm	227.3	6.3	81.5		
1/4 in / 6.3 mm	394.8	11	70.5		
#4	257.3	7.1	63.4		
#8	114.3	18.4	45		
#10	35.5	5.7	39.3		
#16	84.1	13.5	25.8		
#30	72.3	11.7	14.1		
#40	24.6	3.9	10.2		
#50	16.9	2.7	7.5		
#100	25.5	4.1	3.4		
#200	19.3	3.1	0.3		
WAW					
ELUTR.					

Sand Equivalent

Soils Classification

Plasticity Index

MARICOPA COUNTY DEPARMENT OF TRANSPORTATION
CONSTRUCTION MATERIALS LABORATORY
2919 WEST DURANGO ST PHOENIX AZ 85009

FINE AND COARSE AGGREGATES (ASTM C136/C117)

PROJECT:	Happy Valley Rd Alignment	JOB NO:	
LOCATION:	Sample #3	LAB NO:	L11-0039
MATERIAL:	Native Subgrade	SAMPLE DATE:	10/19/10
SAMPLE SOURCE:	Roadway Alignment	TODAY'S DATE:	10/20/10
SUPPLIER:			
TESTS REQUIRED:	SA,		
SAMPLED BY:	FCD	TESTED BY:	

				IN-SITU MOISTURE:		FRACTURED FACES:	
RETAINED #4:		WBW: (Wet)		WW:		TOTAL:	
PASS #4 W:		WBW: (Dry)	413.6	DW:		FF:	
PASS #4 D:		WAW	401.7	MOISTURE %:		%FF:	
TOTAL:	3688.4	ELUTRIATION:	11.9	F. FACTOR			

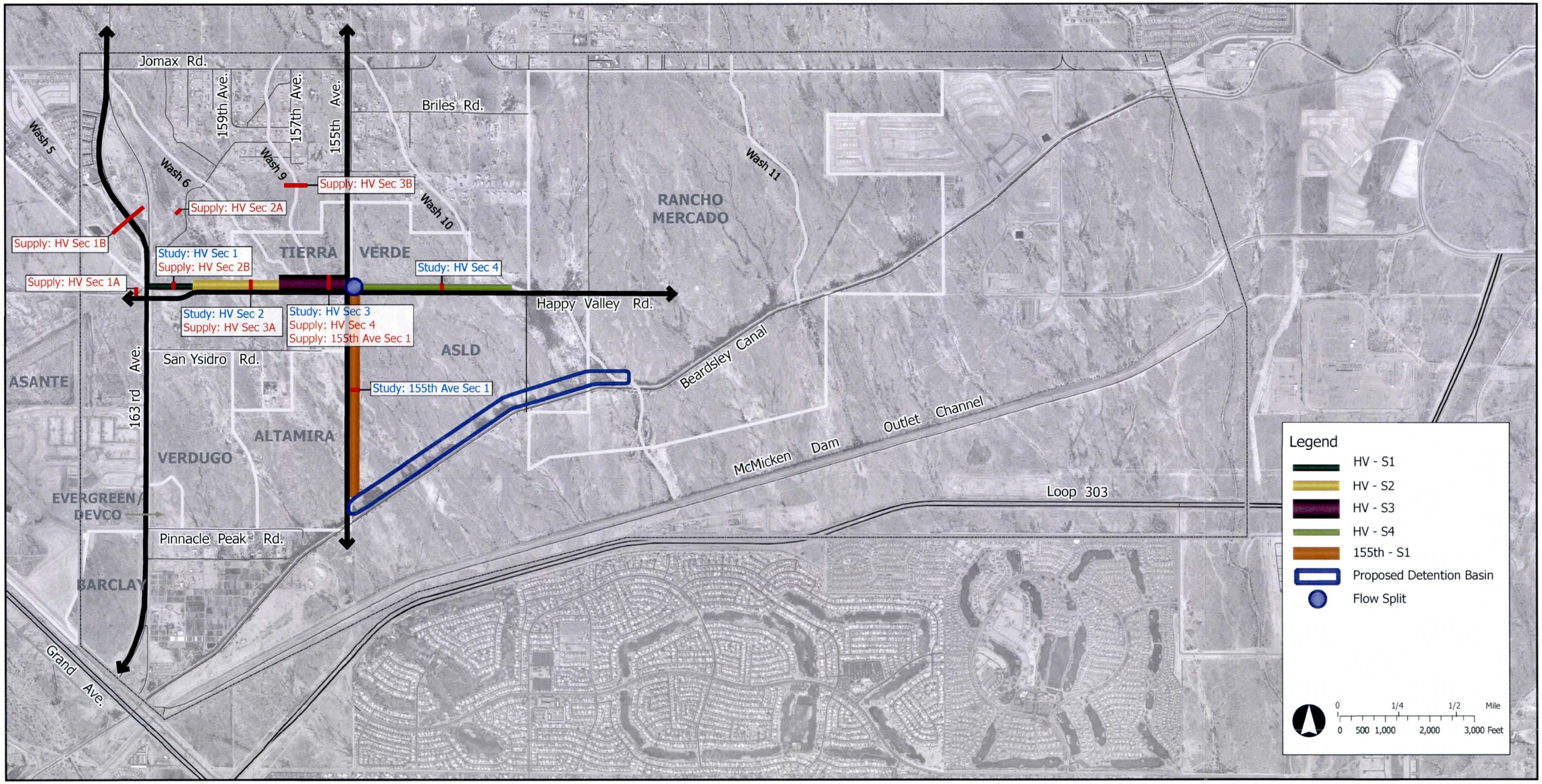
SIEVE NO.	RET.	%RET.	%PASS.	SPECS	PASS (Y/N)?
6 in / 152mm					
4 in / 100mm					
3 in 75 mm					
2 in / 50 mm					
1 1/2 in / 37.5 mm					
1 1/4 in / 31.2 mm			100		
1 in / 25 mm	39.1	1.1	98.9		
3/4 in / 19 mm	12.5	0.3	97.6		
1/2 in / 12.5 mm	43	1.2	97.4		
3/8 in / 9.5 mm	90.3	2.4	95		
1/4 in / 6.3 mm	331.8	9	86.0		
#4	238.1	6.5	79.5		
#8	90.4	17.5	62		
#10	34.5	6.7	55.3		
#16	88.3	17.1	38.2		
#30	91.6	17.7	20.5		
#40	43.3	8.4	12.1		
#50	28.9	5.6	6.5		
#100	20.5	3.9	2.6		
#200	4.2	0.8	1.8		
WAW					
ELUTR.				Sand Equivalent	

Soils Classification

Plasticity Index

Equilibrium Slope Analysis

Happy Valley Design Concept Report
Equilibrium Slope Analysis Section Location Map



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Equilibrium Slope Analysis
Sediment Laden Flow

	Study 155th Ave SEC 1	Supply 155th Ave SEC 1
Va	2.99	2.77
n	0.035	0.035
G	4.02	4.02
Yh	1.85	2
D50	2.8	2.8
qs	0.00159611	0.001120777
W	98.4807692	143.08
Qs	0.15718648	0.160360821

	equlibrium slope	Qs
	0.0023	0.1694
	0.0022	0.157

	Study HV SEC 1	Supply HV SEC 1A	Supply HV SEC 1B	Total Supply HV SEC 1
Va	2.95	3.38	1.76	
n	0.035	0.035	0.035	
G	7.28	7.28	7.28	
Yh	1.71	1.14	0.35	
D50	2.5	2.5	2.5	
qs	0.00215838	0.00438778	0.00037307	
W	38.04	20.01	28.13	
Qs	0.08210487	0.08779947	0.010494462	0.09829393

	equlibrium slope	Qs
	0.0027	0.098526
	0.0026	0.093239

	Study HV SEC 2	Supply HV SEC 2A	Supply HV SEC 2B	Total Supply HV SEC 2
Va	2.81	4.89	2.95	
n	0.035	0.035	0.035	
G	7.28	7.28	7.28	
Yh	1.89	1.7	1.71	
D50	2.5	2.5	2.5	
qs	0.00169773	0.019190033	0.002158382	
W	79.26	26.56	38.04	
Qs	0.13456216	0.509687278	0.082104869	0.5917921

	equlibrium slope	Qs
	0.0052	0.599643
	0.0051	0.57944

	Study HV SEC 3	Supply HV SEC 3A	Supply HV SEC 3B	Total Supply HV SEC 3
Va	2.77	2.81	2.54	
n	0.035	0.035	0.035	
G	4.02	4.02	4.02	
Yh	2	1.89	0.66	
D50	2.8	2.8	2.8	
qs	0.00112078	0.0012128	0.0010748	
W	143.08	79.26	47.52	
Qs	0.16036082	0.09612638	0.0510753	0.147202

	equlibrium slope	Qs
	0.00163	0.150332
	0.0016	0.145484

	Study HV SEC 4	Total Supply HV SEC 4
Va	2.95	2.77
n	0.035	0.035
G	3.47	3.47
Yh	1.7	2
D50	1.7	1.7
qs	0.00195998	0.0014222
W	36.16	143.08
Qs	0.07087282	0.2034873

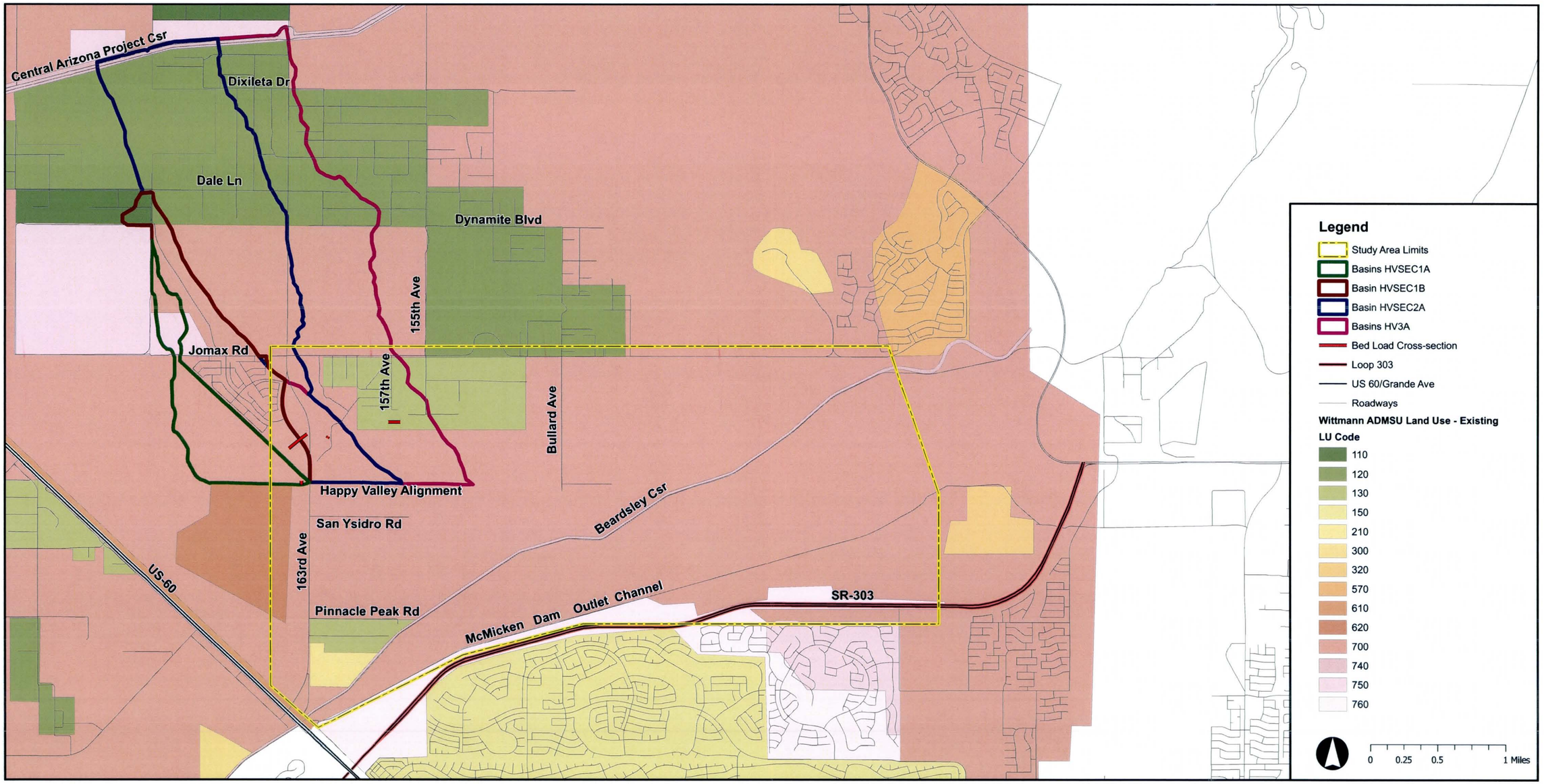
	equlibrium slope	Qs
	0.0049	0.209546
	0.0048	0.202466

Section	100-YR 24-HR Q (CFS)	Soil Sample
Supply HV SEC 1A	482	1
Supply HV Sec 1B	484	1
Study HV SEC 1	751	1
Supply HV SEC 2A	1055	1
Supply HV SEC 2B	751	1
Study HV SEC 2	1409	1
Supply HV SEC 3A	1409	2
Supply HV SEC 3B	1054	2
Study HV SEC 3	2466	2
Supply HV SEC 4	2466	3
Study HV SEC 4	720	3
Supply 155th Ave SEC 1	2466	2
Study 155th Ave SEC 1	1750	2

