MASTER DRAINAGE REPORT
FOR
RANCHO CABRILLO

Stantec

MASTER DRAINAGE REPORT
FOR
RANCHO CABRILLO

FLOOD CONTROL DISTRICT
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ADMIN | C & W
REG | P & PM
ENG | FLE
CONTRACTS
ROUTING

Prepared for:

Robson Communities
2151 East Broadway Road, Suite 210
Tempe, Arizona 85282
(480)446-8800

Prepared by:

Stantec Consulting, Inc.
8211 South 48th Street
Phoenix, Arizona 85044
(602) 438-2200

Registered Professional Engineer (Civil)
CERTIFICATE NO.
34565
GHASSAN
M. AOUAD
Date Signed 9-18-01
ARIZONA, U.S.A.

Revised September 18, 2001
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APPENDIXES

Appendix A1	Pre-development Drainage (By Robert L. Ward, P.E.)
Appendix A2	Dam-Break Analysis for Lake Bonita (By Robert L. Ward, P.E.)
Appendix A3	Happy Valley Road Hydrology (By Robert L. Ward)
Appendix B	Hydraulic Calculations
Appendix C	Erosion Setback Analysis
Appendix D	Retention Calculations
Appendix E	Post-Development Hydrologic Model

1.0 Scope

The purpose of this master drainage report is to present a conceptual drainage plan for the proposed master planned development known as Rancho Cabrillo. This report was prepared in accordance with the drainage design manuals of the Flood Control District of Maricopa County "FCDMC", (Ref. 1 & 2).

2.0 Location

The project site (Fig. 1) is located in an unincorporated area of Maricopa County, Arizona. It is bounded by the street alignments of Dysart Road on the east, Litchfield Road on the west, Jomax Road on the north and the McMicken Dam Outlet Channel on the south.

The project site is located within portions of sections 3 and 10, Township 4 North, Range 1 West, Gila and Salt River Base and Meridian, Maricopa County, Arizona.

3.0 Site Description

The project site is currently an undeveloped desert land (Fig. 2) with a natural ground slope of approximately 0.7% from the northwest to the southeast (Fig. 3). Braided washes and arroyos are the predominant drainage features in the vicinity of the site. Padelford wash, a major natural wash, runs adjacent to the western boundary of the project site and crosses the project's southwest corner in a southeasterly direction. Beardsley Canal, an irrigation structure, runs across the middle of the site in a southwesterly direction. The canal interrupts the natural flow pattern of storm water runoff across the site. Storm water runoff ponds along the north side of Beardsley Canal then flows westerly toward Padelford wash where it crosses the canal over a siphon. Additionally, there is an existing levee that extends approximately 4200 feet northeasterly from the intersection of Padelford Wash and Beardsley Canal (Fig. 3). A portion of this levee extends into the project site. The levee appears to have been built to cut some of the storm water runoff flowing toward the north side of Beardsley Canal and divert this flow along the levee toward Padelford wash. Padelford wash

discharges into the McMicken Dam Outlet Channel that runs easterly parallel to the project's south boundary (Figure 3).

4.0 Flood Zone Classification

4.1 CLASSIFICATION BY THE WITTMANN ADMS

The project site falls within the watershed boundaries of Wittmann Area Drainage Master Study (ADMS), (Ref. 3). Included in the Wittmann ADMS is a flood plain delineation for Padelford Wash and adjacent areas north and south of Beardsley Canal. The floodplain delineation along Padelford Wash was based on an HEC-2 analysis that starts at the outlet of the Wash into the McMickan Dam Outlet Channel. No specific flood hazard zone classification was shown along the Padelford Wash on the corresponding map of the ADMS, map no. MC-26, included here as Figure 4A. The flood plain delineation for the adjacent area was based on approximate methods. The floodplain delineation north of Beardsley Canal was based on ponding at the upsteam side of an existing siphon where Padelford Wash crosses the Beardsley Canal. The flood plain delineation south of Beardsley Canal, according to discussion with the FCDMC, appears to be based on potential flow overtopping or breaching the Beardsley Canal. This area south of Beardsley Canal was classified as Flood Hazard Zone A (Figure 4A).

4.2 CLASSIFICATION BY THE FIRM

The Maricopa County, Arizona and Incorporated Areas Flood Insurance Rate Map (FIRM) Panel Number 040131155 F, panel 1155 of 4350, dated December 3, 1993, shows that the project site is located within flood hazard Zones "X" (shaded) and "A" (Fig. 4B).

Zone "X" (shaded) is defined by FEMA as:

Areas of 500-year flood; Areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and area protected by levees from 100-year flood.

Zone "A" is defined by FEMA as:

Special flood hazard areas inundated by 100-year flood, no base flood elevation determined.

It has been noticed that the subject Zone A on the FIRM represents the outer boundary of the floodplain delineation of Padelford Wash and the areas on both sides of Beardsley Canal. There is no distinction in the FIRM between the reverine flooding along the Padelford wash and ponding or sheet flow flooding in the areas north and south of Beardsley Canal.

5.0 Proposed Development

The project site, approximately 608 gross acres, is proposed to be developed into a master-planned community composed of several parcels (Fig. 5). The project is proposed to be developed in several phases, each encompassing one or more parcels. Most of these parcels are proposed to be developed into single family residential units, some are proposed to be developed into multi-family units and commercial areas. Open space will be provided throughout the project site.

Access to the project site is proposed to be provided through the construction of Happy Valley Road from the project site easterly toward El Mirage Road alignment (Fig. 2).

It is proposed in conjunction with this project to remove flood zone A from the impacted portions of the project site. A separate application will be prepared, in coordination with the FCDMC, and submitted to FEMA to request a Conditional Letter of Map Revision "CLOMR" and ultimately a Letter of Map Revision "LOMR".

All but a small portion of the area of the project site that lies within flood zone A is located south of Beardsley Canal. The basis of removing flood zone A from the impacted portion of the project site South of Beardsley Canal will be providing a drainage channel along the south side of Beardsley Canal to intercept potential flow that may overtop the canal and to convey this flow westerly toward Padelford Wash then southerly within the wash toward the McMicken Dam Outlet Channel. The proposed channel along the south side of Beardsley Canal was sized for a peak flow that assumes both the Beardsley Canal and the existing levee, are breached; i.e., worst case scenario. Calculation sheets are included in Appendix B.

The basis of removing flood Zone A from the small impacted portion of the project site north of Beardsley Canal will be providing a stormwater storage basin that will accommodate the estimated flood volume from the removed area of Zone A. Detailed location and calculations for the storage basin will be provided in subsequent drainage reports.

6.0 Pre-development Drainage Conditions

6.1 OFFSITE & ONSITE DRAINAGE

The project site falls within the watershed of Wittman Area Drainage Master Study (ADMS), (Ref. 3). A separate drainage report was prepared to address the pre-development drainage conditions for the project site by Robert L. Ward, P.E. (Ref. 5) as a subconsultant to Stantec Consulting Inc. That report contains a thorough analysis on the derivation of the peak flows that enter and leave the project site in the pre-development conditions. That report was based on the Wittmann ADMS. A complete copy of that report is included in Appendix A1.

7.0 Lake Bonita

Lake Bonita is located adjacent to Padelford Wash, along Bullard Avenue alignment, approximately 1500 north of Jomax Road (Fig. 3). According to Wittmann ADMS, part B (Ref. 4), the dam at this lake was constructed without the Arizona Department of Water Resources (ADWR) permission or supervision and is currently considered to be in violation of ADWR Dam safety regulations. A separate Dam-Break analysis report was prepared by Mr. Robert L. Ward, P.E. (Ref. 6), as a subconsultant to Stantec Consulting, Inc., to address the impact of such potential Dam Break on the proposed development of Rancho Cabrillo. A complete copy of this report is included in Appendix A2.

8.0 Post-development Drainage Conditions

8.1 OFFSITE DRAINAGE

It is proposed in the post-development conditions to convey the offsite flow entering the project site into the same pre-development discharge locations through the open space provided along the existing natural washes or through proposed onsite channels (Fig. 6). As discussed in section 5.0 of this report, a channel is also proposed along the south side of the Beardsley Canal to intercept any storm runoff that may potentially break over the canal to the south. The normal depth method will be used to estimate the hydraulic parameters along these washes and channels. Supporting preliminary calculations are included in Appendix B.

8.2 ONSITE DRAINAGE

Onsite storm water runoff will be collected in local streets and conveyed into several proposed retention basins throughout the project site. Onsite peak flows will be estimated using the Rational Method. Local streets will be designed to conform to the FCDMC drainage design manuals (Ref. 1 & 2). Onsite peak flow and hydraulic calculations will be provided as a final site plan for each parcel is prepared.

8.3 POST-DEVELOPMENT HYDROLOGIC MODEL

The offsite peak flows shown on Figure 6, which were discussed in Section 8.1 above, were derived from the HEC-hydraulic model of the Wittmann ADMS (Ref. 3). That HE1-1 model was based on the 100-year, 24-hour storm event. Onsite retention was provided for the onsite 100-year, 2-hour design storm. To address the impact of the onsite 100-year, 2-hour retention requirements on the 100-year, 24-hour storm, a post-development HEC-1 hydrologic model was prepared. This model is based on the 100-year, 24-hour pre-development model but it incorporates the retention requirements and flow diversions within the proposed developments. Hydrologic characteristics such as the curve number and the percentage of imperviousness were selected based on the proposed land use in each parcel. Weighted average was used as appropriate.

Comparison of peak flows in the pre and post development models indicate that the post-development peak flows are less than the pre-development ones. The 100-year, 24-hour peak flows leaving the retention basins will be accommodated in the

ultimate/emergency overflow system at each basin. Where an open space or a channel is provided to convey the pre-development offsite flows entering the project site, any additional post-development onsite peak flow will be accommodated in the freeboard provided. The post-development hydrologic model, along with supporting calculations, are included in Appendix E.

8.4 HAPPY VALLEY ROAD CROSSINGS

As indicated in section 5.0 of this report, it is proposed, in conjunction with this project, to construct Happy Valley Road from the project site easterly toward El Mirage Road (Fig. 2). Major peak flows for the roadway flow crossings were estimated separately by Mr. Robert L. Ward, utilizing a revision to the HEC-1 hydrologic model used in the Wittmann ADMS. Excerpts from Mr. Robert L. Ward's analysis are included in Appendix A3. Preliminary calculations for the roadway crossings are included in Appendix B, preliminary crossing structures are shown on Figure 2.

8.5 EROSION SETBACK

Erosion setback requirements were estimated, as applicable, in accordance with the Arizona Department of Water Resources (ADWR) (Ref. 7), which is the current criteria adopted by the FCDMC. Three locations were identified where erosion setback requirements may apply. They are at the two washes labeled Wash 2 and Wash 3 (Fig. 6) and at Padelford Wash, south of Beardsley Canal. None of the contributing areas to these washes is more than 30 square miles which indicate that level one of said criteria apply.