Sediment Yield Land Use Map

Happy Valley Design Concept Report

Sediment Yield - Land Use Map



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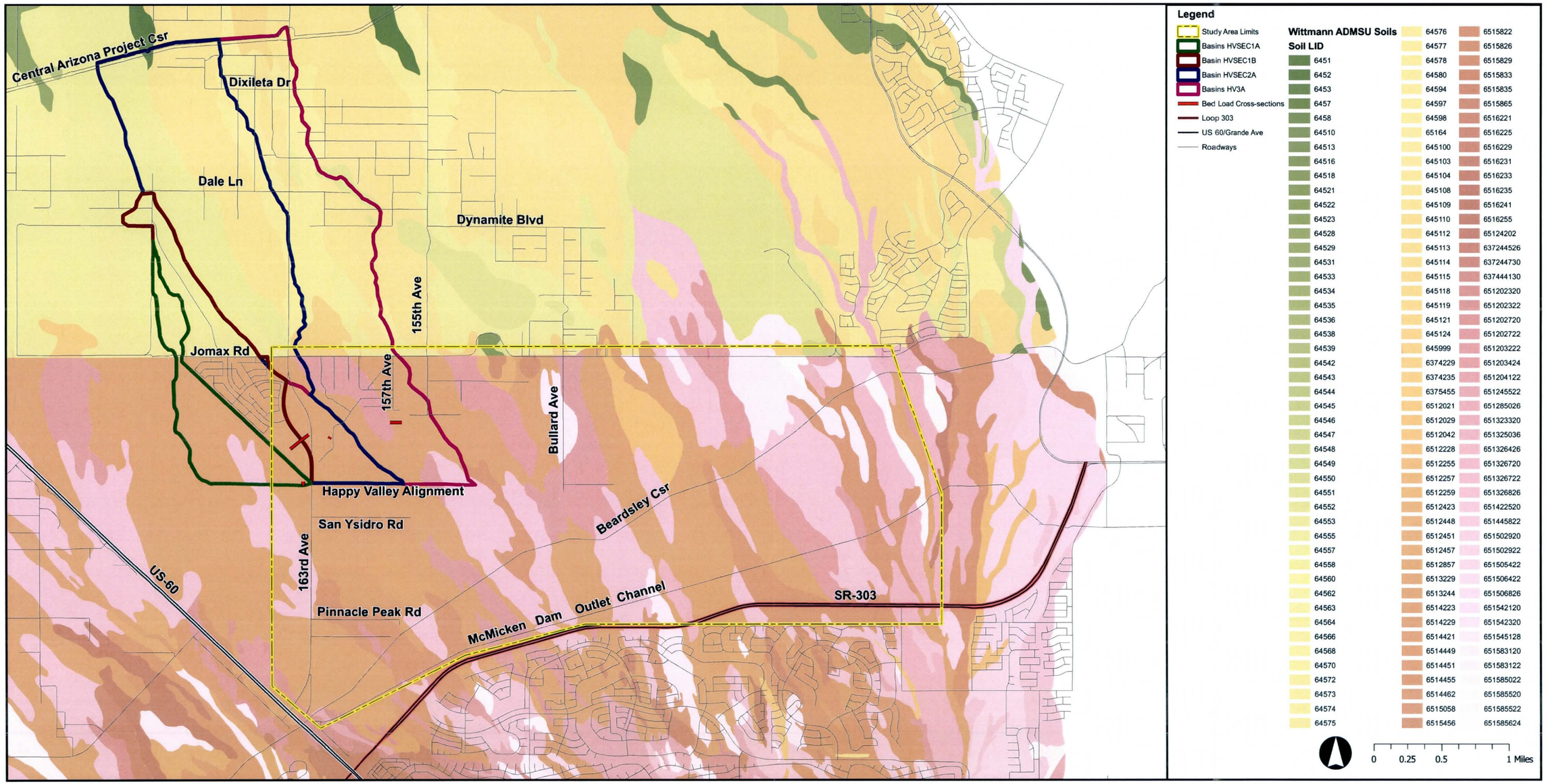
www.fcd.maricopa.gov

Sediment Yield Soil Map

Happy Valley Design Concept Report

Sediment Yield - Soil Map



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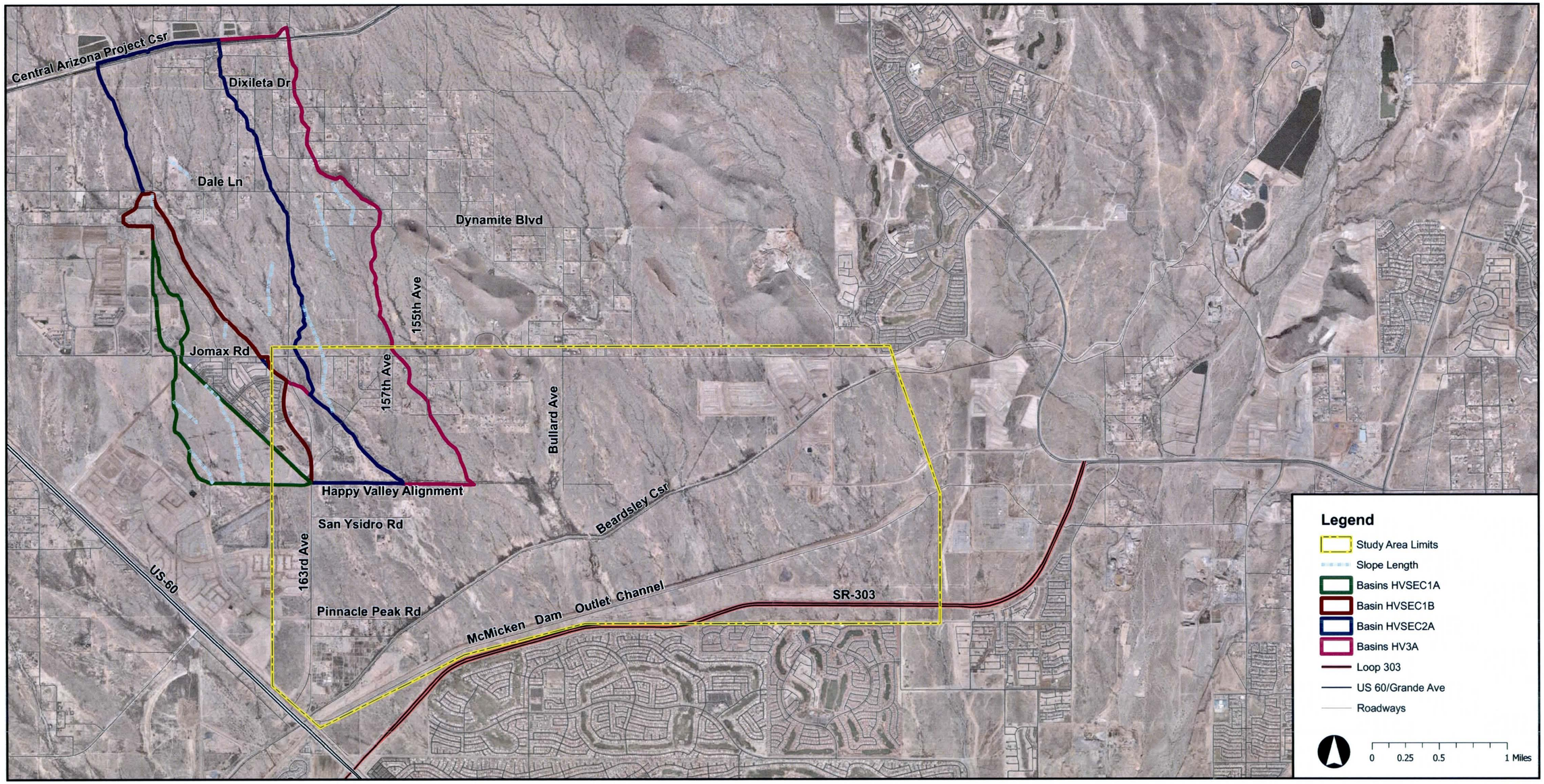
Sediment Yield Slope Lengths

Happy Valley Design Concept Report

Sediment Yield - Slope Length



2801 West Durango Street, Phoenix, Arizona 85009, (602) 506-1501

APPENDIX C PROJECT STAKEHOLDER CONTACT INFORMATION

HV DCR Stakeholder List

Name	Company	Project Affiliation	e-mail	Phone	Address 1	Address 2	City	State	Zip
Mark Voigt	Voyager Properties	Tierra Verde East	mvoigt@voyagerproperties.com	480 946 9635	6900 East Second Street		Scottsdale	AZ	85251
Charlie Caldwell	William Lyon Homes	Rancho Mercado	charlie.caldwell@lyonhomes.com	480 893 1000	8840 East Chaparral Road, Ste. 200		Scottsdale	AZ	85250
Paul Kroff	Woodside Homes	Tierra Verde West	PKroff@woodside-homes.com	480 755 0801	1811 South Alma School Road, Ste. 190		Mesa	AZ	85210
Stuart Barney	Evergreen Devco	163rd & Pinnacle Peak	stuart.barney@evergreendev.com	602 808 8600	2390 East Camelback Road, Ste. 410		Phoenix	AZ	85016
Anthony Sumner	Sandbox Development Consultants	Verdugo	anthony@sandboxdevelopment.com	602 275 5445	312 West Edgemont Avenue		Phoenix	AZ	85003
Phil Miller	Westpac Development Corporation	Alta Mira	developaz@gmail.com	480 889 1999	7595 East McDonald Drive, Ste. 105		Scottsdale	AZ	85250
Ricardo Aguire	Coe & Van Loo Consultants, Inc.	Tierra Verde East & West, Alta Mira	raguirre@cvlci.com	602 264 6831	4550 North 12th Street		Phoenix	AZ	85014
Brian Rahal	DEI Professional Services	Verdugo	brahal@deipro.com	602 954 0038	6225 North 24th Street, Ste. 200		Phoenix	AZ	85016
Hal Marron	DEI Professional Services	Verdugo	hmarron@deipro.com	602 954-0038	6225 North 24th Street, Ste. 200		Phoenix	AZ	85016
Kevin Kugler	RBF Consulting	HV Study	kkugler@rbf.com	602 467 2249	16605 North 28th Avenue, Ste. 100		Phoenix	AZ	85053
Nathan Ford	RBF Consulting	HV Study	nford@rbf.com	602 467 2254	16605 North 28th Avenue, Ste. 100		Phoenix	AZ	85053
Jeff Davidson	City of Surprise	HV Study	jeff.davidson@surpriseaz.com	623 222 6131	16000 North Civic Center Plaza		Surprise	AZ	85374
Hobart Wingard	City of Surprise	HV Study	Hobart.wingard@surprizeaz.com	623 222 3000	16000 North Civic Center Plaza		Surprise	AZ	85374
Adam Copeland	City of Surprise	HV Study	Adam.Copeland@surpriseaz.com	623 222 3000	16000 North Civic Center Plaza		Surprise	AZ	85374
Debbi Shortal	FCDX	HV Study	dls@mail.maricopa.gov	602 506 1034	2801 W Durango		Phoenix	AZ	85009
Greg Jones	FCDX	HV Study	glj@mail.maricopa.gov	602 506 5537	2802 W Durango		Phoenix	AZ	85009
John Holmes	FCDX	HV Study	jwh@mail.maricopa.gov	602 506 3320	2803 W Durango		Phoenix	AZ	85009
Jon Loxley	FCDX	HV Study	jonloxley@mail.maricopa.gov	602 506 2956	2804 W Durango		Phoenix	AZ	85009
Amir Motamedi	FCDX	HV Study	amm@mail.maricopa.gov	602 506 2956	2805 W Durango		Phoenix	AZ	85009
Kevin Kammerzell	Atwell-Hicks	Rancho Mercado	kkammerzell@atwell-hicks.com	480 218 8831	4700 E. Southern Ave.		Mesa	AZ	85206
Don Breeding	Maricopa Water District	Beardsley Canal	donb@mwdaz.com	623-546-8266	P.O. Box 900		Wadell	AZ	85355
Manish Patel	Arizona State Land Department	ASLD Trust Lands	mpatel@land.az.gov	602-542-3671	1616 West Adams Street		Phoenix	AZ	85007

APPENDIX D MEETING AGENDAS AND MINUTES

SURPRISE
ARIZONA

HAPPY VALLEY CHANNEL DCR
STAKEHOLDER KICK-OFF MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

August 20, 2009
9:00 am – 11:00 am
FCDMC – New River Conference Room

I. Introduction & Welcome

II. Project Stakeholder Contact Information Confirmation

III. Project Overview & Schedule

IV. Summary of Project Objectives & Preliminary Findings of Fact

- Project Purpose & Intent
- Summary of Existing Project Conditions/Variables

V. Identification of Project Stakeholder Opportunities/Constraints

- Group Discussion and/or map exercise to identify;
  1) Any missing links in the data presented,
  2) Individual project goals, and
  3) Concerns or issues of awareness

- Alta Mira
- Rancho Mercado
- Tierra Verde
- Verdugo
- City of Surprise
- FCDMC

VI. Consideration of Other Project Logistics

- Project Site Visit
- Future Meeting Locations
- Communication Protocol

VII. Meeting Summary & Action Items

VIII. Adjournment

SURPRISE
ARIZONA

Happy Valley DCR
Project Stakeholder Contact List

Project Name: Verdugo
Property Owner: SCC Canyon II LLC
Owner Representative: Anthony Sumner, Sandbox Development Consultants, Inc
312 W. Edgemont Ave.
Phoenix, AZ 85003
(602) 275-5445
anthony@sandboxdevelopment.com

Owner Engineer: Hal E. Marron/Brian Rahal, DEI Consulting Engineers
6225 North 24th Street, Suite 200
Phoenix, AZ 85016
(602) 954-0038
hmarron@deipro.com

Project Name: Tierra Verde West
Property Owner: Woodside Homes of Arizona
Owner Representative: Paul Kroff
Address
Address
Phone #
PKroff@woodside-homes.com

Owner Engineer: Paul Siders, Coe & Van Loo Consultants, Inc
4550 N. 12th Street
Phoenix, AZ 85014
(602) 264-6831
psiders@cvlci.com

Project Name: Tierra Verde East
Property Owner: Mark Voigt, Voyager
Owner Representative: Mark Voigt, Voyager
6900 East Second Street
Scottsdale, AZ 85251
(480) 946-9635
mvoigt@voyagerproperties.com

Owner Engineer: Paul Siders, Coe & Van Loo Consultants, Inc
4550 N. 12th Street
Phoenix, AZ 85014
(602) 264-6831
psiders@cvlci.com

Project Name:	Rancho Mercado
Property Owner:	William Lyon Homes, Inc.
Owner Representative:	Charlie Caldwell, William Lyon Homes, Inc. 8840 E. Chaparral Rd., Ste. 200 Scottsdale, AZ 85250 (480) 893-1000 charlie.caldwell@lyonhomes.com
Owner Engineer:	CMX – no forwarding contact info known at this time