At Wash 2 and Wash 3, the observed sandy bottom of the wash is not more than 5 feet wide, with a relatively shallow depth. As part of the open space provided throughout the project site, a minimum of 50 feet is provided on each side of the sandy bottom at these two washes. The corresponding flow is estimated to pass through the open space at a depth of less than 2 feet and a velocity in the range of 3.0 fps. (App. C). Under these conditions it was assumed that the erosion set back requirements at these two washes, 20 feet each side at each of Wash 1 and Wash 2 (App. C), will be accommodated in the open space provided along each wash. At Padelford Wash, the erosion setback limits, according to ADWR criteria, should be measured from the floodway line. The floodway can typically be established by equal encroachment on each side of an existing floodplain such that the increase in the base flood elevation is

no more than one foot. In this application, instead of trying to establish a floodway, the required erosion setback width, approximately 53 feet (App. C), was set inside the floodplain limits, measured from the flood plain line. These erosion setback limits were coded as encroachment stations in the Padelford Wash HEC-2 run, established in the Wittmann ADMS, to evaluate the impact on the increase in the base flood elevations. Comparing the outputs of the original and modified HEC-2 runs (App. C), it was observed that the impact is insignificant and therefore estimating the erosion setback limits in this fashion is conservative. Additionally these erosion setback limits were observed against the physical limits of the wash as shown on the aerial photography (Fig. 2) and found to be reasonable and outside the main conveyance section of the wash. Erosion setback requirement calculations are included in Appendix C. The erosion setback limits along padelford wash are shown on Figure 6.

9.0 Retention Requirements

Onsite storm water storage basins will be provided in each parcel (Fig. 6) to accommodate the retention requirements of the 100-year, 2-hour storm in accordance with the FCDMC criteria. The retention basins will be designed to drain within 36 hours through outlet pipes into the adjacent washes or though percolation and drywells. Development phasing will be accommodated by providing temporary measures to store or reroute flows from upstream parcels until such parcels are improved and self retention are provided. In this master drainage report, retention requirements were estimated based on the proposed land use in each parcel. Final retention requirements will be revised as a complete site plan for each parcel is prepared. The retention basin in Parcels C and P will also be sized to accommodate the estimated flood volume of Zone A in this area. This portion of flood zone A is proposed to be removed as discussed in Section 5.0. Preliminary retention calculations are included in Appendix D.

10.0 References

1. Drainage Design Manual for Maricopa County, Arizona, Volume I Hydrology, January 1, 1995.

2. Drainage Design Manuals for Maricopa County, Arizona, Volume 2 Hydraulics, January 28, 1996.

3. WLB Group, Inc., Wittmann Area Drainage Master Study (ADMS) Part A, Hydrology and Hydraulics, March 10, 1989.

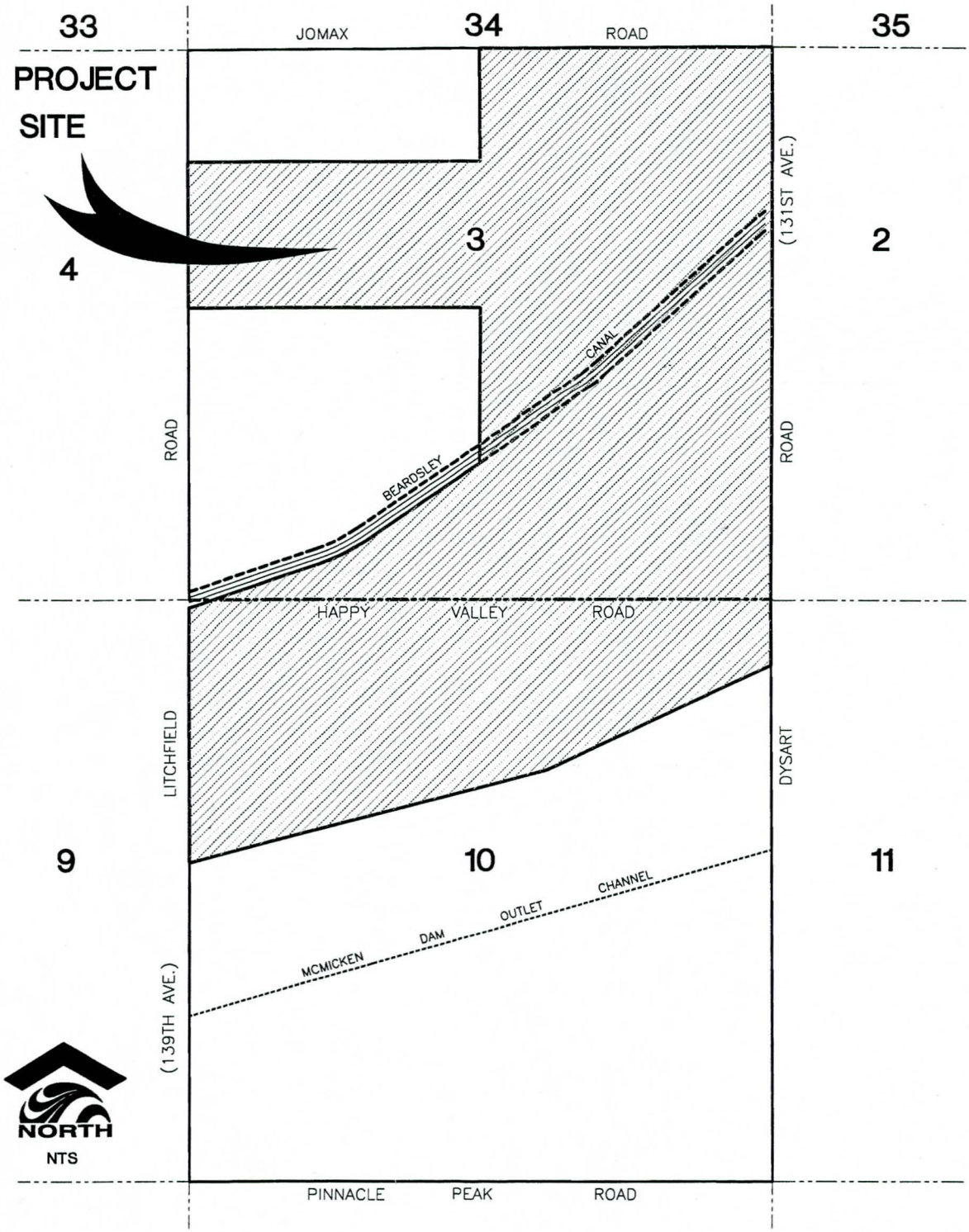
4. WIB Group, Inc. Wittmann Area Drainage Master Study (ADMS), Part B, Storm Water Management Plans, March 10, 1989.

5. Robert L. Ward, P.E., Consulting Engineer, Hydrology Analysis, pre-development, Rancho Cabrillo, Maricopa County, Arizona, May 11, 2000.

6. Robert L. Ward, P.E. Consulting Engineer, Dam-Break Analysis for Lake Bonita, Maricopa County, Arizona, August 29, 2000.

7. Arizona Department of Water Resources, Flood Warning and Dam Safety Section, Water System Sediment Balance, September, 1996.

FIGURES



Legend

PROJECT SITE

10 SECTION NUMBER

Stantec

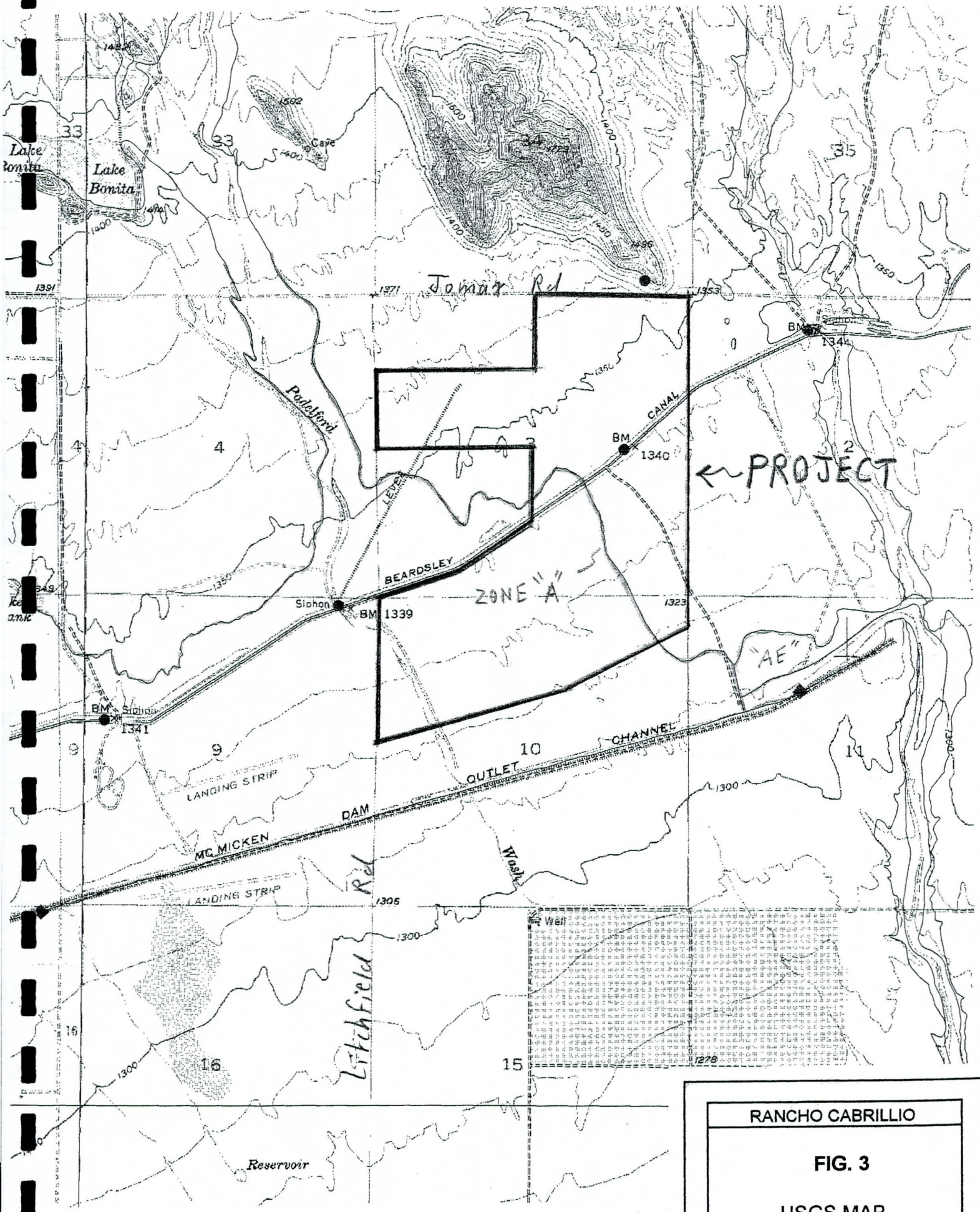
Client/Project
Rancho Cabrillo Development