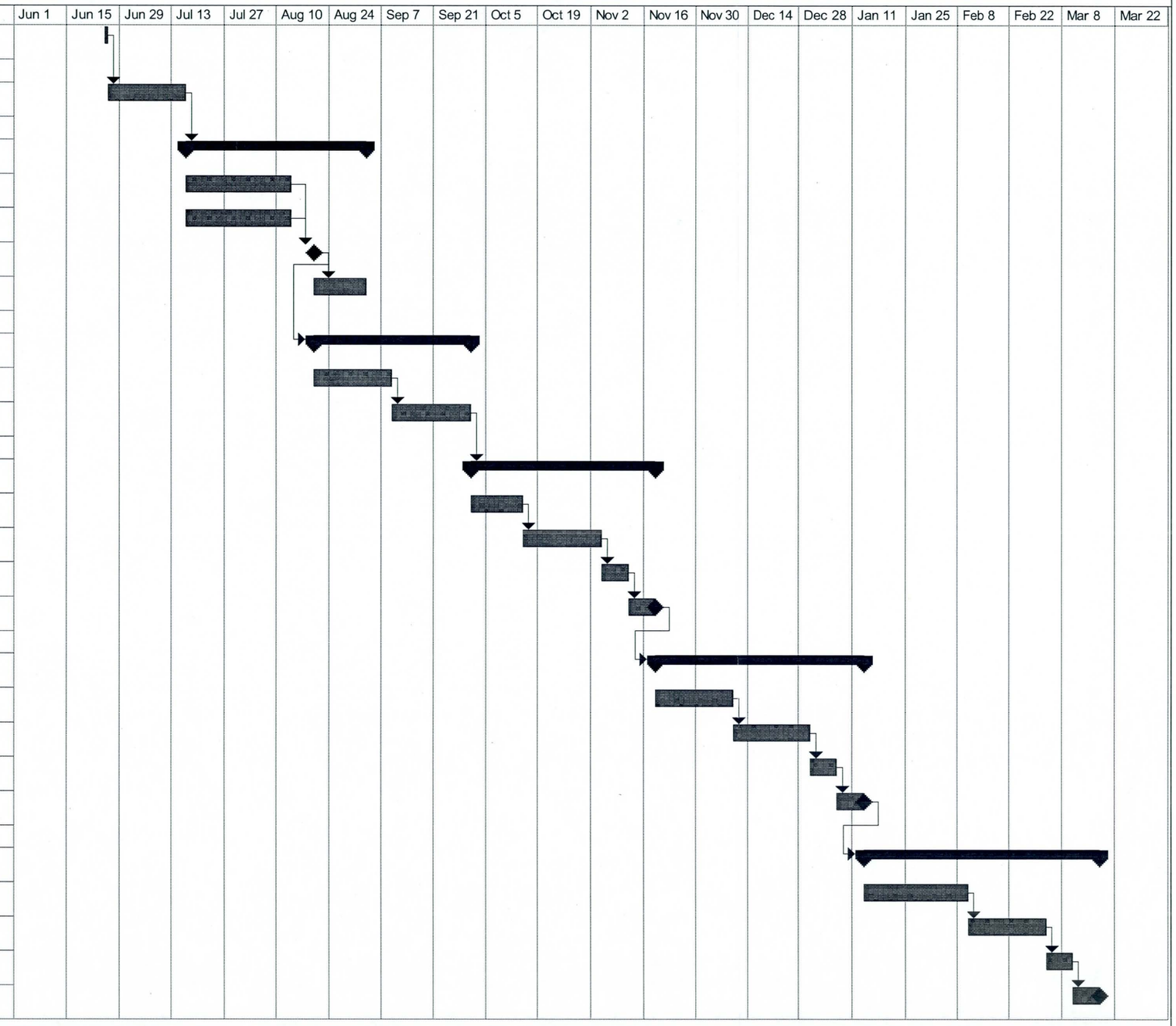
Project Name:	Alta Mira
Property Owner:	371 on 163, LLC
Owner Representative:	Phil Miller, Westpac Development Corporation 7595 East McDonald Drive, Suite 105 Scottsdale, AZ 85250 (480) 889-1999 developaz@gmail.com
Owner Engineer:	George Cannataro, Coe & Van Loo Consultants, Inc 4550 N. 12th Street Phoenix, AZ 85014 (602) 285-4726 gjcannataro@cvlci.com
Happy Valley DCR Representative:	Debbi Shortal Associate Project Manager Planning & Project Management Division Flood Control District of Maricopa County (602) 506-1034 dls@mail.maricopa.gov
Happy Valley DCR Representative:	Jeff Davidson, P.E., CFM Civil Engineer City of Surprise Public Works 16000 N Civic Center Plaza Surprise, AZ 85374 (623) 222-6131 jeff.davidson@surpriseaz.com
Happy Valley DCR Representative:	Kevin Kugler, AICP Director of Planning RBF Consulting 16605 North 28th Avenue, Suite 100 Phoenix, AZ 85053-7550 (602) 467-2249 kkugler@rbf.com

Happy Valley DCR Representative:

Nathan Ford, P.E.
Project Manager
RBF Consulting
16605 North 28th Avenue, Suite 100
Phoenix, AZ 85053-7550
(602) 467-2254
nford@rbf.com

Happy Valley DCR - Project Milestones and Schedule

ID	Task No.	Task Name	Duration
1		**Notice to Proceed Received - June 25**	**1 day**
2			
3	**12.0**	**FCDMC & City of Surprise provide data to RBF**	**3 wks**
4			
5	**12.1 - 12.8**	**RBF Data Compilation**	**6.8 wks**
6		Compile / Review Data	4 wks
7		Site Visits	4 wks
8		Stakeholder Kick-off Meeting	0 days
9		Data Collection Report	2 wks
10			
11	**13.0**	**Baseline Hydrology / Hydraulics**	**6 wks**
12		RBF Preparation	3 wks
13		FCDMC/City of Surprise Review	3 wks
14			
15	**14.0**	**Preliminary Alternatives Formulation**	**7 wks**
16		RBF Preparation	2 wks
17		FCDMC/City of Surprise Review	3 wks
18		RBF makes revisions / updates	1 wk
19		Stakeholder Meeting	1 wk
20			
21	**15.0**	**Proposed Alternatives Analysis**	**8 wks**
22		RBF Preparation	3 wks
23		FCDMC/City of Surprise Review	3 wks
24		RBF makes revisions / updates	1 wk
25		Stakeholder Meeting	1 wk
26			
27	**16.0**	**Recommendation Plan**	**9 wks**
28		RBF Preparation	4 wks
29		FCDMC/City of Surprise Review	3 wks
30		RBF makes revisions / updates	1 wk
31		Stakeholder Meeting	1 wk



Project: Happy Valley DCR
Date: Wed 8/19/09

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

STUDY AREA LIMITS
Bajada Dr
Red Bird Rd
Andrea Dr
Bajada Rd
Beardsley Csr
Jomax Rd
163rd Ave
155th Ave
143rd Ave
160th Dr
Wash 6 East South
Wash 9 East
157th Ave
Reems Rd
Briles Rd
Wash 10 East
El Cortez Pl
147th Ave
Bullard Ave
Wash 11 East (Padelford Wash)
Litchfield Rd
133rd Ave
131st Ave
Wash 5 East
TIERRA VERDE
RANCHO MERCADO
El Granada Blvd
Dysart Rd
Happy Valley Rd (alignment)
San Ysidro Rd
Happy Valley Channel
ALTAMIRA
VERDUGO
EVER-GREEN/ DEVCO
Pinnacle Peak Rd
Planada Ln
Outlet Channel
McMicken Dam
SR 303
Electra Ln
Junipero Dr
Figueroa Dr
Grand Ave
BARCLAY
Tomahawk Wy
Las Brizas Ln
Robertson Dr
Vega Dr
Arrellaga Dr
Williams Dr
Gunsight Dr
Montego Dr
Parada Dr
Heritage Dr
Mission Dr
Deer Valley Dr
SR 303 SR 303

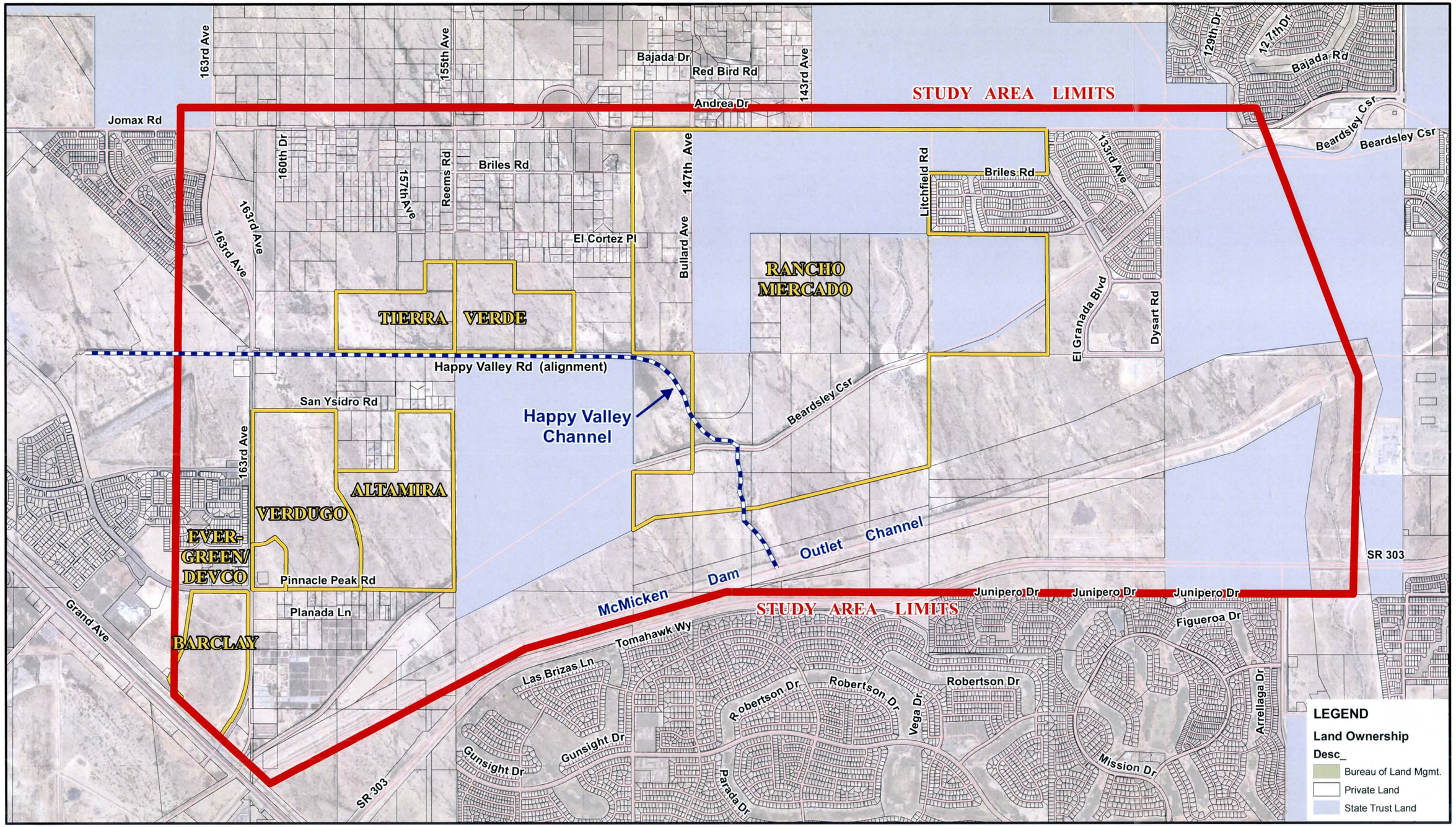
LEGEND
FEMA Floodplain
Zone
A
AE
FW
X1

N
0.5 0.25 0 0.5 1 Miles

Happy Valley Drainage DCR

Existing FEMA Floodplain

Date 8.18.09



N

0.5 0.25 0 0.5 1 Miles

Happy Valley Drainage DCR

Land Ownership

Date 8.18.09

STUDY AREA LIMITS

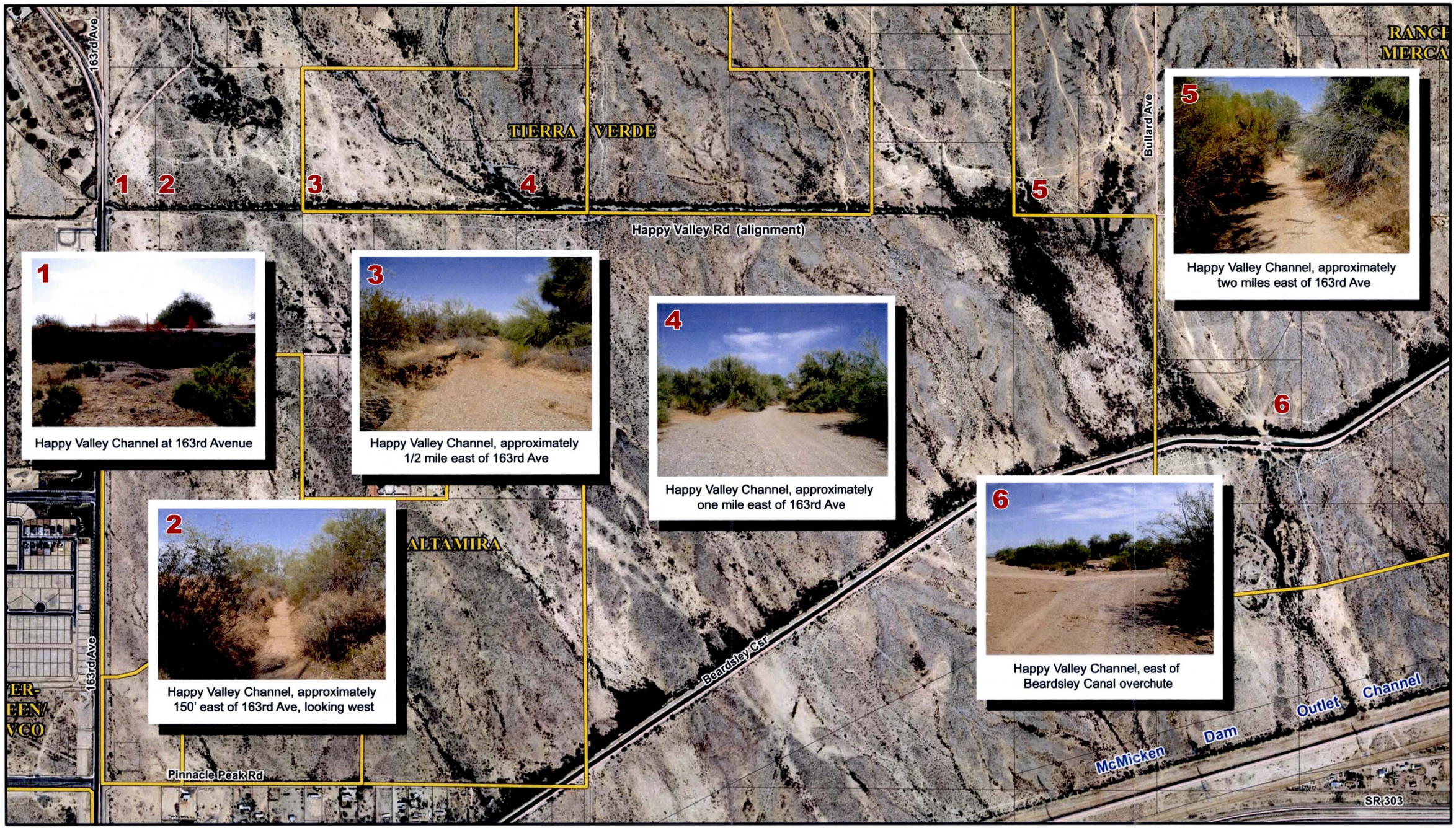
Jomax Rd
163rd Ave
160th Dr
157th Ave
155th Ave
Reems Rd
Briles Rd
Bajada Dr
Red Bird Rd
Andrea Dr
143rd Ave
Bullard Ave
El Cortez Pl
Litchfield Rd
Briles Rd
133rd Ave
127th Dr
Bajada Rd
Beardsley Csr
Beardsley Csr
El Granada Blvd
Dysart Rd
TIERRA VERDE
RANCHO MERCADO
Happy Valley Rd (alignment)
San Ysidro Rd
Happy Valley Channel
Beardsley Csr
ALTAMIRA
VERDUGO
Pinnacle Peak Rd
Planada Ln
WWTP
Outlet Channel
McMicken Dam
SR 303
Electra Ln
Junipero Dr
Junipero Dr
Junipero Dr
STUDY AREA LIMITS
Figueroa Dr
Grand Ave
BARCLAY
Tomahawk Wy
Las Brizas Ln
Robertson Dr
Robertson Dr
Robertson Dr
Vega Dr
Arrellaga Dr
Williams Dr
Gunsight Dr
Gunsight Dr
Mission Dr
Beardsley Csr
SR 303 SR 303
Montego Dr
Parada Dr
Parada Dr
Deer Valley Dr

LEGEND
- Regional Trail
- Community Trail
- Local Trail
- Sewer Line
- Wastewater Treatment Plant (WWTP)

N
0.5 0.25 0 0.5 1 Miles

Happy Valley Drainage DCR
Opportunities & Constraints

Date 8.18.09



N

0.25 0.125 0 0.25 0.5 Miles

Happy Valley Drainage DCR

Happy Valley Channel Character

Date 8.18.09

SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY CHANNEL DCR
STAKEHOLDER KICK OFF MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

August 20, 2009
9:00 am – 11:00 am
FCDMC – New River Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Brian Rahal, DEI
Hal Marron, DEI
Rich Hoppe, DEI
Paul Siders, CVL
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Stuart Barney, Evergreen DevCo
Anthony Sumner, Sandbox Development
Ricardo Aguirre, CVL
Jeff Davidson, City of Surprise
Jon Loxley, FCDMC
Greg Jones, FCDMC
Amir Motamedi FCDMC
Debbi Shortall, FCDMC
Scott Vogel, FCDMC
Kevin Kugler, RBF
Nathan Ford, RBF

I. Introduction & Welcome

Ms. Shortal, the FCDMC Project Manager welcomed the group and asked everyone to introduce themselves. Ms. Shortal noted that the purpose and intent of the Happy Valley DCR project was to evaluate the current discrepancies with the various hydrology studies in the area and to develop a regional solution that brought the greatest benefit to the greatest number of stakeholders in a cost effective manner.

II. Project Stakeholder Contact Information Confirmation

Mr. Kugler, the Consultant Project Manager was introduced and asked the attendees to review the information on the contact list provided and to make any changes or additions in order to have one complete contact list.

III. Project Overview and Schedule

Mr. Kugler directed the group's attention to the project schedule provided and he proceeded to review the individual tasks and project schedule. He suggested that, though not identified on the project schedule, there will be an opportunity to meet and discuss the results of the hydrology data review/modeling identified in Task 13 of the project scope. Mark Voigt and Hal Marron both reminded the group that it will be important to recognize the need for the improvement of Happy Valley Road and how that will influence the development of alternatives and conclusions brought forth in this project. Mr. Kugler noted that Happy Valley Road is designated as a minor arterial roadway with a 110-foot right-of-way.

IV. Summary of Project Objectives and Preliminary Findings of Fact

Mr. Kugler reiterated Ms. Shortal's earlier comments regarding the project's purpose and intent. Mr. Kugler encouraged an interactive dialogue and that garnering feedback from them, the "experts" who have been working on these issues for quite some time would be critical at this kick off stage of the process. Mark Voigt asked if RBF had obtained all the information necessary to complete the project. Mr. Kugler responded that indeed we believe we have all the information with the exception of a HEC-1 model from Rancho Mercado and the Asante projects but that their HEC-1 models were not a focus of the project scope.

Mr. Kugler then told the group he was going to summarize the nature of the competing hydrology studies and informed the group that, once he had completed his review of the project study area, summary of existing conditions, and each stakeholder project development status, each stakeholder would have the opportunity to identify, 1) Any missing links in the data presented, 2) Individual project goals, and 3) Concerns or issues of awareness.

Mr. Kugler noted that the Wittmann Area Drainage Master Study Update (WADMSU) was completed in July of 2007 and that the existing condition hydrology was either incomplete and/or inaccurate. The WADMSU did not include or contemplate the Happy Valley Channel/berm in its analysis/modeling. Zone AE Floodplains were delineated north of the Happy Valley Channel (limits of the AE study) and the Zone A "blob" as it is often referred to as remains south of the Happy Valley Channel.

The Wittmann Area Drainage Master Plan (WADMP) was completed in June of 2009. The WADMP utilizes the existing conditions hydrology from the WADMSU. The WADMP conducted a visual character assessment, identified flood control alternatives, selected a preferred alternative and looked at various wash and channel hydraulics. The preferred alternative developed in the WADMP did identify the Happy Valley Channel as a component of the preferred alternative but also identifies regulatory floodplain south of the Happy Valley Channel.

Mr. Kugler then went on to summarize the two competing hydrology reports representing developer projects in the area.

The Tierra Verde drainage report/CLOMR request is dated October 2007 and was prepared by CVL. The report's hydrology modeling is patterned after the WADMSU hydrology whereby the Happy Valley Channel is not acknowledged. The report

suggests that drainage in the area be returned to its historic flows by modifying the floodplain to redirect the flows of Wash 6 East to be combined with the Wash 9 East flows, ultimately discharging at Happy Valley Road (alignment) just west of the 155th Avenue alignment. Tierra Verde has a letter from the USACOE indicating that there are no regulatory waters of the United States and therefore the project is not subject to the provisions of Section 404 of the Clean Water Act.

The Verdugo and Alta Mira projects (formerly known together as "Pinnacle Peak Estates") conducted a drainage study completed in June of 2008 and was prepared by DEI. This report basically suggests that the WADMSU incorrectly omitted the channel from the analysis and that although the berm along the south side of the Happy Valley Channel is not a certified levee, the channel itself has existed since 1942 and the capacity of that channel should be a contributing factor in capturing a portion of the upstream flows and thereby reducing the downstream regulatory floodplain burden. The DEI report then assessed the levee and non-levee conditions and updated the area hydrology model to demonstrate what they purport to be a more accurate assessment of the existing conditions hydrology in the study area.

Mr. Kugler briefly noted that the Rancho Mercado project has not been a primary focus of the data review since the nature of the project dilemma was essentially between the conflicting CVL and DEI studies. Mr. Kugler also noted that this project was not going to answer the questions as to what is defined as "historic flows". Greg Jones added that this project was going to analyze existing flow conditions and if the question of historic flows was an issue for the stakeholders, they would have to work that out amongst themselves.

Prior to each project taking its turn to identify issues, Paul Kroff inquired about other project stakeholders, notably the ASLD. The group identified the following properties that could be included or notified at key project milestones as decisions made with and through this process may impact their property.

1. ASLD – large land holdings between the Alta Mira and Rancho Mercado projects
2. Handful of long-time property owners at the southeast corner of 163rd Avenue and Happy Valley Road.
3. Maricopa Water District (Beardsley Canal)
4. Property owners south of the Verdugo and Alta Mira projects
5. Asante Project just west of 163rd Avenue
6. Culverts located at the Jomax Rd./163rd Avenue intersection (existing noteworthy condition, no notification necessary)
7. Desert Oasis project near the northwest corner of 163rd Avenue and Happy Valley Road

Jon Loxley pointed out the ownership map identified BLM land in the legend but none was shown in the project study area.

Each project was then asked to provide input based on the three questions previously identified.

Alta Mira

- ► 178 acres, 534 single family detached and cluster units proposed
- ► PAD zoning application currently under city review

Ricardo Aguirre confirmed the project facts as presented and suggested that their desire is to develop a solution whereby the project can develop in a stand-alone fashion and not rely upon others.

Rancho Mercado

- ► zoning approved from city for approximately 5,000 residential units
- ► had a preliminary plat for approximately 1000 lots that is on hold pending the outcome of this study

Charlie Caldwell added that the drainage study for Rancho Mercado utilized the hydrology from the WADMSU and that their drainage study concluded that there are no flows in Happy Valley Channel impacting his property.

Tierra Verde West & East

- ► Tierra Verde East (Voyager)– zoned for 259 residential units, has an approved preliminary plat and has final plat and construction drawings submitted and under city review.
- ► Tierra Verde West (Woodside) - zoned for 295 lots with an approved preliminary plat and has final plat and construction drawings submitted and under city review.

Mark Voigt confirmed the facts as presented and added that the Happy Valley Road is necessary to the development of Tierra Verde and to Rancho Mercado and must be taken into account in this study. Paul Kroff echoed Mr. Voigt's sentiments and added that there are three roadway connections into Tierra Verde from Happy Valley Road and the inclusion of any wash crossings would make those crossings very expensive, the cost of which had not been previously contemplated.

Verdugo

- ► Recently received zoning approval from the city for up to 641 residential units with supporting Neighborhood Commercial and Professional Office land use components.

Anthony Sumner added that he desires the Verdugo project to be able to move forward in a stand-alone fashion and not rely upon others. This drainage issue must be figured out first prior to moving forward with the preparation of a preliminary plat. Mr. Sumner suggested that the Verdugo project was not as concerned with the alignment of the Happy Valley Road alignment because the Verdugo project was not dependent upon Happy Valley Road for vehicular access.

Evergreen DevCo

Stuart Barney confirmed that they own the commercial corner at the northeast corner of 163rd Avenue and Pinnacle Peak Road and that Walgreens has purchased a pad on the site. He does not want to see additional flows to his site. He added that any increase in flows received to his site will disproportionately add to the burden of his site due to its small size.

City of Surprise

Jeff Davidson added that the City of Surprise is seeking a solution that is the best fit for all parties and meets the city's needs. He desires to see all projects have the ability to develop.

FCDMC

Jon Loxley stated that there needs to be a thorough review of the multi-use trail functions identified and reviewed with each alternative in accordance with FCDMC guidelines. He added that not only should the flood control function be a priority in the solution, but the aesthetics and "feel" of the channel should be consistent with the city's goals for the area, adjacent planned communities and the District's policies.

Greg Jones added that the purpose of this project is to develop a cost effective solution that has tangible regional benefits. He said this project is important to the District which is why a CIP representative was in attendance. He suggested that the economies of scale associated with a regional solution will be more cost effective for all and that no one property owner could or should bear the cost of these improvements alone and that FCDMC was a likely funding partner. Each stakeholder will be asked to contribute their pro rata share in the design solution, but nothing more.

VI. Consideration of Other Project Logistics

Ms. Shortal noted for the group that Kevin and Nathan have visited the site, but another site visit is scheduled and informed the group that they are welcome to attend and that a date and invite will be sent out soon.

Ms. Shortal also surveyed the group as to where they preferred to hold future stakeholder meetings. The group unanimously concluded that future meetings should be conducted at FCDMC offices.

The meeting adjourned at approximately 10:42 am.

SURPRISE
ARIZONA

HAPPY VALLEY DCR
PROGRESS MEETING

October 7, 2009
10:00 am – 12:00 pm
FCDMC – Adobe Conference Room

I. Introduction – *Debbi S.*

II. Project Process – *Kevin K*

III. Data Collection Process Update – *Kevin K.*

IV. Hydrology Report Summary & Findings – *Nathan F.*
- a. Key Assumptions, Data Sources
- b. Methodology – review agreed upon study parameters
- c. Physical Parameters
- d. Problems Encountered
- e. Final Results

V. Stakeholder Review Comments – *Kevin K./Nathan F.*
- ► Group discussion
- ► Identify issues as:

1) Agreed/Resolved
2) Not Agreed/Unresolved
3) Needs further study/clarification

VI. Preliminary Alternatives – *Debbi S./Kevin K.*

VII. Action Items and Next Steps

RBF CONSULTING

SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
PROGRESS MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

October 7, 2009
10:00 am – 12:00 pm
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Brian Rahal, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Stuart Barney, Evergreen DevCo
Anthony Sumner, Sandbox Development
Philip Miller, PM Consultants
Kevin Kamerzell, Atwell-Hicks
Ricardo Aguirre, CVL
John Holmes, FCDMC
Gregory L. Jones, FCDMC
Debbi Shortall, FCDMC
Steven Rogers, RBF
Kevin Kugler, RBF
Nathan Ford, RBF

I. Introduction & Welcome

Ms. Shortal, the FCDMC Project Manager welcomed the group and asked everyone to introduce themselves. Ms. Shortal noted that the purpose and intent of the Progress Meeting for the Happy Valley DCR project was to review any comments or issues on the Hydrology Report findings and to begin to brainstorm ideas for the development of the Preliminary Alternatives.

II. Project Process

Mr. Kugler, the Consultant Project Manager gave a brief update on the progress thus far. Since the initial two week delay in data collection, the project has been on schedule through the completion of the Hydrology Report. Mr. Kugler introduced the notion of including a neighborhood meeting into the process that would allow the opportunity for additional stakeholders/nearby property owners to give and receive input on the proposed alternatives. In order to avoid the timing of this meeting over the Christmas holiday season, it was felt that a mid-January meeting was desired and would thus slide

the schedule back two to three weeks. Mr. Kugler then reminded the group of the next two project tasks to get to that point in the process

III. Data Collection Update

Mr. Kugler gave a brief update on the data collection process, concluding that it appeared that the data collection phase was complete having recently received the Landscape Inventory and Assessment (LIA) report from FCDMC staff. This report provides more detailed information on the landscape, scenery and recreation analyses in the project area. The LIA also provides an overview of flood control structure types, methods and the compatibility analyses among them. Greg Jones inquired on the Data Collection Report status. Ms. Shortal replied that it would be completed next week as the information was just obtained by RBF.

Mr. Kugler then took a brief opportunity to introduce Steven Rogers, RBF's Landscape Architect for this project. Mr. Kugler noted that the inclusion of Landscape Architecture as we begin to develop the Preliminary Alternatives is essential at the onset to ensure a cohesive, integrated, functional and aesthetically pleasing design that meets stakeholder objectives. Mr. Rogers then introduced himself and reviewed his background.

IV. Hydrology Report Summary & Findings

Nathan Ford gave an overview of the Hydrology Report's key assumptions, methodology, study parameters, problems encountered and final results.

V. Stakeholder Review Comments

One question that arose by most stakeholders was the use of the 24-hour event versus the 6-hour event. Mr. Ford indicated that for a variety of reasons, primarily accounting for the inclusion of those flows into our project area from the over chutes of the CAP canal and need to evaluate the "worst case scenario". The use of the 24-hour storm event was mutually determined with direction from FCDMC staff.

Kevin Kamerzell asked if the study identified the need to utilize different n-values based on the varying widths of the channel. Brian Rahal concluded that no field verification was conducted on the topographic data, however the 1-foot contour information provided by CVL was utilized and sufficient for study at that time.

John Holmes concluded that his review of the Hydrology Report found no inconsistencies with reference to any of the Whittmann ADMP data and felt that the report was complete and accurate. No additional comments were provided by the group.

It was determined by the group that all stakeholder comments would be compiled, each with an identified response or resolution and that report would be transmitted out to the group.

VI. Preliminary Alternatives

Ms. Shortal informed the group that the next stage of the process, assuming the hydrology information is complete and understood by the stakeholders, it was time to

begin to brainstorm some preliminary alternatives for this project. Mr. Kugler reviewed the intent and purpose of the Preliminary Alternatives task, noting that six (6) Preliminary Alternatives would be developed, including a no-action alternative. From there, 4 Proposed Alternatives, including the no-action alternative would be synthesized from the six Preliminary Alternatives.

Mark Voigt noted that a group of the developer stakeholders in the area had indeed developed a series of alternatives and asked if that information was received. Mr. Ford confirmed that that information was indeed included as part of the data collection effort. Mr. Voigt suggested that many, if not all of the alternatives require some level of regional coordination and/or financial assistance as no one developer can take on this level of needed improvements.

The group then identified a series of concerns and/or issues to be identified and considered in the development of the Preliminary Alternatives. In no particular order, the following were identified:

Phil Miller

Wants to see a regional solution that can be built/implemented in pieces and in a timely fashion, but does not hold any individual development project hostage.

The Beardsley Canal over chute has a limited capacity and can not handle any additional flows.

Look at shifting Happy Valley Road alignment to the south of the section line and keeping channel in its existing location.

Charlie Caldwell

Wants to stick with the original Whittmann ADMSU findings; maintain flows to the south.

Mark Voigt

Stakeholders have developed several alternatives that should be utilized in developing the six Preliminary Alternatives.

Need guidance from the City of Surprise in determining the Happy Valley Road alignment soon; critical to channel(s) solution.

Leave flows to the south but evaluate Q's with berm and without berm.

Evaluate financing provisions with the City of Surprise; CFD?

Paul Kroff

Should evaluate the shortest distance from "point A to point B" for water conveyance. Evaluate putting water in an improved channel to south. This would reduce the project right of way and construction cost burdens.

Anthony Sumner

Does not want to increase flows to properties to the south above and beyond the existing conditions.

Look at using State Land Department property for potential retention basin - helps reduce the concentration of increased flows that may be a result of a conveyance channel solution.