Figure No.
1

Title
Vicinity Map

05/23/00
81500770

K:\81500770-Rancho\drawings\drainage\VicinityMap.dwg

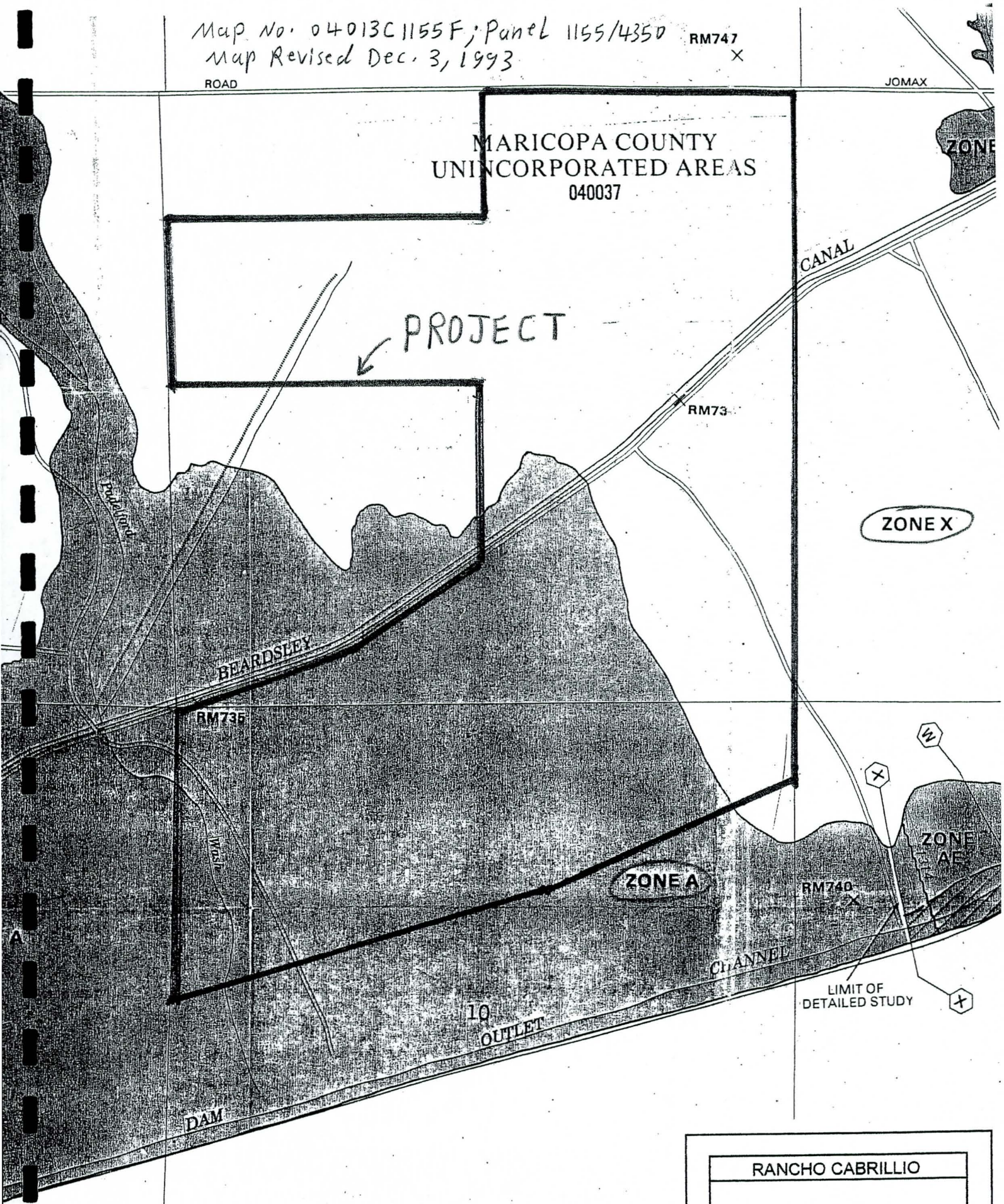


RANCHO CABRILLIO

FIG. 3

USGS MAP

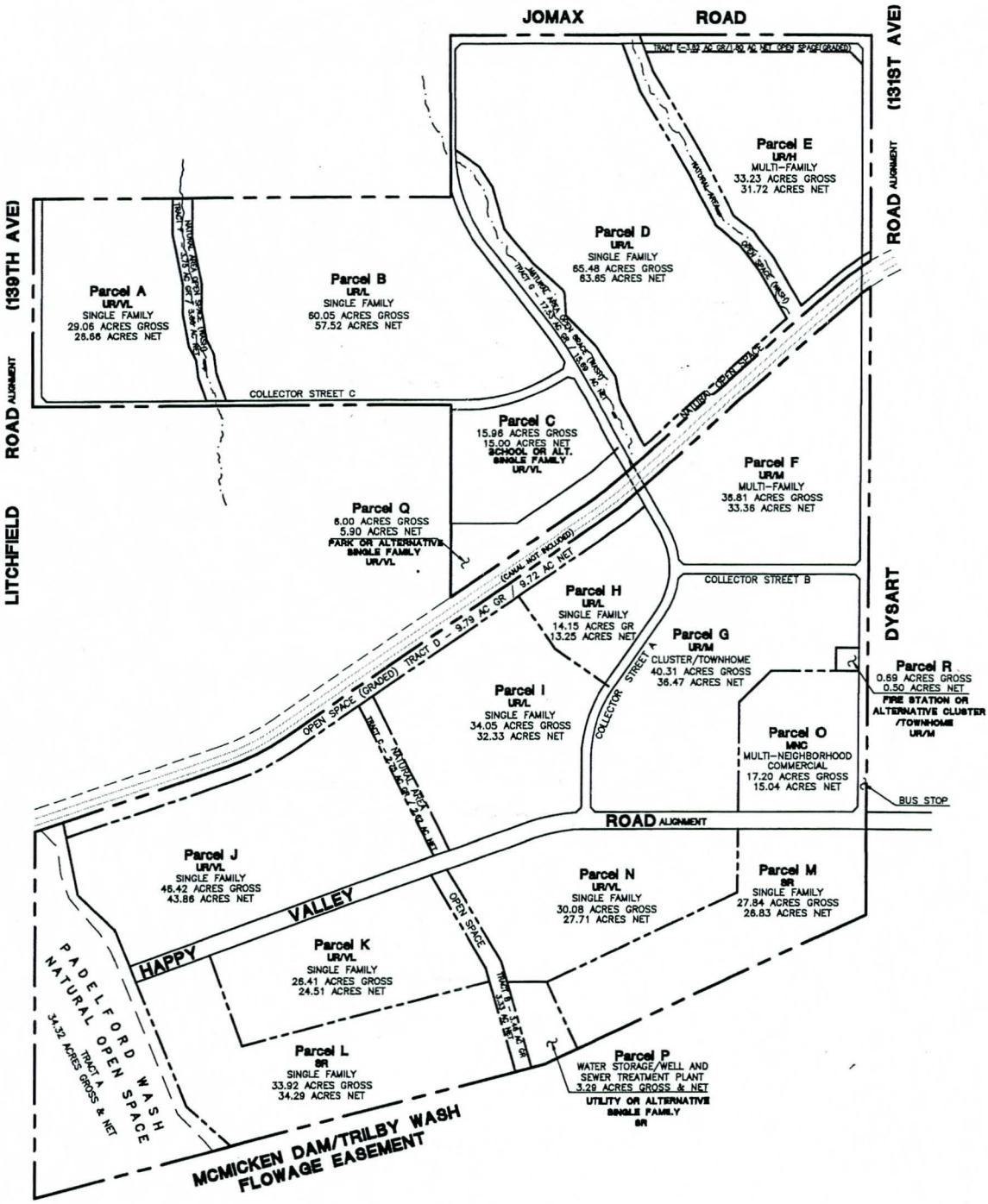
Map No. 04013C1155F; Panel 1155/4350
Map Revised Dec. 3, 1993



RANCHO CABRILLIO

FIG. 4 B

FIRM MAP



Legend

Client/Project
Rancho Cabrillo

Stantec

Figure No.
5

Title
Land Use Plan

05/22/00	ORIGINAL
07/20/00	REVISION 1

07/20/00
81500770
CASE NO. DMP 2000005

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          .         .         V
3643      .         .      123B1
          .         .         .
          .         .         .
3646      .         .         .       123B
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          .         .         .         .
3652      .         .      123B2............
          .         .         V
          .         .         V
3655      .         .      123A3
          .         .         .
          .         .         .
3658      .         .         .       123H
          .         .         .         V
          .         .         .         V
3664      .         .         .      123N1
          .         .         .         .
          .         .         .         .
3667      .         .         .         .       123N
          .         .         .         .         .
          .         .         .         .         .
3673      .         .         .      123N2............
          .         .         .         V
          .         .         .         V
3676      .         .         .      123N3
          .         .         .         .
          .         .         .         .
3679      .         .         .         .       123G
          .         .         .         .         .
          .         .         .         .         .
3685      .         .         .         .         .       123F
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          .         .         .         .         V
3694      .         .         .         .      123N4
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3697      .         .         .      123N5............
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          .         .         .         V
3700      .         .         .      123M1
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          .         .         .         .
3703      .         .         .         .       123E
          .         .         .         .         V
          .         .         .         .         V
3709      .         .         .         .      123M2
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3712      .         .         .         .         .       123M
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3718    .         .         .     123M4.......................
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        .         .         .        V
3721    .         .         .     123L1
        .         .         .        .
        .         .         .        .
3724    .         .         .        .       123L
        .         .         .        .         .
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3732    .         .         .        .         .         .<------- 123K2B
3730    .         .         .        .         .     123K2B
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3735    .         .         .        .         .         .         .<------- 123I3B
3733    .         .         .        .         .         .     123I3B
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3736    .         .         .        .         .      123IK............
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        .         .         .        .         .         V
3739    .         .         .        .         .      123L2
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3742    .         .         .     123L3.......................
        .         .         .        V
        .         .         .        V
3745    .         .         .     123A4
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        .         .         .        .
3748    .     123A5.......................
        .         V
        .         V
3753    .     123BC
        .         V
        .         V
3759    .     121B1
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        .         .
3762    .         .       121B
        .         .         .
        .         .         .
3768    .     121B2............
        .         V
        .         V
3771    .     121C1
        .         .
        .         .
3774    .         .       121C
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        .         .         .
3780    .     121C2............
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3783      121C3............
             V
             V
3786      122C1
             .
             .
3789         .        122A
             .          V
             .          V
3795         .       122C2
             .          .
             .          .
3798         .          .        122C
             .          .          .
             .          .          .
3804      122C3........................
             .
             .
3807         .        122B
             .          V
             .          V
3813         .       122C4
             .          .
             .          .
3816      122C5............
             V
             V
3819      122E1
             .
             .
3822         .        122D
             .          V
             .          V
3828         .       122E2
             .          .
             .          .
3831         .          .        122E
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             .          .          .
3837      122E3........................
             V
             V
3840       C132
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Partial copy from RC1-24I

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KM      RUNOFF FROM SUB 123D
BA .3444
LS          78.3
UK   250    .011     .11     100
RK  7400   .0091     .05           TRAP      40      10
*
KK 123K1      CP
KM      ROUTE SUB 123D TO CP 123K1
RM   1.2    .061      .2
*
KK  123K     SUB
KM      RUNOFF FROM SUB 123K
BA .0293
LS            77
UK   250    .011     .11     100
RK  1100   .0081     .05           TRAP      40      10
*
KK 123K2      CP
KM      COMBINE SUB 123K & CP 123K1
HC     2
*
KK123K2A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123K2B
DI     0    5000
DQ     0    2500
*
KK 123I1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123K2A) ALONG LEVEE TO CP 123I1
RM    .8    .038      .2
*
KK  123C     SUB
KM      RUNOFF FROM SUB 123C
BA .1205
LS            77
UK   250    .011     .11     100
RK  5000   .0089     .05           TRAP      30      10
*
KK 123C1     DIV
KM      RATIO FLOW FROM SUB 123C TO SUB 123I
DT 123C2
DI     0    5000
DQ     0    2500
*
KK 123I2      CP
KM      ROUTE DIV 123C1 TO CP 123I2
RM   1.7    .087      .2
*
KK  123I     SUB
KM      RUNOFF FROM SUB 123I
BA .0324
LS            77
UK   250    .011     .11     100
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RK  1560   .0081     .05            TRAP      30      10
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KK 123I3      CP
KM      COMBINE SUB 123I, CP 123I1 & 123I2
HC     3
*
KK123I3A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123I3B
DI     0    5000
DQ     0    2500
*
KK 123J1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123I3A) ALONG LEVEE TO CP 123J1
RM    .5    .024      .2
*
KK 123C2     RET
KM      RETRIEVE REMAINING FLOW FROM SUB 123C
DR 123C2
*
KK 123J2      CP
KM      ROUTE RET 123C2 TO CP 123J2
RM   1.4    .069      .2
*
KK  123J     SUB
KM      RUNOFF FROM SUB 123J
BA .0163
LS            77
UK   250    .011     .11     100
RK  1250   .0081     .05            TRAP      30      10
*
KK 123J3      CP
KM      COMBINE SUB 123J, CP 123J1 & 123J2
HC     3
*
KK 123B1      CP
KM      ROUTE CP 123J3 ALONG LEVEE TO CP 123B1
RM    .4    .019      .2
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KK  123B     SUB
KM      RUNOFF FROM SUB 123B (RLW BASIN, NOT WLB)
BA .0933
LS            77
UK   250    .011     .11     100
RK  4300   .0074     .05            TRAP      25      10
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KK 123B2      CP
KM      COMBINE SUB 123B & CP 123B1
HC     2
*
KK 123A3      CP
KM      ROUTE CP 123B2 ALONG LEVEE TO CP 123A3
RM   2.2    .111      .2
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RK  2700   .2250     .05            TRAP      35      10
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KK 123N1      CP
KM      ROUTE SUB 123H TO CP 123N1
RM   2.4    .119      .2
*
KK  123N     SUB
KM      RUNOFF FROM SUB 123N
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LS            77
UK   250    .011     .11     100
RK  2450   .0081     .05            TRAP      45      10
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KK 123N2      CP
KM      COMBINE SUB 123N & CP 123N1
HC     2
*
KK 123N3      CP
KM      ROUTE CP 123N2 TO CP 123N3
RM   3.9    .194      .2
*
KK  123G     SUB
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BA .0803
LS            82
UK   250   .2250     .15     100
RK  3200   .2250     .05            TRAP      35      10
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KK  123F     SUB
KM      RUNOFF FROM SUB 123F
BA .2898
LS          82.5
UK   250    .011     .11     100
RK  8400   .0092     .05            TRAP      40      10
*
KK 123FG      CP
KM      COMBINE SUB 123F & 123G
HC     2
*
KK 123N4      CP
KM      ROUTE CP 123FG TO CP 123N4
RM   2.5    .125      .2
*
KK 123N5      CP
KM      COMBINE CP 123N3 & 123N4
HC     2
*
KK 123M1      CP
KM      ROUTE CP 123N5 TO CP 123M1
```

```
RM   2.4    .118      .2
*
KK  123E     SUB
KM      RUNOFF FROM SUB 123E
BA .0488
LS            77
UK   250    .011     .11     100
RK  5000   .0092     .05           TRAP      20      10
*
KK 123M2      CP
KM      ROUTE SUB 123E TO CP 123M2
RM   2.7    .136      .2
*
KK  123M     SUB
KM      RUNOFF FROM SUB 123M
BA .0935
LS            77
UK   250    .011     .11     100
RK  2450   .0081     .05           TRAP      25      10
*
KK 123M4      CP
KM      COMBINE SUB 123M, CP 123M1 & 123M2
HC     3
*
KK 123L1      CP
KM      ROUTE CP 123M4 TO CP 123L1
RM   3.7    .185      .2
*
KK  123L     SUB
KM      RUNOFF FROM SUB 123L
BA .1956
LS            77
UK   250    .011     .11     100
RK  2150   .0081     .05           TRAP      40      20
*
KK123K2B     RET
KM      RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123K2
DR123K2B
*
KK123I3B     RET
KM      RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123I3
DR123I3B
*
KK 123IK      CP
KM      COMBINE RET 123K2B & 123I3B
HC     2     .25
*
KK 123L2      CP
KM      ROUTE CP 123IK TO CP 123L2
RM   2.2    .108      .2
*
KK 123L3      CP
KM      COMBINE SUB 123L, CP 123L1 & 123L2
HC     3
```

```
*
KK 123A4      CP
KM      ROUTE CP 123L3 TO CP 123A4
RM   7.8    .389      .2
*
KK 123A5      CP
KM      COMBINE CP 123A2, 123A3 & 123A4
KM      THIS IS THE TOTAL INFLOW TO THE PADELFORD WASH CROSSING OF
KM      THE BEARDSLEY CANAL SIPHON
HC     3
*
KK 123BC
KM      STORAGE ROUTE THROUGH 123BC.  58' WIDE SIPHON ON THE BEARDSLEY CANAL.
RS     1    STOR       0       0
SV     0   34.78  148.48     190
SQ     0     493    1392    8712
SE  1338    1340    1342    1343
*
KK 121B1      CP
KM      ROUTE C123 TO CP 121B1
RM   1.9    .094      .2
*
KK  121B     SUB
KM      RUNOFF FROM SUB 121B
BA .1406
LS            77
UK   250    .011     .11     100
RK  2360   .0069     .05           TRAP      40      10
*
KK 121B2      CP
KM      COMBINE SUB 121B & CP 121B1
HC     2
*
KK 121C1      CP
KM      ROUTE CP 121B2 TO CP 121C1
RM   1.0    .048      .2
*
KK  121C     SUB
KM      RUNOFF FROM SUB 121C
BA .0759
LS            77
UK   250    .011     .11     100
RK  1200   .0071     .05           TRAP       0      10
*
KK 121C2      CP
KM      COMBINE SUB 121C & CP 121C1
HC     2
*
KK 121C3      CP
KM      COMBINE CP 121.1 & 121C3
HC     2
*
KK 122C1      CP
KM      ROUTE CP 121C3 TO CP 122C1
```

```
RM   4.0    .200      .2
*
KK  122A     SUB
KM      RUNOFF FROM SUB 122A
BA .1818
LS            77
UK   200    .011     .11     100
RK  2650   .0071     .05           TRAP      40      10
*
KK 122C2      CP
KM      ROUTE SUB 122A TO CP 122C2
RM   1.3    .067      .2
*
KK  122C     SUB
KM      RUNOFF FROM SUB 122C
BA .2216
LS            77
UK   200    .011     .11     100
RK  1350   .0077     .05           TRAP       0      15
*
KK 122C3      CP
KM      COMBINE SUB 122C, CP 122C1 & 122C2
HC     3
*
KK  122B     SUB
KM      RUNOFF FROM SUB 122B
BA .2159
LS            77
UK   200    .011     .11     100
RK  2950   .0071     .05           TRAP      40      10
*
KK 122C4      CP
KM      ROUTE SUB 122B TO CP 122C4
RM   1.7    .083      .2
*
KK 122C5      CP
KM      COMBINE CP 122C3 & 122C4
HC     2
*
KK 122E1      CP
KM      ROUTE CP 122C5 TO CP 122E1
RM   3.8    .189      .2
*
KK  122D     SUB
KM      RUNOFF FROM SUB 122D
BA .0775
LS            77
UK   200    .011     .11     100
RK  1400   .0071     .05           TRAP      30      10
*
KK 122E2      CP
KM      ROUTE SUB 122D TO CP 122E2
RM   4.2    .211      .2
*
```