Look at ADOTs plans for traffic interchange locations along SR 303, look at the timing, funding. Possible use of retention basin in conjunction with construction – joint use facility.

Kevin Kammerzell

Look at directing metered flows south to new over chute at the Beardsley Canal along the eastern property line of the Alta Mira project. Utilize areas of the Alta Mira project already designed to convey and/or retain flows.

At the conclusion of the brainstorming exercise, Ms. Shortal noted that everyone's comments were appreciated and that they will be captured in the meeting minutes and distributed to the stakeholders when available.

The meeting adjourned at approximately 11:32 am.

SURPRISE
ARIZONA

HAPPY VALLEY DCR
PROGRESS MEETING

December 7, 2009
2:00 pm – 3:30 pm
FCDMC Adobe Conference Room

I. Introduction – *Debbi S.*

II. Project Schedule – *Kevin K*

III. Introduction of the Six Preliminary Alternatives – Debbi/Kevin/Nathan
   a. Defining Characteristics
   b. Stakeholder Impacts
   c. Flood Protection Types and Methods
   d. Multi Use Opportunities
   e. Implementation & Cost
   f. Operations & Maintenance

IV. Stakeholder Review & Analysis on the Preliminary Alternatives.
   a. Identification of Additional Opportunities & Constraints
   b. Identification of Other Potential Alternatives/Hybrids for Consideration

V. Stakeholder Ranking of Preliminary Alternatives & Selection of Four Proposed Alternatives

VI. Action Items and Next Steps

DRAFT

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SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
PRELIMINARY ALTERNATIVES EVALUATION STAKEHOLDER MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

December 7, 2009
2:00 pm – 3:30 pm
FCDMC – Adobe Conference Room

Attendees:
Hobart Wingard, City of Surprise
Adam Copeland, City of Surprise
Jeff Davidson, City of Surprise
Charlie Caldwell, William Lyon Homes
Hal Marron, DEI
Brian Rahal, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Stuart Barney, Evergreen DevCo
Anthony Sumner, Sandbox Development
Philip Miller, PM Consultants
Kevin Kamerzell, Atwell-Hicks
Ricardo Aguirre, CVL
Scott Vogel, FCDMC
Gregory L. Jones, FCDMC
Debbi Shortal, FCDMC
Steven Rogers, RBF
Kevin Kugler, RBF
Nathan Ford, RBF

I. Introduction & Welcome

Ms. Shortal, the FCDMC Project Manager welcomed the group. Ms. Shortal noted that the purpose and intent of this meeting was to review the Preliminary Alternatives as presented, agree to the criteria by which the Preliminary Alternatives will be judged and for the group to select four of the alternatives for more in depth analysis as we move the DCR process forward.

II. Evaluation Criteria

Ms. Shortal gave a brief review of the various criteria that will be used to evaluate and rank each of the alternatives. After review of the identified criteria, Ms. Shortal asked for

any questions and sought consensus from the group on the criteria that have been identified. Paul Kroff asked about the exercise of ranking the alternatives. Ms. Shortal responded that we would address the exercise as item #4 on the agenda and that right now she was merely seeking consensus on the criteria used to evaluate each of the Preliminary Alternatives. No other questions or comments were provided.

III. Presentation of the Preliminary Alternatives

Mr. Kugler began his comments by suggesting to the group that the alternatives were carefully created to capture a variety of potential design solutions and that there is clearly no one "silver bullet" solution in this exercise. Mr Kugler also suggested that it may be likely that any one alternative in it's entirety may not be the solution either – in fact, a hybrid solution that incorporates different components of the various alternatives may indeed occur. Mr. Kugler also reminded the group that whatever the recommended solution becomes, this group needs to be prepared to equitably shoulder their share of the design solution, as this process is intended to seek a value-added solution providing the most benefit to the most stakeholders.

Mr. Kugler then presented Preliminary Alternatives 1, 1A, 2, 3, 4, 5 and 6. Mr. Kugler noted recent legal guidance received from the City of Surprise suggests that it is not in the City's best interest (due to increased liability) to entertain a solution that incorporates a FEMA certified berm. Because of increased liability for the city for any solution that would contemplate a FEMA certified berm the Preliminary Alternatives presented today do not incorporate a FEMA certified berm as a component of the alternatives. Mr. Kugler then presented the Preliminary Alternatives, describing each of them by 1) Defining Characteristics, 2) Stakeholder Impacts, 3) Flood Protection Methods, 4) Multi-Use Opportunities, 5) Implementation & Cost, 6) Operation & Maintenance.

IV. Discussion of the Preliminary Alternatives

After the presentation by Mr. Kugler, several members of the stakeholder group asked some questions to clarify or reiterate what was presented. Mr. Kugler and Ms. Shortal each answered those questions.

Mr. Kugler asked the group to provide any additional opportunities or constraints that may have been overlooked. No additional comments were offered. The stakeholders then began an open dialogue primarily between themselves, questioning the various components of the alternatives. As the group walked through the various alternatives, it was concluded that Preliminary Alternative #1A was going to be eliminated for further consideration.

As discussion amongst the stakeholders ensued, two additional hybrid alternatives were developed. Kevin Kamerzell suggested a blending of Preliminary Alternatives #1 and #2 that would include shifting the proposed detention basin on the ASLD parcel from the identified southwest corner to the northeast corner of the ASLD property.

Ricardo Aguirre then suggested Hybrid #2 that consisted of a blend of the Preliminary Alternative #5 (basin north of Happy Valley Road) and the flow split and detention basin

component of Preliminary Alternative #2. The group gave consensus that these two hybrid alternatives were worthy of additional consideration.

V. Evaluation & Selection of the Proposed Alternatives

Ms. Shortal reviewed the Preliminary Alternatives Evaluation Matrix provided to each of the stakeholders. Ms. Shortal gave instructions and asked that each project representative (one only per project), the City of Surprise and the FCDMC staff each rank/prioritize each of the Preliminary Alternatives. Four alternatives, including the No Action Alternative would be moving forward for further consideration as a Proposed Alternative. The next 20 minutes were spent on individual deliberations by the group.

After some additional deliberation by the group and Ms. Shortal's use of the electronic spreadsheet, it was determined in the best interest of the group (due in part to limited time) to tabulate their scores on the Evaluation Matrix and submit their forms to Ms. Shortal. Ms. Shortal then advised the group that she would collect the forms and solicit additional input from her FCDMC colleagues. Once the scores/ranking had been compiled, Ms. Shortal would then provide the information to the stakeholders as the project moves forward to the Proposed Alternatives stage.

The meeting adjourned at approximately 3:43 pm.

SURPRISE
ARIZONA

HAPPY VALLEY DCR
PROGRESS MEETING

February 18, 2010
9:00 am – 10:00 am
F CDMC – Adobe Conference Room

I. Introduction – *Debbi S.*

II. Determination of Four Proposed Alternatives – *Debbi S.*

III. Public Open House Recap – *Debbi S./Kevin K.*

IV. Progress Report on Proposed Draft Alternatives - *Nathan F./Kevin K.*
   a) Hydrology Modeling Summary & Preliminary Findings
   b) Approach and Key Assumptions
   c) Preliminary Channel Cross Sections
   d) Preliminary Basin Cross Sections/Footprints

V. Stakeholder Review Comments – *Kevin K./Nathan F.*

VI. Updated Project Schedule – *Debbi S./Kevin K.*

VII. Action Items and Next Steps

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SURPRISE
ARIZONA

HAPPY VALLEY DCR
PROGRESS MEETING

February 18, 2010
9:00 am – 10:00 am
FCDMC – Adobe Conference Room

I. Introduction – *Debbi S.*

II. Determination of the Four Proposed Alternatives – *Debbi S.*

III. Public Open House Recap – *Debbi S./Kevin K.*

IV. Progress Report on Proposed Draft Alternatives - *Nathan F./Kevin K.*
   a) Hydrology Modeling Summary & Preliminary Findings
   b) Approach and Key Assumptions
   c) Sample of Preliminary Channel Cross Sections
   d) Preliminary Basin Footprints
   e) Next Steps/Timeline
   f) Questions/Discussion

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ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
STAKEHOLDER PROGRESS MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

February 18, 2010
9:00 am – 10:00 pm
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Brian Rahal, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Anthony Sumner, Sandbox Development
Philip Miller, PM Consultants
Ricardo Aguirre, CVL
Scott Vogel, FCDMC
Jon Loxley, FCDMC
John Holmes, FCDMC
Gregory L. Jones, FCDMC
Debbi Shortall, FCDMC
Kevin Kugler, RBF Consulting
Nathan Ford, RBF Consulting

I. Introduction & Welcome

Ms. Shortal, the FCDMC Project Manager welcomed the group. Ms. Shortal noted that the purpose and intent of this Stakeholder Progress Meeting for the Happy Valley DCR project was to recap for the group how the four (4) Proposed Alternatives were derived from the original Preliminary Alternatives and give the group a progress report on the preliminary hydrology and other findings relative to the ongoing development of the Proposed Alternatives.

II. Determination of Four Proposed Alternatives

Ms. Shortal gave a brief recount of the previous Progress Meeting held December 7, 2009 and discussed the final results of the evaluation and stakeholder rankings. Ms. Shortal noted that the existing four Proposed Alternatives being evaluated, including the No Action alternative, were identified based upon the discussion and selection at the December 7, 2009 meeting that evaluated 6 alternatives in addition to the two hybrid alternatives that were identified through group discussion. Ms. Shortal explained that the four Proposed Alternatives were the highest ranked alternatives by the stakeholders and comprise a diverse and mix of project components previously reviewed by the team.

III. Public Open House Recap

Mr. Kugler gave a brief update on the Public Open House that was held on January 14, 2010 from 6-7:30 pm at the Desert Oasis Elementary School. Mr. Kugler noted that about a half dozen interested persons attended the meeting, including Mark Voigt. Attendees were shown a series of boards conveying relevant project information and the alternatives being evaluated. District staff had available a comment sheet in case attendees felt compelled to complete one for added input. Generally, most of the attendees either lived outside the study area or within the study area, but not in close proximity and therefore not impacted/effected by any of the alternatives. One "old timer" who attended had some general observations and complaints regarding localized drainage issues caused, in his mind, by the construction of new city roadway facilities. Otherwise, no other significant input that would influence the development of Proposed Alternatives was offered.

IV. Progress Report on Draft Alternatives

Mr. Ford gave an overview of;

1. Hydrology modeling summary and preliminary findings
2. Approach and key assumptions
3. Sample of preliminary channel cross sections
4. Preliminary basin footprints

After Mr. Ford presented his findings and modeling assumptions, Ms. Shortal responded to a question regarding buffers. Ms. Shortal explained that FCDMC is utilizing buffers on projects and are a component for future cost sharing. Their exact width will need to be determined along with the city, but a reduction could reduce potential District cost sharing. Jon Loxley clarified that there is a District policy that does not allow a tree canopy overhang into a maintenance road and is why the buffer needs to be of sufficient width.

The group collectively questioned and Mr. Ford discussed in more detail the various basin sizes and hydrologic functions in more detail.

Mark Voigt then offered that the stakeholders had been discussing their own alternative that is a hybrid of the various alternatives the RBF and the District have done a good job of bringing forward. Ricardo Aguirre, on behalf of the project stakeholders introduced a preliminary concept they had been working on, including "decision points" that needed additional group evaluation. Mr. Ford and Mr. Aguirre then discussed some of the key modeling criteria and assumptions to ensure that Mr. Aguirre understood what was included in Mr. Ford's modeling efforts since some of the identified flows seemed to vary from those just identified by Mr. Ford.

Mr. Voigt and Ms. Shortal engaged in a dialogue finding a balance on how to fold their newly introduced alternative into the process and how to avoid added project costs, etc. It was discussed that in order for the District to cost share, a dedicated outfall was necessary. Mr. Jones indicated that the District and RBF would take a look at it, discuss it and get back with them and perhaps it could be folded into the process as the final

recommended plan could indeed still consist of hybrid of those alternatives reviewed today.

Mr. Kugler then identified the next steps in the process that included the preparation of an Alternatives Report and a likely target date of the third or fourth week of March for the next stakeholder meeting that would include the selection of the Recommended Plan.

The meeting adjourned at approximately 10:12 am.

SURPRISE
ARIZONA

HAPPY VALLEY DCR
PROGRESS MEETING

April 30, 2010
10:00 am – 11:00 am
FCDMC – Adobe Conference Room

I. Review and Discussion of Development Consortium Memo – *Debbi S./Kevin K.* (20 minutes)

a) Buffers
b) Sidewalks/Trails
c) Channels

II. Introduction to Five Proposed Alternatives – *Kevin K./Nathan F.* (40 minutes)

a) Plan View Drawings
b) Channel Cross Sections
c) Basin Footprints
d) Opportunities & Constraints
e) Opinion of Probable Cost - Order of Magnitude

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SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
STAKEHOLDER UPDATE MEETING
MARICOPA WATER DISTRICT
FCDMC/CITY OF SURPRISE
RBF CONSULTING

May 13, 2010
1:00 pm – 2:00 pm
MARICOPA WATER DISTRICT OFFICES

Attendees:
Debbi Shortal, FCDMC
Chris Cain, MWD
Jennie Ogden, MWD
KoKo Kristad, MWD
Glen Vortherms, MWD
Nathan Ford, RBF Consulting
Kevin Kugler, RBF Consulting

I. Project Overview

Ms. Shortal opened the meeting by thanking Maricopa Water District (MWD) staff for taking time out of their schedule and for hosting the meeting. Ms. Shortal gave a brief description of the project, discussed stakeholder and City of Surprise collaboration and some of the project background. She then introduced Mr. Kugler to provide a more comprehensive overview of the Happy Valley DCR project. Mr. Kugler then referenced a presentation board to highlight the Happy Valley DCR study area, background information, historic drainage patterns in the area and explained the existing status of the DCR process and next steps in the DCR process.

II. Hydrology and Hydraulic Modeling Findings and Assumptions

Mr. Ford led an overview of the hydrology and hydraulic modeling findings and key assumptions, also linking them to the Wittmann ADMP findings. Mr. Ford reviewed the drainage characteristics and existing conditions in the project area. Mr. Vortherms asked if the study was evaluating areas of ponding and overtopping along the stretch of Beardsley Canal within the study area. Mr. Ford responded that yes, both the existing and proposed hydrologic conditions for the ponding areas and overtopping areas have been analyzed. Mr. Ford also noted the existence of a grade break below the southerly Alta Mira property line. Mr. Ford went on to say that any amount of flows planned among any of the four Proposed Alternatives do not increase or worsen the amount of flows being impounded or overtopped under existing conditions. Mr. Ford continued with discussing the various hydrology and hydraulic characteristics in the study area and the "with berm" and "without berm" scenarios utilized in evaluating the worst case conditions.

III. Alternatives Review

Mr. Kugler led a discussion of the review of the four Proposed Alternatives plus the No Action Alternative. Mr. Kugler generally reviewed the flow characteristics of each alternative, detailed each of the design components and addressed the general character of each proposed channel and basin facility.

IV. MWD Comments, Questions and Considerations

Mr. Vortherms thanked the group for the presentation and began by stating that MWD's objective was to eliminate the overtopping of the Beardsley Canal if possible. He said that the MWD was now delivering water to an Arizona-American Water Company (AAWC) water treatment facility located roughly at Cactus Road along the Beardsley Canal. MWD's arrangement with AAWC brings additional focus by MWD to minimize adverse impacts to water quality where possible and MWD may be willing to participate financially in a design solution that achieves their objectives. The MWD staff collectively referred to similar provisions in the design of the siphon/overchute on the Rancho Mercado property that achieved similar objectives. Mr. Vortherms added that the 300-foot wide inverted siphon and overchute design on the Rancho Mercado project was a $2.5 million that included two, 10-foot ADOT boxes.