```
KK  122E     SUB
KM      RUNOFF FROM SUB 122E
BA .3888
LS            77
UK   200    .011     .11     100
RK  5200   .0063     .05            TRAP      40      10
*
KK 122E3      CP
KM      COMBINE SUB 122E, CP 122E1 & 122E2
HC     3
*
*
*                END OF APRIL 2000 RANCHO CABRILLO REVISIONS
*
*
KK  C132
KM      ROUTE FLOW AT CP 122E3 TO C132 (USE ORIGINAL WLB ROUTING DATA)
RM     1     .44      .2
```

John Hathaway - FCDX

From: Aouad, Ghassan [GAouad@stantec.com]
Sent: Friday, September 21, 2001 10:18 AM
To: 'joh@mail.maricopa.gov'
Subject: STANTEC/RANCHO CABRILLO

Hi John.
On September 19 Stantec submitted a revised copy of the master drainage report for Rancho Cabrillo to the FCDMC. Included in the report are two disks that contain the electronic Hec-1 files for the pre and post-development conditions. I have noticed that the name of the files were inadvertently typed the same on the label of both disks. please note that the disk with the label date may 11,2001 contain the pre-development Hec-1 files RC1.24I & RC1.24O.
If you have any question please call me at 602-438-2200

Sincerely

Ghassan Aouad , P.E

ZONE CHANGE

TAC COMMENTS AND RESPONSES

Prepared for:	Prepared by:
Scott Homes 2151 East Broadway, Suite 210 Tempe, AZ 85282 (480) 446-8800	Stantec Consulting, Inc. 8211 South 48th Street Phoenix, AZ 85044 Ms. Penny Milton, A.I.C.P. Mr. Bob Murphy, P.E. (primary planning/engineering contact) (602) 438-2200

MARICOPA COUNTY
PLANNING AND DEVELOPMENT
DEPARTMENT

TO: **Scott Homes / Stantec Consulting**

FROM: **Maricopa County Flood Control District**
David Boggs, Richard Harris, John Hathaway
2801 W. Durango
Phoenix, AZ 85009

SUBJECT: **Drainage TAC Comments – July 24, 2001, August 28, 2001, September 10, 2001, September 12, 2001**

The following are Planning and Zoning comments on this project: The responses incorporate discussion with Mr. Boggs, Mr. Harris, Mr. Hathaway or the Maricopa County Flood Control District (MCFCD).

July 24th, 2001

1. Per the last paragraph of section 5, page 4 of the main report text, "The basis of removing Flood Zone A from the small impacted portion of the project site north of Beardsley Canal will be providing stormwater storage basin that will accommodate the estimated flood volume from the removed area of Zone A". The current submittal does not contain a volumetric analysis to determine such a design; it does contain conveyance channel design of sections 4A and 5A within Appendix B. These features apparently are meant to capture flows impacting the north side of Beardsley Canal to direct them to the Padelford Wash siphon. However, such a design may be in violation of the Drainage Regulation for Maricopa County by altering the character of historic flow patterns (concentrating flow). If the Consultant believes that this is the historic flow pattern, then they will be required to provide hydraulic analysis/verification along with a statement to this effect within the report text, for clarification. If this is not the historic flow pattern, then this design would require that a drainage easement be obtained from the property owner (State of Arizona) of the land located north of the canal, between the subject development site and Padelford wash.
RESPONSE: A volumetric analysis and corresponding details in support of the proposed concept to remove Flood Zone A from the impacted portion of the project site will be prepared along with the CLOMR application of which the MCFCD will receive a copy of before submitting to FEMA.

   In the pre-development conditions, storm water runoff from the contributing watershed north of Beardsley Canal is collected along the north side of the canal's dike and conveyed westerly, along the dike, into Padelford Wash. Appendix A contains a pre-development drainage analysis, which supports this flow pattern. Therefore the proposed drainage concept along the north side of Beardsley Canal is consistent with pre-development conditions and no drainage easement would be required from adjacent properties.

2. The labels of proposed hydraulic features on Figure 6, Onsite Drainage Map are too dim. This is also true of many of the section sketches within Appendix B of the Drainage Report.
RESPONSE: Figure 6 has been revised accordingly.

3. A post-development hydrologic model on diskette must be submitted to the District prior to zoning approval of this project. The model must include design criteria set forth in the Drainage Design Manual for Maricopa County. These criteria include modeling the 100-year, 6-hour (or 24-hour, if this is the current model) runoff event, minus the onsite runoff retention for the 100-year, 2-hour storm event. Given the proposed development density, the model must include some percentage of imperviousness, not zero percent imperviousness as shown on page six of Appendix A1.
RESPONSE: A post-development hydrologic model has been prepared and is included in Appendix E of the revised drainage report. This model uses the 100-year, 24-hour storm and incorporates the 100-year, 2-hour storm water storage requirements and incorporates imperviousness percentages per proposed land use.

4. As shown in the hydraulic analysis, water surfaces in sections 1, 2, and 3 extended vertically above the endpoints. This suggests that the needed Tract widths may be wider than currently estimated, if these Natural Area Open Spaces (Tract G on the Development Plan) are to not have any improvements to increase flow capacity.
RESPONSE: Cross-sections 1,2 & 3 have been revised. Please refer to Appendix B of the revised drainage report.

5. Section widths for sections 4A and 5A do not include designed freeboard. Also, the tract width on the Development Plan for the location where section 4A will be is only 60'-70' wide, while the capacity calculation is for a channel 110'.
RESPONSE: Cross-section 4A. & 5A. has been revised. Please refer to Figure 6 and Appendix B of the revised drainage report.

6. The capacity calculation for section 4A is for only 262-CFS, while the Plate 5 value for that location is closer to 465-CFS. Also, the flow velocity is shown to be less than 2 fps, which could lead to sediment accumulation and capacity loss. The District's Drainage Design Manual sets forth design calculations for improved channel flow, requiring designs that provide minimum flow velocities of at least 2-3 fps.
RESPONSE: The peak flows shown on plate 5 are for pre-development conditions. 262-CFS is the offsite flow being conveyed across cross-section 4A. A minimum of 1.0 feet of freeboard has been provided to accommodate flows in excess of the onsite design storm of 100-year, 2-hour.