Mr. Ford then elaborated on the existing ponding and overtopping conditions in the two locations in the study area previously identified. The group focused the discussion on Alternative #2 in particular. Mr. Kugler noted that the report calls for additional study in these two existing ponding areas to evaluate potential designs that would include a detention basin near the southerly portion of the Alta Mira property or if an additional overchute of the canl here is warranted. Mr. Vortherms replied that the inclusion of an additional overchute in this area is something that was "on the table" for them.

Mr. Ford then asked Mr. Vortherms if the proposed detention basin adjacent to the northern Beardsley Canal bank as shown on Alternative #1 poses any issues or concerns for the MWD. Mr. Vortherms replied than the detention basin location and concept were fine with MWD as long as it was not situated within or negatively impact MWD right-of-way. Ms. Ogden added that the current MWD right-of-way is 139-feet in width with a 69.5 foot half right-of-way.

Ms. Shortal inquired about the stands of dense vegetation associated with the ponding areas along the north side of the Beardsley Canal. Mr. Vortherms said that MWD didn't particularly care about the maintaining or removing of that vegetation as long as it was not in the MWD right-of-way.

Mr. Kugler asked about MWD's position relative to allowing pedestrian access/trails within the Beardsley Canal right-of-way. Mr. Vortherms responded that MWD's position was to prohibit such access and try to work with adjacent landowners to not encourage this access in their residential community designs.

V. Next Steps

Ms Shortal explained that there was planned to be a progress meeting with the project stakeholders for Friday, May 14th and May 24th and that any of the MWD staff were welcome to attend.

Ms. Shortal explained that a selection meeting, picking one Recommended Plan was tentatively schedule for the end of May or sometime in June. Ms. Ogden offered to provide a copy of the canal survey for our records.

The meeting adjourned at approximately 2:15.

SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
STAKEHOLDER PROGRESS MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

May 14, 2010
10:00 am – 11:00 pm
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Hal Marron, DEI
Brian Rahal, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Anthony Sumner, Sandbox Development
Philip Miller, PM Consultants
Ricardo Aguirre, CVL
Kevin Kammerzell, Atwell-Hicks
Manny Patel, ASLD
Jeff Davidson, City of Surprise
John Holmes, FCDMC
Gregory L. Jones, FCDMC
Debbi Shortall, FCDMC
Kevin Kugler, RBF Consulting
Nathan Ford, RBF Consulting

I. Review & Discussion of Development Consortium Memo

Ms. Shortal, the FCDMC Project Manager welcomed the group. Ms. Shortal noted that the purpose and intent of this Stakeholder Progress Meeting for the Happy Valley DCR project was to have a brief discussion and follow up to the developer consortium memorandum as well as to introduce the five Proposed Alternatives.

Ms. Shortal continued to give a brief summary of the issues presented in the developer consortium memorandum primarily relating to channel buffers, side slopes, and cost effective design measures. Ms. Shortal reminded the group that the issue of buffers were a relative concept (in terms of their sizing) and that the buffers themselves were eligible for cost share with the District and was the reason for their inclusion. Ms. Shortal again suggested to the group that the District was not going to dictate precise buffer requirements as that was up to each developer to work out with the City of Surprise for their respective projects.

Mr. Kammerzell inquired on the status of the hydrology comments. Mr. Ford responded that the comments were completed in January and he would verify with District staff that they were finalized.

Mr. Miller asked if, at the end of this process, that he or any other developer would be able to proceed forward with developing their site without inclusion in the "regional solution". He wants to have lots ready in preparation of the residential real estate market returning and fears this process may not allow him to achieve that. Mr. Davidson responded that yes, Mr. Miller could move forward but the costs will be much higher as designs for storm water conveyance will have redundancies and inefficiencies.

Mr. Sumner asked if the basins were planned to be permanent and if they were going to be landscaped. Mr. Kugler responded that since the City has not identified the need for a park facility in this area the basins were intended to be landscaped with a natural Sonoran Desert landscape materials palette. Mr. Ford responded that each basin was designed to be permanent.

Mr. Voigt then inquired as to why, if the buffers were going to be dealt with on a case by case basis, did they have to be uniformly illustrated at 40-feet when, in his opinion, the channel itself serves as a buffer and lots adjacent to the wash would be sold at a premium. The buffer, as shown, is consuming developable land and reducing his lot count. Ms. Shortal suggested that the inclusion of buffers was per the District's policy however the exact width of the buffer will be determined by the City of Surprise and more thoroughly addressed at the Recommended Plan stage. Mr. Jones asked the group to look at the buffers as a percentage of the overall whole project costs. So, if the existing 40-foot buffers are thought to be 10% of the overall project cost and the buffers are reduced, your percentage of the overall project cost will be reduced accordingly.

Mr. Miller then asked that if the buffers were going to be determined on a case by case basis with the City of Surprise, why does this buffer need to be in the report. Ms. Shortal again replied that it is District policy and that there is a potential for District cost sharing for the buffers.

Mr. Sumner pointed out that each individual project will likely have a different set of circumstances and requirements. In places where the subdivision perimeter has open space tracts adjacent, perhaps the use of a buffer becomes duplicated open spaces and unnecessary. In circumstances where the channel is internalized within the development, perhaps larger buffers are not needed. Mr. Davidson reiterated Ms. Shortal's remarks by indicating that each development project will be handled on a case by case basis and agreed that there was not likely to be a one-size fits all approach to the channel buffers. Mr. Sumner asked for a "note" or "asterisk" in the plan to account for such an acknowledgement. Mr. Jones said that would be fine and asked Mr. Sumner to draft the footnote. Mr. Sumner agreed to do so.

II. Introduction of the Five Proposed Alternatives

Mr. Kugler gave an overview of each of the five Proposed Alternatives, including the No Action alternative. Mr. Kugler referred to the plan view drawings while he gave a synopsis of each alternative's general design characteristics and functions, sizes and flow characteristics. Mr. Kugler also made observations relative to each alternative's

opportunities and constraints, operations and maintenance pro's and con's and rough order of magnitude cost estimates.

Mr. Patel noted that the ASLD would not look favorably upon Alternative's #2 and #3. He also noted that Alternative #4 has the most merit and that Alternative #1 could perhaps work. Mr. Patel suggested that he is the only ASLD staff to have reviewed the information thus far and that he had a meeting scheduled with the Planning and Sales/Leasing Departments to review these alternatives in more detail and may have some additional feedback at the conclusion of those internal meetings. Mr. Patel also noted that the ASLD preference would be to include any onsite retention storage needed for their parcel to be factored into the sizing and design of any basin proposed upon ASLD property. Mr. Davidson responded that the City of Surprise policy currently does not permit the co-mingling of onsite and offsite flows.

Mr. Voigt asked about the possibility of a certified levee on the south side of Happy Valley Wash. Mr. Patel noted that he also inquired about the possibility of a levee in his meeting with District staff. Mr. Davidson reminded the group that the levee must be constructed to FEMA certified standards and sponsored by a governmental agency. The City of Surprise nor the District is willing to be the sponsor agency primarily due to liability reasons.

Mr. Aguirre asked Mr. Patel if the ASLD would advocate the use of interim basins. Mr. Patel said that the ASLD would not advocate the use of interim basins due to liability reasons and complications arising when development parties change, etc.

Mr. Kroff asked if the District would be willing to consider a "no touch" alternative whereby the existing Happy Valley Wash alignment remained in it's natural condition. Ms Shortal responded that it is appropriate for the process to develop a hybrid approach to what has been identified to date.

III. Next Steps

Ms. Shortal suggested that the process will not lend itself to a Selection Meeting on May 24th, but thought that it would be useful to have another progress meeting that focused on the hydrology. This meeting is scheduled for Monday, May 24, 2010 at 10:00 at District offices.

Ms. Shortal told the group that a Selection Meeting to identify the recommended Plan will likely be scheduled for sometime in mid-June and that the stakeholders will receive the materials, included Opinion of Probable Cost estimates at least one week prior to that scheduled meeting

The meeting adjourned at approximately 11:10 am.

SURPRISE
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HAPPY VALLEY
DESIGN CONCEPT REPORT

EXISTING & PROPOSED HYDROLOGY UPDATE MEETING
FCDMC/CITY OF SURPRISE/PROJECT STAKEHOLDERS
May 24, 2010
10:00 am – 11:15 am

AGENDA

I.	**Wittmann ADMSU Framework Summary**	*5 minutes*
II.	**Re-Visit & Synopsis of Existing Hydrology Results**	*15 minutes*
III.	**Review Responses to Stakeholder Comments**	*20 minutes*
IV.	**Review Proposed Alternative Hydrology**	*35 minutes*

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ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
EXISTING & PROPOSED HYDROLOGY UPDATE MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

May 24, 2010
10:00 am – 11:15 am
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Brian Rahal, DEI
Hal Marron, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Anthony Sumner, Sandbox Development
Manny Patel, ASLD
Philip Miller, PM Consultants
Ricardo Aguirre, CVL
Scott Vogel, FCDMC
John Holmes, FCDMC
Debbi Shortal, FCDMC
Kevin Kugler, RBF Consulting
Nathan Ford, RBF Consulting

I. Wittmann ADMSU Framework Summary

Mr. Kugler briefly welcomed the group and noted that the purpose of today's meeting was to re-visit the existing hydrology findings and assumptions, review the responses to the stakeholder questions on the hydrology report/model and examine the findings relative to the proposed conditions hydrology for each of the four Proposed Alternatives plus the No Action Alternative. Mr. Kugler then turned the time over to Mr. Ford as the majority of this meeting was going to be his focus.

Mr. Ford then briefly recapped the Wittmann ADMSU findings pertinent to the Happy Valley DCR study area. Referencing the map and table handouts, Mr. Ford reviewed the sub-basins and how those sub-basins were modified for this study. Mr. Ford also reviewed and concluded that the Wittmann ADMSU did not acknowledge the existing Happy Valley channel and as a result, no flows were identified as being conveyed (berm or no berm condition) in the Happy Valley channel and is in part the reason why the Happy Valley DCR study was needed.

II. Re-Visit & Synopsis of Existing Hydrology Results

Referencing the handouts, tables and presentation boards, Mr. Ford began to re-cap the existing hydrology report findings that have been submitted since September of 2009.

Mr. Ford first pointed to Concentration Point CPI 612 that identified the existence of a flow split of Wash 6 & 9 that was previously identified in the Wittmann ADMSU and the easterly conveyance of these flows versus the southerly conveyance of these flows represents a key difference/change between the Wittmann ADMSU and the Happy Valley DCR existing hydrology results. Mr. Ford noted that there is approximately 1,406 cfs at this point with approximately 1,055 breaking out and conveyed to the south.

Mr. Ford went on to explain that the existing hydrology for the Happy Valley DCR included the modeling of flows for a "berm" and "no berm" scenario to evaluate the full range of "worst case scenarios" that really speaks to the nature of this study.

Mr. Ford, referencing the table provided, then spoke more specifically to Concentration Points CPI 606, CPI 609 and the various differences in their flow rates between the "berm" and "no berm" scenario and how these variations impact each of the various stakeholder projects.

Mr. Ford explained that RBF utilized the DEI HEC RAS model that included the 100-year, 6-hour storm events west of 163rd Avenue and incorporated the 100-year, 24-hour storm figures from the flow split to the east per District guidance. Mr. Marron asked if RBF kept the upstream flow split. Mr. Ford responded yes.

Mr. Ford, again referring to the provided table of figures, explained that the overall controlling variable was the maximum flows at the Beardsley Canal overchute at Concentration Point CPI 603. Mr. Ford concluded the existing hydrology discussion by comparing Concentration Points CPI 603 and CPI 624 by indicating that with both points more flows were conveyed to the east under the "with berm" scenario and more flows occurred to the south under the "no berm" scenario. When asked if any of the stakeholders had any additional questions or comments, none were posed.

III. Review Responses to Stakeholder Comments

Mr. Ford then referred to the Stakeholder Comment Matrix handed out to the group. Mr. Ford identified each comment and the RBF response to each.

Comment #1
Mr. Ford summarized the comment and response and no additional questions were asked by the stakeholders.

Comment #2
Mr. Ford summarized the comment regarding the use of NOAA 2 vs. NOAA 14. Ms. Shortal explained that NOAA 2 figures were utilized in order to maintain consistency with the Wittmann ADMSU models and that the overall differences between the NOAA 2 and NOAA 14 numbers for this area were negligible.

Comment #3
Mr. Ford summarized the comment and response and no additional questions were asked.

Comment #4
Mr. Ford summarized the comment and response and no additional questions were asked.

Comment #5
Mr. Ford summarized the comment and response and went on to suggest that the differing velocities will be incorporated and further evaluated in the Recommended Plan stage of the project.

Comment #6
Mr. Ford summarized the comment and response regarding varying velocities to be used in the HEC RAS model. Mr. Kroff asked what if we don't change the existing conditions–would that be a problem for the District or the City? Velocities could be as high as 7 to 9 feet per second. Mr. Voigt went on to ask about the existing conditions, using 4 feet per second plus a soils analysis is probably needed to confirm. Mr. Vogel suggested that the City nor the District have any ownership of this property so there is no need for the District to do anything. The District will review the results of this DCR study and take the information into account. Mr. Davidson added that he knows what the stakeholders are getting at...if they don't want to change the velocities, then perhaps no change could occur, but should be further evaluated once each developer is ready to submit improvement plans.

Comment #7
Mr. Ford summarized the comment and response and went on to suggest that RBF can extend the cross sections if the group desires, but the information was requested previously and not provided by DEI. Mr. Vogel suggested that extending the cross sections probably makes sense. Mr. Rahal suggested that DEI did not have authorization from their client to incur the costs to assemble the requested data. Mr. Aguirre indicated that CVL has the topographic data and will forward that data if it will benefit the project. Mr. Ford said he would follow up with Mr. Aguirre to obtain the data.

Comment #8
Mr. Ford summarized the comment and response regarding the weir coefficient of 2.8 being assigned and that it was maintained from DEI's HEC RAS analysis. Mr. Marron agreed that the coefficient of 2.8 assigned for lateral weirs was within the accepted realm for weirs.

Comment #9
Mr. Ford pointed out that this comment was the same as comment #3 and suggested the group move along. No additional comments were provided.

Comment #10
Mr. Ford summarized comment #10 regarding the need to check channel width and dimension routing. Mr. Ford concluded by reiterating that RBF will check to verify and modify the response comment accordingly.

Comment #11
Mr. Ford briefly summarized the comment regarding the parameters the District gave RBF in evaluating "existing conditions" of development versus that of "future conditions". Mr. Aguirre added that it had been some time since this comment was made and that he felt it had been addressed previously and offered no additional comments.

Comment #12
Mr. Ford reiterated comment #12 and pointed out that, as previously discussed with the stakeholder group, the 100-year 24 hour storm event was used to conform with District policies based on the size of the watershed that includes contributing flows from north of the CAP canal. The 100-year, 6-hour storm event was used on the Asante flows as they were found to be higher using the 6-hour event. Mr. Patel questioned if the volumes were different. Mr. Ford and Ms. Shortal both responded that yes the volumes were different.

Comment #13
Mr. Ford briefly summarized this comment regarding the "functional" berm. Ms. Shortal suggested that the existing berm and its "functional" characteristics will be amplified in the report. Mr. Patel questioned how the "functional" berm impacted the modeling of existing conditions, particularly in the breach areas and how erosion was addressed.

Mr. Aguirre then questioned how the model factored erosion in the channel – were higher velocities of up to 7 feet per second evaluated? He continued to ask what was the starting point and was it reviewed equitably? Mr. Marron responded that review of historical aerial photographs over the past 20 years indicate that vegetation in the channel has stabilized over time. He continued by adding that the HEC RAS model does not capture the decrease in velocities based on the corresponding increase in vegetation. Mr. Aguirre responded by suggesting that he believes the H&H modeling for this project should explore how velocities of 7 to 10 feet per second impacts this area. Mr. Ford concluded that RBF is tasked with evaluating varying velocities in the Recommended Plan stage and that further soils investigations will also influence these factors and H&H findings.

Comment #14
Mr. Ford reiterated what was already discussed in comment #12 – yes, contributing flows north of the CAP were included in the HEC-1 model and that all inflow hydrographs matched and nothing changed from the Wittmann ADMP.

Comment #15
Mr. Ford summarized the comment regarding clarification of channel reaches and routing names being illustrated upon a map. Mr. Ford responded that RBF can clarify in the notes. Mr. Aguirre said he thought the comment was handled.

Comment #16
Mr. Ford addressed this comment relating to flowrate estimates and concluded that RBF will include further clarification in the final report.

Comment #17
Mr. Ford summarized this comment that suggested that an updated floodplain delineation be shown and how that would illustrate the flow splits more naturally. Mr. Ford responded that a new floodplain delineation was not included in the project scope. Mr. Holmes added that the report should perhaps explain in more detail how the flow splits were developed and how they are shown.

Mr. Aguirre added that CVL has run a Flow 2D model for this area. He suggested that he wanted to ensure that everybody was equitably treated and wanted to analyze it from a grander scale. He noted that he would be happy to share his findings with the group if

they so chose. Ms. Shortal added that RBF will expand its response on this issue for the final report.

Comment #18
Mr. Ford reiterated that his comment relating to the use of the 100-year, 24-hour event versus the 100-year, 6-hour event has already been addressed. No other questions or discussion occurred.

Comment #19
Mr. Ford summarized the comment and response by suggesting that the contributing drainage areas were manually "hard coded" for concentration points downstream of diversions. He concluded his comments by adding that RBF will provide additional explanation of this fact in the final report.

Comment #20
Mr. Ford summarized the comment relating to page 6, paragraph #4 needing further clarification and perhaps an exhibit to illustrate the point being conveyed. Ms. Shortal added that RBF will re-write this section in order to clarify/explain the problems that were encountered with the HEC RAS modeling of the lateral weirs.

Comment #21
Mr. Ford read the comment that referenced page 6, paragraph 5 of the report. With no other group discussion, Mr. Ford concluded that RBF will remove the paragraph all together to avoid confusion.

Comment #22
Mr. Ford summarized the long comment that captures DEI's review and conclusions of the RBF modeling. The conclusion overall supports RBF's findings, but the question remained what areas were modeled as "developed" versus "undeveloped". Mr. Marron elaborated that the question was simply a matter of passage of time and the recent economic slow down. Mr. Ford added that DEI's model assumed that all of the Asante project was "developed" where RBF modeled the undeveloped phases of Asante as natural desert based on the existing conditions today.

Comment #23
Mr. Ford reviewed this comment that questioned the "breach" in the existing Asante levee and the possibility that perhaps there exists channel capacity for up to 1/3 of the flows that would then contribute to Happy Valley Channel flows to the east of 163rd Avenue. Mr. Ford noted the RBF approach of following the Wittmann ADMSU that identifies all of these flows continuing to the south. He said additional input from District staff will be needed if we vary from the existing approach.

Mr. Marron added that today there is a borrow pit that handles much of these flows since phases three and four of Asante were halted. North of Tillman Road is probably ok where perhaps south may not be. Mr. Holmes suggested that he would like the opportunity to discuss the issue with Amir Motamedi and agreed to follow up with Mr. Ford to provide guidance on this matter.

With no additional questions or comments offered by the group, Mr. Caldwell said that he wanted to reserve the right to provide additional comments on the hydrology report prior to the selection meeting since Mr. Kammerzell was unable to attend and be

available due to health reasons. Ms. Shortal responded that the updated report will be sent out to the stakeholders at least one week in advance of the selection meeting.

IV. Review Proposed Alternative Hydrology

Mr. Ford reminded the group that much of the review of the Proposed Alternative hydrology was introduced and reviewed at the recent Stakeholder Progress Meeting on May 14, 2010. Mr. Ford noted that he would briefly review the alternatives due to limited time and that a quick review could help conclude and link the issues discussed today.

Mr. Ford then gave a brief overview of each of the four Proposed Alternatives plus the No Action Alternative. After Mr. Ford's explanation of Proposed Alternative #4, Mr. Davidson added that a large sewer trunk line is designed and planned for construction along the west side of 155th Avenue, leading to the new wastewater treatment facility to the south.

Ms. Shortal asked Mr. Kugler to discuss next steps and re-cap action items from the meeting. Mr. Kugler reiterated that CVL was going to provide the topographic information to Mr. Ford relative to Comment # 7, Mr. Holmes was going to speak with Amir and provide Mr. Ford guidance relating to comment #23 and RBF was going to provide updates and changes to the final report regarding a handful of comments presented today, particularly relating to comment numbers 10, 13, 15, 16, 17, 19 and 20.

Mr. Sumner asked for an updated schedule to be made available at the next meeting. Mr. Miller added that he was going to be gone the third week in June and requested that the selection meeting not be held that week.

The meeting adjourned at approximately 11:32 am.

SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
ALTERNATIVES EVALUATION AND
PREFERRED ALTERNATIVE SELECTION MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

August 9, 2010
2:30 pm – 4:30 pm
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Hal Marron, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Guy Lake, Sandbox Development
Manny Patel, ASLD
Kevin Kammerzell, Atwell-Hicks
Philip Miller, PM Consultants
Ricardo Aguirre, CVL
Jeff Davidson, City of Surprise
Terry Lowe, City of Surprise
Greg Jones, FCDMC
Scott Vogel, FCDMC
John Holmes, FCDMC
Debbi Shortal, FCDMC
Lynn Thomas, FCDMC
Kevin Kugler, RBF Consulting
Nathan Ford, RBF Consulting

I. Introduction

Debbi Shortal briefly welcomed the group and noted that the purpose of today's meeting was to review the project background, review each of the alternatives and introduce the stakeholders to the evaluation method and then finally to evaluate the existing alternatives and select a preferred alternative to move forward with as a regional project, or perhaps if the stakeholders cannot select a preferred alternative, the project concludes with providing a completed and updated hydrology report for the project area. Ms. Shortal reminded the group that the selection of a preferred alternative is intended to assist the stakeholders, make things more efficient by saving time and money and looking out for the City and District's interests.

II. Agenda Overview & Project Background

Mr. Jones, utilizing a Powerpoint presentation, described the meeting process and intentions in more detail. Mr. Jones first wanted to ensure that all of the stakeholders understood the selection process and criteria. Mr. Jones then gave an overview of each of the alternatives and then focused on matters pertaining to project implementation.

Regarding project implementation, Mr. Jones first pointed out that the District would likely be a 50/50 funding partner with the City of Surprise in any regional facilities that may be contemplated. Mr. Jones elaborated that the City was going to likely look to the development community to come up with their cost share due to lack of municipal funds at this time. Mr. Davidson confirmed that to be the case. Mr. Jones elaborated that these costs can be applied to permits (CLOMR/LOMR), design, construction, and construction management costs. Mr. Jones went on to state that if the stakeholders cannot come together to select a preferred alternative and there is no regional project, updated hydrology will be provided and everybody would be on their own to construct the necessary conveyance facilities.

Kevin Kammerzell asked if there was going to be an update to the hydrology reporting, especially in regards to the n-values and flow splits. Nathan Ford responded that the preferred alternative was going to be evaluated using multiple n-values and that the District is currently completing the field survey work necessary to complete the additional flow split analysis.

III. Consultant Recommendation

Mr. Kugler led the presentation to introduce the criteria that RBF Consulting used in selecting the consultant recommendation, review each alternative and provide the justification for the consultant's recommended alternative.

Mr. Kugler first reminded the group of the project objective that was agreed to at the onset of the process. The project objective is to select a preferred alternative that provided regional efficiencies that was beneficial and equitable for the maximum number of stakeholders as possible. Under that premise, RBF evaluated each of the alternatives in an objective, non-biased fashion using the following four criteria:

1) Alternative Eliminates or Significantly Reduces Floodplain
2) Alternative Complements Community Character
3) Alternative Minimizes Construction Costs/Achieves Regional Synergies
4) Alternative Maximizes Operation & Maintenance Efficiencies

Mr. Kugler suggested that there wasn't a single silver bullet solution and that each alternative had certain advantages and disadvantages but the RBF recommendation attempted to achieve maximum equity and efficiency for the "greater good". Mr. Jones let the stakeholders know that the District did not influence RBF's decision and they had not heard the RBF recommendation.

Alternative #3

Mr. Kugler summarized Alternative and reviewed why Alternative #3 was not selected based upon the four (4) criteria. Alternative #3 is not hydrologically efficient, ASLD

previously voiced their objection, it did not compliment much of the community character, the total linear footage of channels is 16% greater than the preferred plan, high construction and ROW costs, and Alternative #3 is one of the least efficient in terms of operations and maintenance costs. Mr. Kammerzell questioned if RBF evaluated the use of off-line versus in-line basins. Mr. Ford responded that the basins were evaluated using diversions into the ASLD basin. It was agreed this issue would be put in the "parking lot".

Alternative #4
Mr. Kugler noted that this was the hybrid alternative originally introduced by the stakeholders but turned out to be the most expensive. Mr. Kugler summarized why Alternative #4 was not selected as the preferred plan. He noted that floodplain was significantly reduced but at too high of cost, that it was moderately consistent with the community character, it has the most linear feet of channel, the most ROW acquisition costs, the highest O&M and therefore the most expensive alternative overall.

Alternative #2
Mr. Kugler noted that Alternative #2 was appealing from a natural systems perspective, but it was not quite as efficient and effective as Alternative #1. Mr. Kugler also reminded the group that this was the alternative that ranked the highest when the stakeholders voted on the Preliminary Alternatives before Christmas.

Alternative #2 did the poorest job in significantly reducing existing floodplain and additional costs to accommodate the flows at the outfall of Wash 5 and Wash 6 & 9 were not resolved, likely increasing the costs of the alternative with at least one additional overchute and another retention basin likely on the Alta Mira property.

Community character for stakeholders south of the Happy Valley Wash was not complemented with this alternative as the planned channels would bifurcate their parcels in a non-efficient manner. Alternative #2 was the least expensive on paper but did not include the likely costs for additional overchutes. This fact causes us to evaluate the opportunity costs of inefficient land use plans, roads and infrastructure costs that would result from the diagonal bifurcation of the washes upon stakeholder parcels south of Happy Valley Wash. These factors appear, in our opinion, to outstrip the other efficiencies of Alternative #2.

Alternative #1
Mr. Kugler identified Alternative #1 as the consultant preferred plan. Mr. Kulger summarized the reasons by noting that Alternative #1 was the most efficient in reducing the existing floodplain, or "blue blob". Simply put, Alternative #1 represents the smallest floodplain footprint while maximizing the amount of developable property for the vast majority of the stakeholders. Alternative #1 most represents (in part) the original Wittmann ADMP preferred alignment.

Mr. Kugler went on to suggest that Alternative #1 best reflects the community character in the area for all stakeholder properties though the Tierra Verde property was probably carrying the heaviest burden. Verdugo and Alta Mira benefit the most by eliminating their respective floodplains without having to construct facilities. And unless there was a certified levy along Happy Valley Wash, this alternative represents the best case condition for ASLD as well.

Mr. Kugler stated that Alternative #1 was the second least expensive on paper, but at the end of the day, when you add the additional costs not yet captured in Alternative #2, Alternative #1 is likely the least expensive. Alternative #1 had the smallest channel footprint at 12,475 lineal feet and was the second least expensive in ROW costs and was the cheapest in terms of O&M costs, being anywhere from 16% to 30% cheaper than any of the other alternatives and had the greatest ability to transfer these O&M costs to HOA's.

IV. Evaluation

Mr. Jones made some additional comments relative to project implementation. He noted that implementation measures need to be reviewed in more detail, but generally noted that there are several methods for cost sharing – improvement districts, cash and carry and others and the question of how costs would be split among the stakeholders needs to be determined. Mr. Miller asked if there was going to be a "benefitted area" identified at the conclusion of this project. Mr. Jones and Mr. Kugler both noted that could be a possibility if an improvement district or community facilities district were created, but it was not part of the existing project scope at this time. Mr. Jones asked that this issue be put in the "parking lot" as an item for future evaluation and discussion.

Mr. Miller offered an alternative solution for group discussion suggesting that each of the alternatives were very expensive and that there was no ability to include the ASLD in an improvement district to share costs. As a result, he offered that the group should evaluate the possibility of removing the "sugar-dike" or berm along the south side of the existing Happy Valley Channel. Mr. Miller suggested that this in effect would put all of the stakeholders – north and south of the wash – on equal footing with respect to existing conditions and each stakeholder could move forward with their own design solution and not be dependent upon a regional project to increase time and costs.

Mr. Voigt added that if the developers have to cover 50% of these costs for just 1800 acres, they cannot afford to do so. Mr. Miller noted that the bond market was the only viable way to obtain dollars in today's market. He said removing the berm is a regional benefit. After a roundtable discussion, Mr. Vogel concluded by suggesting that it would not make sense for the District to take an action that would knowingly reduce existing flood protection for properties downstream, too much liability etc. Mr. Kammerzell noted that he would not be willing to support such a design. Mr. Marron did note that he probably would support a CLOMR/LOMR for those flows identified for just removing the berm, but no engineer would design it. He noted the "perception of protection" as being fundamentally important. Mr. Vogel and Mr. Jones both added that the District would have to provide an equal protection downstream to account for the loss of the removal of the "sugar-dike" and that it wasn't likely a sellable plan to senior staff of the Board. The notion was added to the "parking lot". Mr. Voigt excused himself to attend a funeral.

Changing gears to the evaluation tool for the selection of the preferred alternative, Mr. Jones began to review the criteria and explained the procedures on how stakeholders needed to cast their vote and that he was going to tabulate the results to be shown on the screen overhead. As the evaluation and ranking process began to occur, more group discussion came forward.

V. Confirmation of Preferred Alternative

Mr. Miller openly suggested that he did not need to go through an elaborate ranking exercise - he thought Alternative #1 and the No Action Alternative were the likely choices here. Mr. Kroff added that he supports Alternative #1 as long as Happy Valley Road can be shifted south of the section line. Mr. Kroff went on by adding that the stakeholders have benefitted from this process – collaboration, talking and that all concerns may not fit in the Alternative #1 "box" perfectly, but the entire process has been helpful and instructive for all the stakeholders.

Mr. Miller noted that he would like the City to consider a smaller cross section utilized for Happy Valley Road or shift the road south of the section line.