The low velocities associated with Section 4A. is due to the fact that the existing conveyance area on the north side of Beardsley Canal is relatively flat. This area is within the Beardsley Canal ROW/Easement, outside the project boundary. Therefore flow velocities are anticipated to remain low within this area, as in the pre-development conditions.

7. To expedite and economize the future drainage feature designs for this development, I suggest that the engineer use box culvert designs currently provided in ADOT's standard details.
RESPONSE: We take this as a suggestion. Thank you.

8. Per the HEC-1 Routing Schematic Plate 5, the existing levee that crosses parcels A and B is considered a permanent feature. Therefore, Tract F should be expanded and realigned such that the modeled flow discharges can be carried within it, along the upstream side of the levee. The stability of the levee should be described in the report, and modeled accordingly.
RESPONSE: The subject tract has been revised as shown on Figure 6 of the revised drainage report. The flow along the existing levee will remain consistent with the pre-development conditions.

Cross-section 12 along the south side of the Beardsley Canal (Fig. 6) was analyzed for a peak flow that incorporates the flows along the north side of this levee, i.e., assuming the levee failed. Therefore, because failure of the levee is assumed, (worst case scenario), there is no need to analyze the stability of the levee for the purpose of this proposed development.

9. The word "Beardsely" on Figure 6 is misspelled.
RESPONSE: OK. It has been corrected.

10. The Tract G portion located just east of El Granada Boulevard could provide much more flow in a natural state if the Boulevard were to be shifted west to a ridgeline, there.
RESPONSE: We take this as a suggestion. Thank you.

11. The spelling of the word "monumentation" on sheet 3 of 5 should be checked.
RESPONSE: OK. It has been corrected.

12. If the intent is to intercept flows along the north boundaries of the development and direct them to the tracts shown, then expansion of adjoining tracts, or additional tracts, will be needed to provide this infrastructure and must be shown on the DMP.
RESPONSE: The proposed tracks for offsite drainage has been revised. Please see Figure 6 of the revised drainage report.

13. Is mass grading on some parcels intended for this development? If not, additional drainage tracts should be added for parcels K, L, M, O, G, and Q (per aerial photo stream traces). Many of the parcels located south of Beardsley Canal have different ID's on Figure 6 when compared to the Development Plan sheet 4.
RESPONSE: The subject stream traces reflect conditions prior to the Beardsley Canal existence. The canal cut off offsite flow into these streams. No tracts are necessary. The parcel ID's on Figure 6 of the drainage report have been revised to correspond to those on the development plan sheet.

14. Please describe how the cross-section geometric data for the hydraulic feature analyses was obtained, in the report. Also, please reference the survey and survey notes on the Onsite Drainage Map. The map will need to be stamped by an RLS.
RESPONSE: The cross-section geometric data for the hydraulic feature analyses was obtained from the recent topography generated as part of the project development. It was agreed that adding a note on the drainage exhibit to indicate that it is an integral part of the drainage report, which must be sealed by a professional engineer, should satisfy the demands raised in this comment. Such note has been added to Figure 6 of the drainage report.

15. Before approval of the GDP, the MWCD should be contacted and a copy of an approval letter to use part of their ROW must be sent to the District.
RESPONSE: The alignment of the proposed drainage channel along the south side of Beardsley Canal has been revised. The channel is proposed to be constructed solely within the project boundary. Please see the typical channel section in Appendix B of the revised drainage report. Therefore, as no part of the MWCD ROW is used, no approval letter is needed.

16. Before zoning approval of the GDP, calculations and a revised onsite Drainage Map will be needed to show that retention basin sizes are relative to required volume calculations given in the report. The report should include typical basin dimension drawings to show embankment side-slopes and ponding depths. The basin locations should be shown where future drainage improvements could be minimally sized for conveyance towards them.
RESPONSE: It was agreed that it is early at this stage of the development plan to provide detailed information of the required retention basins. Such information will be provided in subsequent stages. Figure 6 of the drainage report include conceptual locations of the anticipated retention basins.

17. To substantiate the proposed drainage infrastructure locations, a composite map of the proposed zoning and onsite drainage map should be provided. The plan should be sealed by an Arizona Registered Professional Civil Engineer.
RESPONSE: It was agreed that such composite map is not needed.

18. The address and site description in the P&D cover letter for this project, listed under "Subject", is not for this project.
RESPONSE: It was agreed that this comment was listed by error and should be ignored.

19. A conceptual design and cost estimate for the channel proposed along the south edge of the Beardsley Canal, must be submitted and approved by the District prior to zoning approval. The questions of by whom and when this channel will be built should be addressed within the report. A stipulation should be made that prior to zoning approval, the developer must provide proof of financial responsibility towards constructing the channel. Prior to approval of any Preliminary plats, a CLOMR must be prepared and submitted to FEMA.
RESPONSE: The timing of submitting a CLOMR in relation to MCFCD approval of any preliminary/final plat has been discussed several times with the county. It was concluded, supported by a letter from the county dated May 22, 2001, that the approval of the final plat, not the preliminary plat should be tied to submitting the CLOMR. It was also concluded that the drainage report should be adequate for the preliminary plat approval process.

20. Per the report, it appears that the dam-break analysis was for a 100-year, 24-hour event. It would seem that this analysis provides better floodplain delineation information than the previous mapping for the area south of the Beardsley Canal. Therefore, it should be shown on the Development Master Plan as a "Potential Floodplain", with a note referencing the study from which the boundary was taken.