Through the discussion, the stakeholders unanimously concluded that Alternative #1 was the Preferred Alternative with the option of still deferring to the No Action Alternative in the event that specific implementation details are unable to be worked out or afforded by the stakeholders. They wanted a "disclaimer" in the final report noting this fact. All stakeholders agreed that there was no reason to formally complete the evaluation matrix since everyone agreed on Alternative #1.

VI. Next Steps

Mr. Kugler passed out the revised project schedule and reviewed the remaining tasks and timelines associated with each. He informed the group that the District was finishing a field survey that would provide additional information for Nathan to complete a more refined analysis of the flow splits that remain a concern to some stakeholders. Mr. Kugler noted that the project was scheduled to conclude in mid-December.

<u>Items Identified for the Parking Lot</u>

1. Benefitted Area
2. Optimization of Basin
3. Rating Table Wash 10 overchute
4. Off line versus on line basins
5. Final Report qualifying No Action Alternative disclaimer
6. Implementation Plan
7. Eliminating Berm
8. Happy Valley Road Alignment Disclaimer

The meeting adjourned at approximately 4:32 pm.

Happy Valley DCR Comment Resolution Meeting
Flood Control District of Maricopa County
December 13, 2010 • 9:00 a.m. - Noon

By the end of this meeting, we will have...A list of concise changes needed in order to finalize the Preferred Alternative Report and the Hydrology Report.

Topic	Desired Outcomes	Who	Time
Welcome/Introductions	An understanding what we're trying to achieve today & how we'll go about it	Greg, Jen	9:00
Overview of Preferred Alternative Report • Hydraulic Analysis • Opinion of Probable Cost	Overview of report content so the group can offer informed comments	Kevin, Nathan	9:10
Overview of Hydrology Report	Awareness of report content so the group can offer informed comments	Kevin, Nathan	9:30
Report Comments & Resolution	A list of concise changes needed in order to finalize the Preferred Alternative & Hydrology reports	All	9:40
Further Considerations for Design & Implementation	A list of implementation considerations to include in the Preferred Alternative Report	All	11:00
Next Steps	An understanding of the action items and the next steps	Greg	11:45
Adjourn			Noon

SURPRISE
ARIZONA

MEETING MINUTES

HAPPY VALLEY DCR
COMMENT RESOLUTION MEETING
FCDMC/CITY OF SURPRISE
RBF CONSULTING

December 13, 2010
9:00 am – 12:00 pm
FCDMC – Adobe Conference Room

Attendees:
Charlie Caldwell, William Lyon Homes
Hal Marron, DEI
Paul Kroff, Woodside Homes
Mark Voigt, Voyager Properties
Anthony Sumner, Sandbox Development
Manny Patel, ASLD
Kevin Kammerzell, Atwell Group
Philip Miller, PM Consultants
Ricardo Aguirre, CVL
Michael Boule, City of Surprise
Terry Lowe, City of Surprise
John Holmes, FCDMC
Greg Jones, FCDMC
Shimin Li, FCDMC
Jen Pokorski, FCDMC
Lynn Thomas, FCDMC
Scott Vogel, FCDMC
Bing Zhao, FCDMC
Kevin Kugler, RBF Consulting
Nathan Ford, RBF Consulting

I. Introduction

Greg Jones briefly welcomed the group and noted that the purpose of today's meeting was to review the Preferred Alternative Report and receive and consider Stakeholder comments. District staff, City of Surprise staff, and the Consultant Team will evaluate the comments and later determine which comments will be accepted, modified or rejected. Greg Jones then turned the meeting over to Jen Pokorski who then reviewed in more detail the meeting agenda, protocol, and instructions for the meeting.

II. Overview of the Preferred Alternatives Report

Mr. Kugler first reminded the group of the project objective that was agreed to at the onset of the process. The project objective is to select a preferred alternative that provided regional efficiencies that was beneficial and equitable for the maximum number of stakeholders as possible. Under that premise, the Project Stakeholders evaluated each of the Proposed Alternatives and selected this Preferred Alternative at the August 9, 2010 Stakeholder Meeting generally based on the following criteria:

1) Alternative Eliminates or Significantly Reduces Floodplain
2) Alternative Complements Community Character
3) Alternative Minimizes Construction Costs/Achieves Regional Synergies
4) Alternative Maximizes Operation & Maintenance Efficiencies

Mr. Kugler then led the overview of the contents of the Preferred Alternative Report. Being that the Stakeholders received the report and reviewed its contents prior to the meeting, Mr. Kugler provided a brief summary of the contents, emphasizing the design components of the Preferred Alternative, highlighted the inclusion of the new "hydraulic iterations", slight change to the opinion of probable cost, and the 15% conceptual plan drawings.

Mr. Kugler noted that an entire new section of the report was dedicated to additional hydraulic analysis of the Preferred Alternative that evaluated permissible velocities, equilibrium slope, sediment yield and scour depth. Mr. Ford will be reviewing those findings in more depth shortly. Mr. Kugler went on to say that no changes were made to the landscape theming or multi-use opportunities. He went on to note that the opinion of probable cost was reduced by approximately $1.4 million that was attributable to a reduction in landscaping costs associated with the bottom of the detention basin that was agreed to be maintained in a native condition. Mr. Kugler completed his summary by noting that a new section of the Preferred Alternative Report – Further Considerations for Design Implementation has been added. This section attempts to identify issues that will require further examination in the design stage and/or issues or stakeholder coordination and implementation that should be addressed prior to design.

Nathan Ford then provided a summary overview of the additional hydraulic analysis performed on the Preferred Alternative. Mr. Ford noted added discussion on Concentration Point 624C where a breach in the berm was previously identified and how that breach influences previous hydrologic studies and resulting impact on the Happy Valley Channel. Mr. Ford went on to discuss the addition of 7 new basins and some observations relative to Asante Phase I and II study findings. Hal Marron commented and inquired on the finings relative to CP 624C and the comparison of model finding differences between the 100-year 24 hour event and the 100-year 6 hour event.

III. Report Comments & Resolution

Mr. Jones led off the comment review portion of the meeting by suggesting that the group start with a focus on any comments relating to the hydrology reporting/modeling. Once comments have been received and discussed on the hydrology the group discussion will focus on the Further Considerations for Design and Implementation portion of the report. The following reflects a listing of comments, questions or

observations identified for response, clarification or inclusion into the report by the Stakeholders. The listing below are the comments as received and recorded during the meeting and in their "raw" documented form throughout the Stakeholder dialogue. The Stakeholder comment or question is followed by the response or report modification action item (in *italics)* suggested at the meeting.

Hydrology

1. What storm event was used? Why not 100-year 6-hour?
   Discussed on several occasions; noted as such in report.

2. Concern regarding flows at C624
   Further discussion outlining the discourse on this issue will be amplified in the Preferred Alternative Report. Future conditions hydrology will be updated to eliminate the breach in the Asante berm as a result of the development of Asante Phases III and IV. Existing conditions hydrology will remain unchanged.

3. Consistency storm event with FIS
   The Wittmann ADMS and ADMSU provided guidance on this issue and was followed for this Happy Valley DCR.

4. CPI603 – weir crossing, look at discharge/rating curve
   It was agreed that Nathan would follow up and include a provision in the Further Considerations for Design" section of the Summary Report.

5. Routing length short vs existing routing length, HVC 1, 2 – evaluate, not capturing attenuation of flow
   Comment was in reference to a wrong location, no issue.

6. Mannings n and HEC RAS model, previous comments incorporated? Some comments incorporated, some not. .026 (existing) vs .035 (proposed design) n value, .025 considered low – hec ras and hec 1 don't match, will look at
   RBF changed the HEC-1 to match the HEC RAS, changes are minimal. A test showed minimal change of less than 100 cfs so the DEI n values were maintained.

7. If update diversions at HVC 1, 2 - will have to incorporate into HEC 1 model
   Not precisely the case, but provisions were made in the previous modeling effort.

8. Routing for n values were changed to match DEI's
   Statement to acknowledge this fact and agreed.

9. Consider two n values for design condition (high/low)
   A note reflecting this fact was agreed to be included into the Summary Report.

10. NOAA 2 used, minimal change to NOAA 14, established early in process
    Redundant, identified and discussed above.

11. 155th Ave split – will initial flows split b/w, inverts same at same elevation, continuous flow
    A note will be included in the Summary Report that suggests that design should evaluate a potential change in the hydraulic line where some smaller event flows

stay within the Happy Valley Channel with diversion of larger events into the 155th Avenue Channel only.

12. Did you do update to n steps b/w Wittmann and this study?
    Yes, the n steps were updated for this DCR study.

13. Fig 6 compared to Alt #1, HVC 4 - have offsite watersheds been highlighted? 609 not highlighted, but off site flows impacting section, why not shaded? How incorporated – thru hydrograph?
    Sub basins that are modified from the WADMSU were shaded.

14. Breach vs low point in berm – clarification in terms, berm has a low point and still elevated higher than adjacent ground in most cases. In 100 yr event, flows pass thru low point but question on overtopping berm, terminology issue...Nathan referring to berm in Asante where there is breach
    Comment addressed above and duly noted in the Summary Report.

Preferred Alternative Section of Report (pgs 1-4)

1. Pg iv – strike FCDMC as part of team
   Will finalize change with District staff.

2. Pg – 1 – strike "lengthy"
   Will make change.

3. Bing's comments in separate memo – any questions? Need sketch showing labels for each channel section – add plan view figure to report
   Labels will be provided on graphic in final report.

Hydraulic Considerations

1. Question on basin, water ponding, intent to drain, keep mesquitos down, etc. Everyday events, ponding. Existing ponding condition, dead end of sorts. Overchute only outlet. O&M issue. Drywells?
   FCDMC haven't found them to be successful. ASLD concerned as landowner. Drywell design depends on depth of water table. Drywells need to be factored into O&M plan. Additional reference to this concern will be included in the "Future Considerations" section of the Summary Report.

2. Nuisance water/vector control – water must be drained off. Take smaller events down HVC to avoid smaller flows getting to basin. Concern – area flat.
   Note will be added as consideration into report. Opportunity for small overchutes to bleed off flows not too viable and 10 foot separation under the canal may challenge design ability to do so.

3. Consider new overchute at 155th Ave. alignment and eliminate detention basin.
   Additional language will be added to the Further Considerations" section of the Summary Report that speaks to the need to provide further evaluation and a cost/benefit anal ysis between the basin and an additional overchute. Observation will note the Sewer trunk on west side and that the Concept was previously eliminated based on cost.

4. Permissible velocities – consider self armoring?
   It was suggested that this was not significant factor for this type of channel design but a notation suggesting future consideration will be provided in the Summary Report.

5. Slope – final design slope likely to be steeper; added analysis necessary. Try not to be so flat.
   Used a permissible velocity approach, limited sediment movement. Report does have note that slope could be steeper, emphasis on downstream of drop structures.

Landscape/Multi Use

1. 6:1 side slopes – using gravel mulch? Report to acknowledge that rilling may occur, contemplate use of gravel mulch
   Good suggestion, report will include expanded language and a note on O&M as well

2. ASLD wants open space credit from City on detention basin , statement into the report as such
   This and other ASLD requested actions/desires will be noted in the Summary Report.

3. Buffer on cross sections – stip or concept only. Existing projects have differing dimensions. Wants note – if existing zoning/pre-plat that differs from buffers shown here, conceptual in nature, refer to specific development plans.
   A notation that discusses the conceptual nature of the buffers and that their ultimate width will be determined in conjunction with individual project development plan submittals to the City of Surprise.

4. If channel smaller, reduce buffer width? Put trail into buffer instead of separate trail area?
   In similar fashion to buffer width issue and comment above, this will be determined on an individual project basis in conjunction with City of Surprise staff.

5. Forty foot buffer –ASLD has concern on width
   It was noted that ASLD has no conceptual development plans, but the same treatment on the buffers will be applied to ASLD just as with nearby developers. A notation is provided in the Summary Report.

6. Need to utilize buffer for erosion setback? If permissible velocities is basis for design, becomes moot issue.
   Agreed and Summary Report will note this accordingly.

Opinion of Probable Cost

1. Excavation costs -too high. $4 appropriate for this level of analysis. Phil finds $2 or lower, $1.10 in Maricopa job. 30% contingency. All #'s are high in general.
   Will expand opinion of probable cost section to include both a low end and a high end cost estimate to better develop a range of likely unit and total costs. RBF will confer with District staff to determine which components of the cost estimate will be adjusted.

2. Estimate is likely $6 million overstated in costs
   Will expand opinion of probable cost section to include both a low end and a high end cost estimate to better develop a range of likely unit and total costs. RBF will confer with District staff to determine which components of the cost estimate will be adjusted.

3. Suggesting capture costs in a range of costs
   Will expand opinion of probable cost section to include both a low end and a high end cost estimate to better develop a range of likely unit and total costs. RBF will confer with District staff to determine which components of the cost estimate will be adjusted.

4. Drop structure – include rip rap in estimate.
   Ballpark estimate that was anticipated to capture rip rap costs in contingency or conservative unit costs.

5. ROW costs inclusive of buffers etc. Costs are inflated -concern if #'s too high, no one will want to consider. $20k and $40k
   Valid concern that adds to the reasoning for developing a range of low end and high end cost estimate.

6. Identify/Break down costs by ROW, Design, construction. Show CM separate
   These line items are identified by these categories in the estimate.

IV. Further Considerations: Design/Implementation

1. ASLD supports – wants early involvement as project moves forward. Manny needs buy in from other ASLD dept's
   Understood and agreed. Comment to be added to the Summary Report.

2. Consider adding language to report that suggests that city/county agreement to cover ASLD upfront cost component and have stipulation that when entitlement moves forward, that ASLD successor pays back those costs to city/county. For construction/upfront, channel and basin is purchased at fair market value.
   A comment will be added to the Summary Report that suggests this implementation issue as a framework that could be evaluated as the project moves forward.

3. Cost benefit analysis of channels, erosion protection, ROW, etc.
   Determined to be covered within the report and not an issue for further elaboration..

4. Basin vs overchute

Engineering and cost benefit analysis recommended for further consideration and duly noted in the Summary Report.

5. Prioritization Procedure Form should be submitted to FCDMC by the City of Surprise (pg 22 #1) if desired cost share project.
   Will add comment noting "official form" to be completed by the City, if desired, will be noted in the Summary Report.

6. Phasing of implementation (Build HV Channel to 155th and discharge to ASLD property)
   Additional language exploring variable approaches to project construction and implementation, including District component perhaps focusing on outfall facilities included in Summary Report.

7. How to determine City of Surprise funding (how split between properties)
   Language regarding implementation options to be explored provided in the Summary Report.

8. Consider adding a "Benefitted Area" map.
   A new map graphic is created showing a conceptual benefitted area illustrating properties that directly benefit from the construction of regional facilities and that could/should be included in any financial implantation district or funding mechanism or agreement.

9. Privatized money or district
   A note noting the exploration of various implementation approaches as necessary for further consideration to be included in the Summary Report.

10. Maintain existing channel for HV portion of Preferred Alternative – minimize disturbance to wash
    Note to be provided in Summary Report that maintaining existing wash facility to best extent possible should be considered in pre-design discussions and the ability to do so is largely influenced by design of Happy Valley Road.

11. Add reference to which hydrology to use for design
    Reference as requested to be added to the Summary Report.

At the conclusion of the comment period, Mr. Jones thanked the Stakeholders for their hard work during this DCR process. He said he would work with RBF to sort through changes and that Stakeholders will receive a copy of the final Summary Report sometime in mid-January.

The meeting adjourned at approximately 11:48 am.