RESPONSE: It was agreed that the material submitted in Appendix A2 of the drainage report satisfactorily addressed this comment.

August 28, 2001

21. Mr. Robson to post a surety bond to cover costs of the proposed interception swale which would play a role in eliminating the existing floodplain. Ms. Thomas pointed out that not only FEMA, but also the County has a mandate to regulate development within a floodplain. This A Zone floodplain is based upon an approximate study, and no base flow elevations are available.
RESPONSE: Please see comment no. 24.

22. Mr. Robson noted that the other option was to allow the flood flows to pass through the subdivision in easements, tracts, and as sheet flow, elevating building pads above the BFE.
RESPONSE: Please see comment no. 24.

23. Mr. Robson would instruct their engineers to undertake detailed mapping in the watershed and prepare a detained floodplain delineation to ascertain BFEs, in conjunction with geotechnical investigations of the canal and berms currently partially obstructing floodwater flows. These studies should be completed before preliminary plat approval, as a decision of which drainage approach--swale or sheetflow would need to be made to configure lots and drainage easements.
RESPONSE: Please see comment no. 24.

24. It was noted that volume compensation would be required for the sheetflow approach. The District agreed to withdraw the requirement for bonding, awaiting study results, to be submitted before preliminary plat approval.
RESPONSE: This response incorporates comments number 21 through 24. The drainage concept considered along the south side of Beardsley Canal provides an emergency channel to convey emergency storm water flows into Padelford Wash, as discussed in the drainage report. The surety bond is to be discussed between the client and the MCFCD.

September 10, 2001

25. Geotechnical investigations/report on canal.
RESPONSE: Please see comment no. 27.

26. Analysis of "worst case" of canal break.
RESPONSE: Please see comment no. 27.

27. Concept design for modeling of flows overtopping Beardsley Canal (diffuse or concentrated).
RESPONSE: This response incorporates comments no. 25 through 27. The proposed emergency channel along the south side of Beardsley Canal is designed for a peak flow that accommodates the entire flow along the north side of the canal and the flow along the north/west side of the existing levee crossing parcels A&B; i.e., as a worst case conditions, it was assumed that both the levee and the canal dike failed. Therefore, there is no need for a geotechnical investigation on the canal.

28. Post-development hydrology.
RESPONSE: A post-development hydrologic model has been prepared. It is included in Appendix E of the revised drainage report.

September 12, 2001

29. The geotechnical analysis would not be needed if it was if it was assumed that the Beardsley Canal would indeed fail and that the failure would occur at the "worst case" location, i.e., at the eastern end of the Zone A north of the canal. It would only be needed if the intent were to demonstrate that overtopping of the canal would occur at (a) discrete location(s).
RESPONSE: Please see comment no. 27

30. Per David, the consensus of the August 28 meeting included an assessment of what impacts the Zone A south of canal has on the proposed development. The information we are requiring is simply what is needed to determine those impacts.
RESPONSE: As discussed in the drainage report, it is proposed to remove this Zone A through a CLOMR/LOMR.

Stantec Consulting Inc.
8211 South 48th Street
Phoenix AZ 85044
Tel: (602) 438-2200 Fax: (602) 431-9562
stantec.com

Stantec

September 19, 2001
File Number: 81500770-32

John Hathaway, P. E,
Maricopa County Flood Control District
Hydrology
2810 West Durango Street
Phoenix, Arizona 85009
602-506-4973

FLOOD CONTROL DISTRICT
RECEIVED
SEP 19 '01

C & S.W.	FINANCE
PIO	LANDS
ADMIN	C & W
REG	F & PW
ENG	FILE
CONTRACTS	
ROUTING	

RE: RANCHO CABRILLO
Revised Drainage Report / Pre-Post Analysis

Dear John Hathaway;

Enclosed you will find:

1. Two (2) copies of the revised PRELIMINARY MASTER DRAINAGE REPORT FOR RANCHO CABRILLO.
2. Two (2) copies of the written ZONE CHANGE TAC COMMENTS AND RESPONSES, responding to the current MCFCD comments.

Please review both of these as soon as possible. As you know Scott Homes is anxious to remain on the October 4, 2001 agenda for the Planning and Zoning Commission hearing. It is our understanding that MCFCD review of these documents is critical to this agenda.

Please contact Bob Murphy or Ghassan Aquad if you have any questions regarding the content of these documents. 602-438-2200

Thank you for your cooperation in this matter. As always, we look forward to working with you.

Best regards,
Stantec Consulting Inc.

Penny Milton, AICP
Urban Land Division, Associate

COPIED: A copy of the above has been sent to Charles Hart of Maricopa County Planning
ENCLOSURES: Drainage Report and written TAC Comment Responses.

K:\81500770-Rancho\communications\letters\9-19-MCFCD-del Drain Rpt.doc

Buildings
Environment
Industrial
Transportation
Urban Land

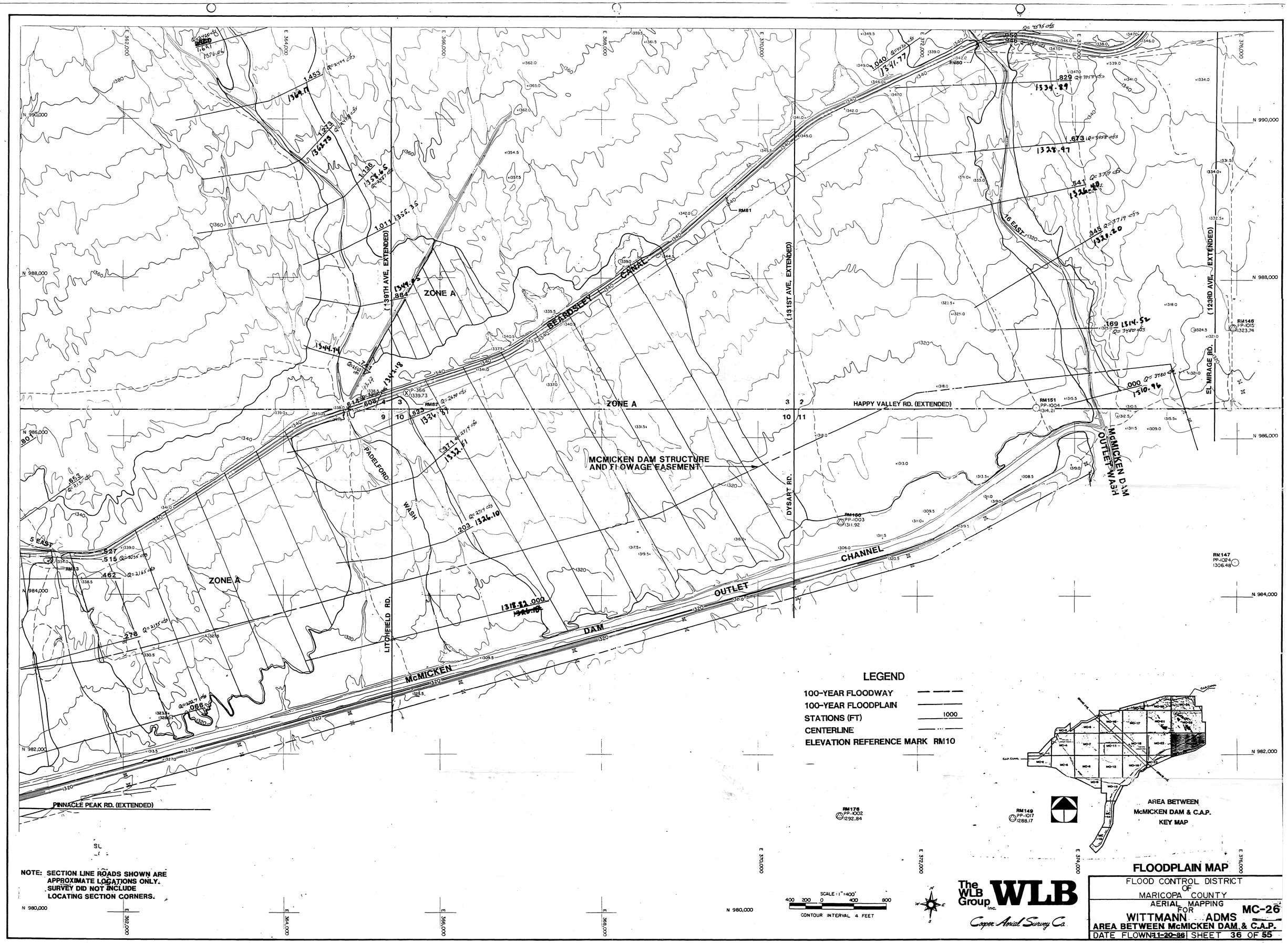
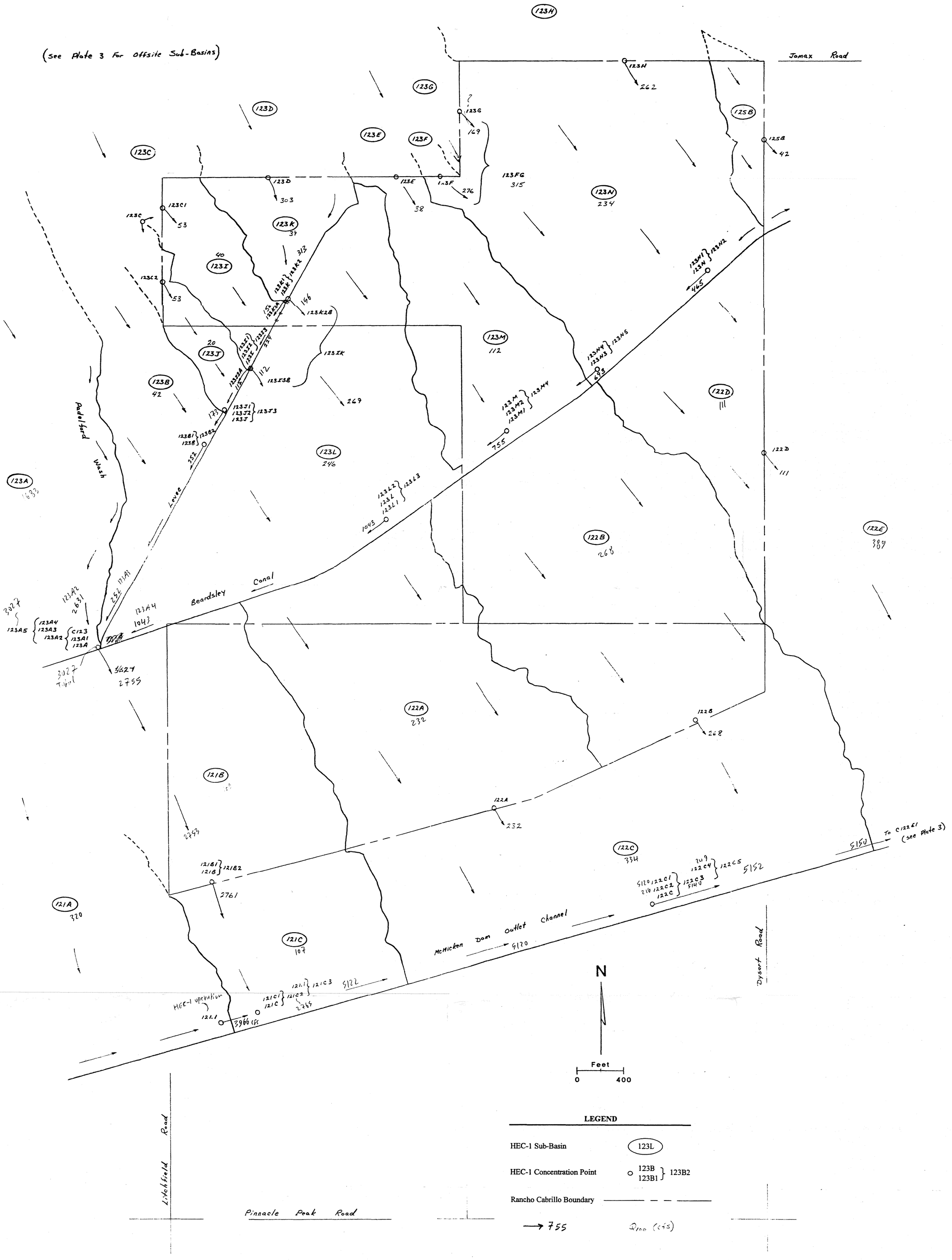

ZONE A
BEARDSLEY CANAL
(139TH AVE. EXTENDED)
(131ST AVE. EXTENDED)
(123RD AVE. EXTENDED)
HAPPY VALLEY RD. (EXTENDED)
MCMICKEN DAM STRUCTURE AND FLOWAGE EASEMENT
McMICKEN DAM OUTLET WASH
PADELFORD WASH
DYSART RD.
EL MIRAGE RD.
LITCHFIELD RD.
McMICKEN DAM OUTLET CHANNEL
PINNACLE PEAK RD. (EXTENDED)
5 EAST
16 EAST
LEGEND
100-YEAR FLOODWAY
100-YEAR FLOODPLAIN
STATIONS (FT)
CENTERLINE
ELEVATION REFERENCE MARK RM10
AREA BETWEEN McMICKEN DAM & C.A.P. KEY MAP
NOTE: SECTION LINE ROADS SHOWN ARE APPROXIMATE LOCATIONS ONLY. SURVEY DID NOT INCLUDE LOCATING SECTION CORNERS.
SCALE: 1"=400'
CONTOUR INTERVAL 4 FEET
The WLB Group Inc. WLB
Cooper Aerial Survey Co.
FLOODPLAIN MAP
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
AERIAL MAPPING FOR WITTMANN ADMS
MC-26
AREA BETWEEN McMICKEN DAM & C.A.P.
DATE FLOWN 11-20-86 | SHEET 36 OF 55

FIG. 4A

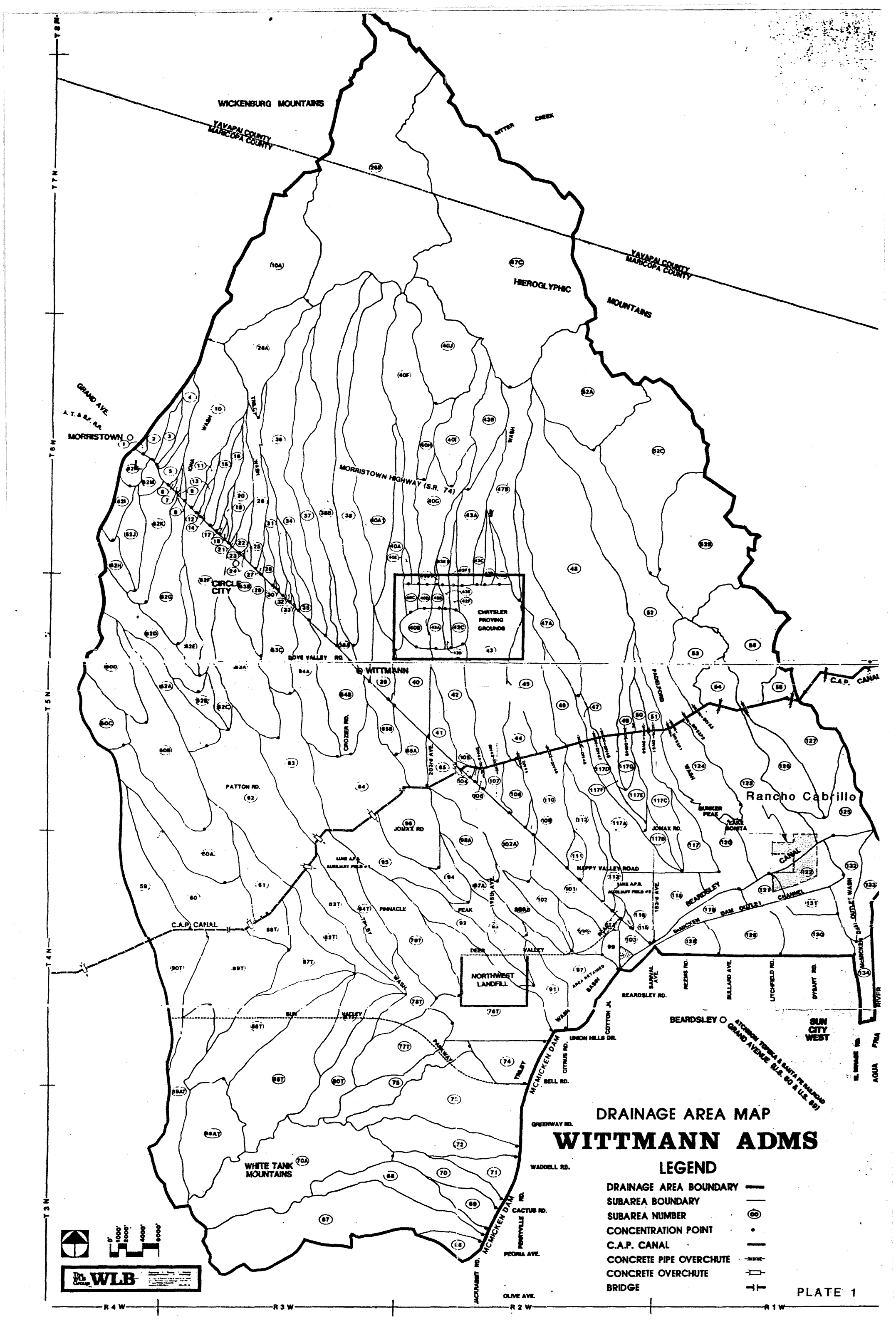


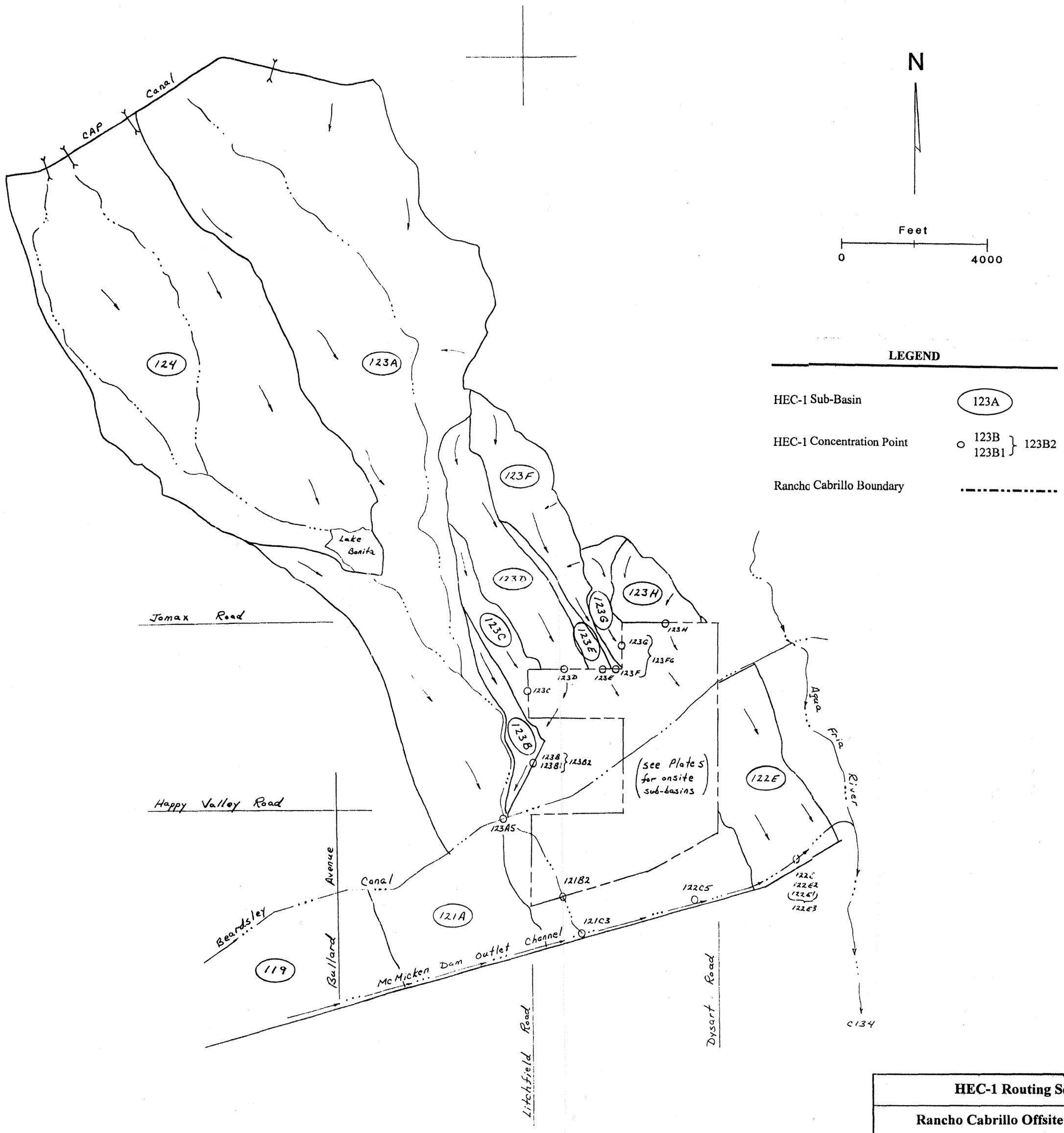
HEC-1 Routing Schematic

Rancho Cabrillo Onsite Drainage Area

Maricopa County, Arizona

May 9, 2000 **PLATE 5**


DRAINAGE AREA MAP
WITTMANN ADMS
LEGEND
DRAINAGE AREA BOUNDARY
SUBAREA BOUNDARY
SUBAREA NUMBER
CONCENTRATION POINT
C.A.P. CANAL
CONCRETE PIPE OVERCHUTE
CONCRETE OVERCHUTE
BRIDGE
PLATE 1
WICKENBURG MOUNTAINS
YAVAPAI COUNTY
MARICOPA COUNTY
HIEROGLYPHIC MOUNTAINS
MORRISTOWN
CIRCLE CITY
MORRISTOWN HIGHWAY (S.R. 74)
CHRYSLER PROVING GROUNDS
WITTMANN
DOVE VALLEY RD.
PATTON RD.
JOMAX RD.
HAPPY VALLEY ROAD
PINNACLE PEAK ROAD
DEER VALLEY
NORTHWEST LANDFILL
BEARDSLEY RD.
BEARDSLEY
SUN CITY WEST
UNION HILLS DR.
BELL RD.
GREENWAY RD.
WADDELL RD.
CACTUS RD.
PEORIA AVE.
OLIVE AVE.
WHITE TANK MOUNTAINS
Rancho Cabrillo
C.A.P. CANAL
McMICKEN DAM
GRAND AVE.
A.T.&S.F. R.R.
R 4 W
R 3 W
R 2 W
R 1 W
T 8 N
T 7 N
T 6 N
T 5 N
T 4 N
T 3 N
WLB

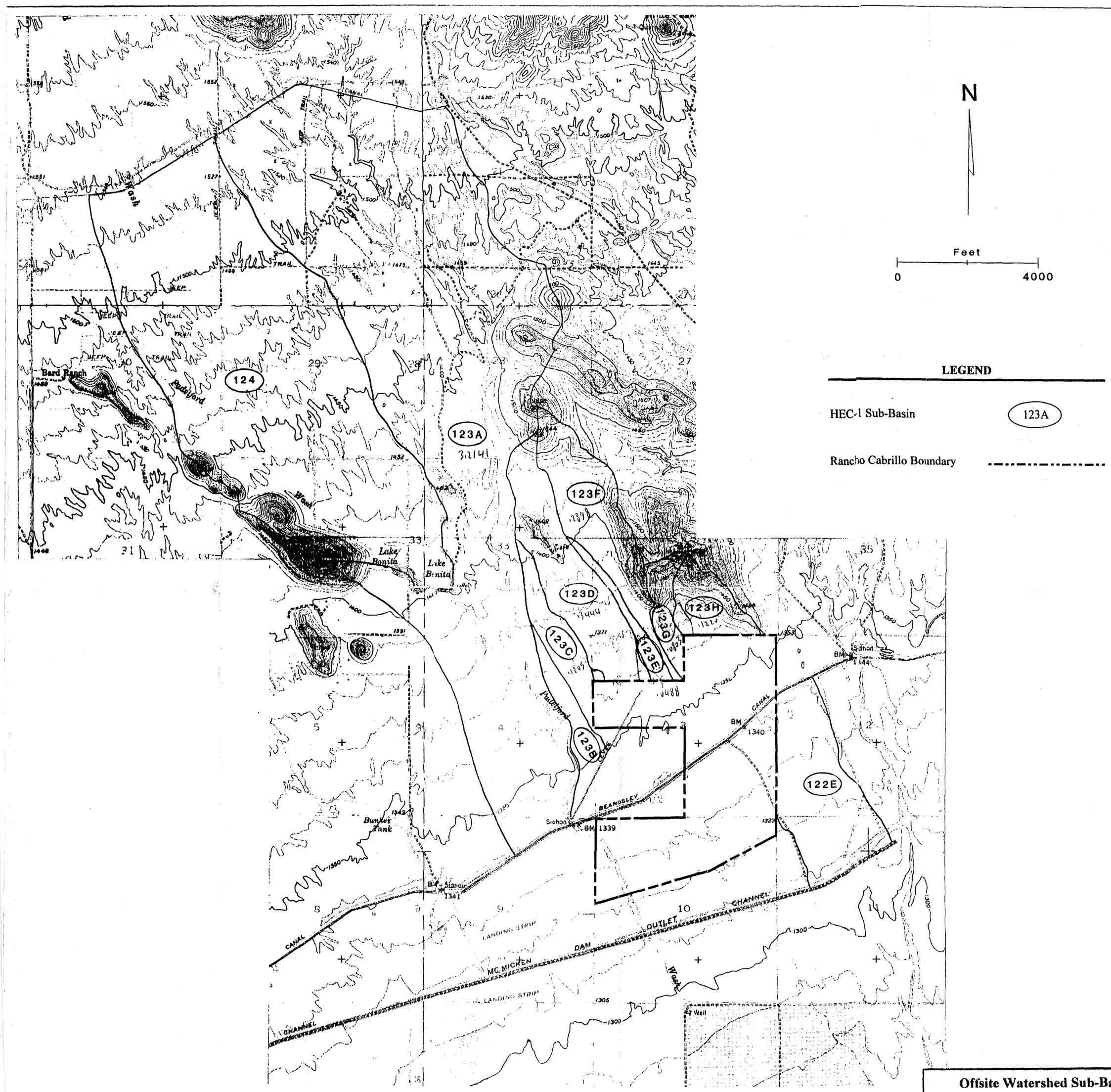


HEC-1 Routing Schematic

Rancho Cabrillo Offsite Drainage Area

Maricopa County, Arizona

May 9, 2000 **PLAT**



Offsite Watershed Sub-Basin Boundaries

Rancho Cabrillo

Maricopa County, Arizona

May 9, 2000 **PLATE**

Electronic files for Appendix A-1 are included on disk. Disks are located at end of report.

APPENDIX A1

Pre-development Drainage

HYDROLOGY ANALYSIS

Pre-Development

Rancho Cabrillo

Maricopa County, Arizona

prepared for:

Stantec Consulting, Inc.
8211 South 48th Street
Phoenix, Arizona 85044-5355

prepared by:

Robert L. Ward, P.E.
Consulting Engineer
5345 East McLellan Road, #112
Mesa, Arizona 85205
(480) 924-5962

Robert L. Ward

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13505
ROBERT L.
WARD
Date Signed 5/11/2000
ARIZONA U.S.A.

May 11, 2000

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Robert L. Ward

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13505
ROBERT L.
WARD
Date Signed 5/11/2000
ARIZONA U.S.A.

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1 PURPOSE OF STUDY

The purpose of this report is to present the results of a pre-development hydrology analysis for a proposed master-planned community known as Rancho Cabrillo. This property, which is located in portions of Sections 3 and 10, T4N, R1W, contains approximately 579 acres. A vicinity map, showing the property location, is enclosed as Figure 1.1.

A pre-development hydrology model was created to establish a baseline condition to: 1) measure inflows along the upstream property boundaries; 2) provide the basis for creating a concept to pass the offsite flows through the property; and 3) provide a comparison to discharges associated with a post-development hydrologic model so that any required drainage mitigation measures can be identified.

This area has previously been modeled as part of the **Wittman Area Drainage Master Study** (ADMS) that was prepared by The WLB Group, Inc. in 1988 for the Flood Control District of Maricopa County (FCDMC). Based on coordination meetings with FCDMC staff on January 13, 2000 and March 6, 2000, it was agreed that the Wittman ADMS HEC-1 model would be the basis for measuring any post-development hydrologic impacts associated with the proposed development. Accordingly, a fourth objective of this study is to present the changes that were made to the Wittman ADMS in order to receive FCDMC approval in using the revised HEC-1 model as the basis for initiating the drainage study for Rancho Cabrillo.

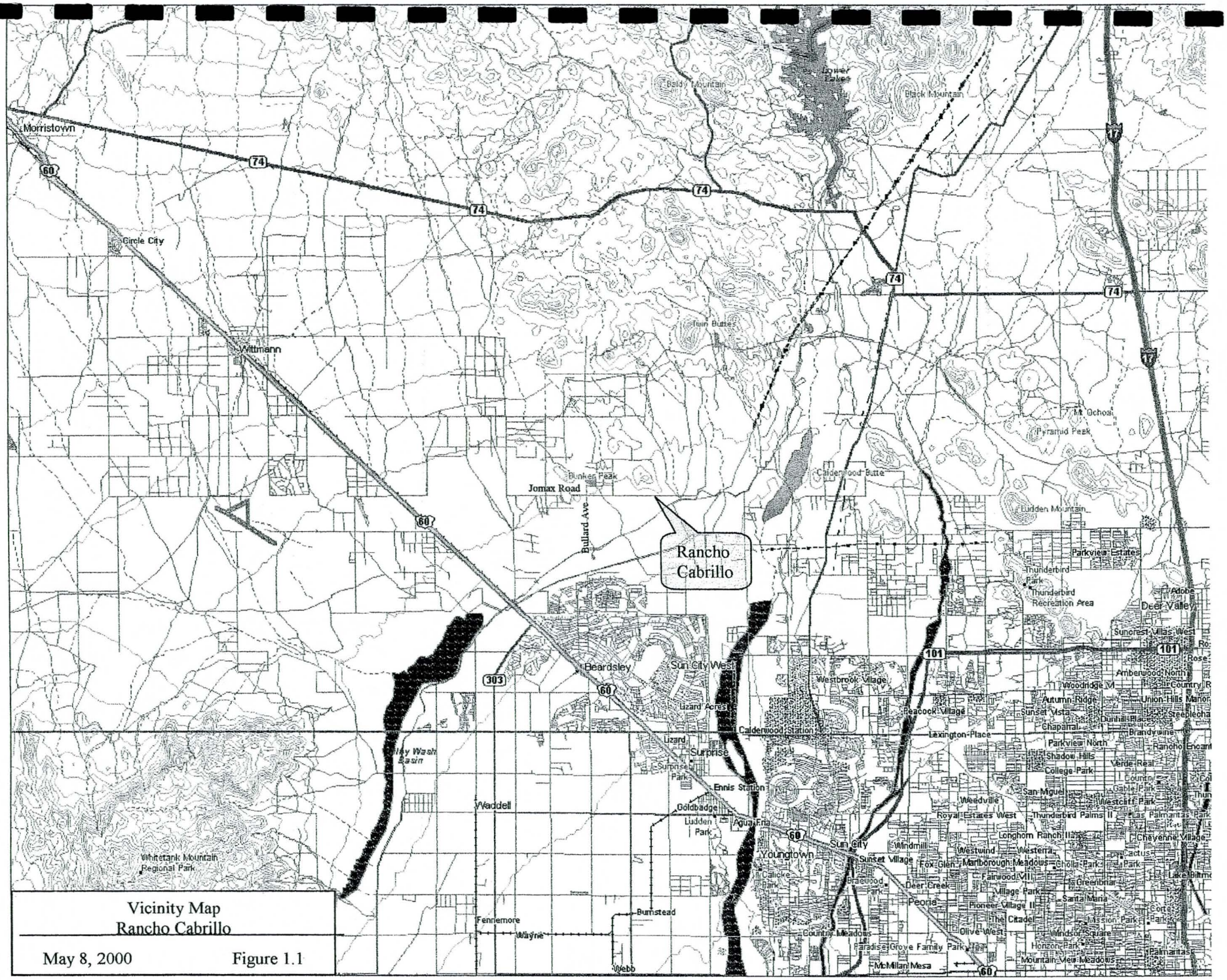
FCDMC provided an electronic copy of HEC-1 file WTM100YR, which is the WLB file for the 100-year, 24-hour storm for the Wittman ADMS. Due to the large size of the sub-basins in this model, it was agreed that those sub-basins draining into the boundaries of Rancho Cabrillo would be sub-divided into smaller areas in order to more accurately identify the rates of runoff that will enter specific locations along the property boundaries.

The following sections of this report discuss the modifications that were made to the WLB HEC-1 model in order to establish the pre-development hydrologic condition for Rancho Cabrillo.

A post-development hydrology model will eventually be prepared to identify any post-development increase in peak discharge at the downstream property boundaries. The final subdivision plans will include mitigation measures that will reduce the post-development discharges to flow rates that are at, or below, those associated with pre-development conditions.

2 HYDROLOGY PARAMETERS & REVISIONS

A computerized rainfall/runoff model was developed for the project watershed using the U.S. Army corps of Engineers *Flood Hydrograph Package* (HEC-1). HEC-1 uses numerical parameters to describe the amount and temporal distribution of rainfall, the runoff characteristics of the watershed, and the hydraulic properties of channels that collect and convey runoff to concentration points. The computer output provides a runoff hydrograph at user-selected locations.


Morristown
Circle City
Wittmann
Jomax Road
Bullard Ave
Rancho Cabrillo
Beardsley
Sun City West
Surprise
Waddell
Whitetank Mountain Regional Park
Youngtown
Sun City
Peoria
Deer Valley
Parkview Estates
Thunderbird Recreation Area
Westbrook Village
Peacock Village
Calderwood Station
Lexington Place
Ennis Station
Goldbadge
Agua Fria
Fennemore
Wayne
Burnstead
Webb
McMillan Mesa
Lower Lakes
Black Mountain
Baldy Mountain
Twin Buttes
Bunker Peak
Calderwood Butte
Ludden Mountain
Pyramid Peak
Mt Ochos
Lizard Acres
Lizard
Surprise Park
Ludden Park
Calicke Park
Braewood Park
Deer Creek
Country Meadows
Paradise Grove Family Park
Olive West
The Citadel
Pioneer Village II
Village Park
Fairwood VII
Marlborough Meadows
Fox Glen
Westwind
Westerra
Windmill
Sunset Village
Royal Estates West
Weedville
Thunderbird Palms II
Longhorn Ranch II
Cheyenne Village
Cactus Park
Cholla Park
Greenbriar
Santa Maria
Mission Park
Windsor Square
Horizon Park
Mountain View Meadows
Palmaritas
Las Palmaritas Park
Westcliff Park
Gable Park
San Miguel
Verde Real
College Park
Shadow Hills
Parkview North
Chaparral
Sunset Vista
Autumn Ridge
Woodridge
Amberwood North
Union Hills Manor
Steeplechase
Brandywine
Rancho Encanto
Country R
Rose
Sunrest Villas West
Lake Pilmo
Cort Park
Thun
Col
Ro
Adobe
Valley Wash Basin
Morristown
Circle City
Wittmann
Jomax Road
Rancho Cabrillo
Beardsley
Sun City West
Surprise
Waddell
Youngtown
Sun City
Peoria
Deer Valley
Lake Pilmo
Vicinity Map
Rancho Cabrillo
May 8, 2000
Figure 1.1

2.1 HEC-1 Program Version

The original WLB HEC-1 model was run under a 1985 version of HEC-1 that was distributed by Haestad Methods as Version 3.1a. This program version included a modification by Haestad Methods that allowed 900 time ordinates to be calculated for each hydrograph, compared to only 300 ordinates allowed in the 1985 program version distributed by the Corps of Engineers.

For unknown reasons, the 1985 Heastad version of HEC-1 would not execute the revised HEC-1 file that was created for Rancho Cabrillo. Accordingly, a joint decision was made with FCDMC to use the June 1992 version (4.0.3E) of HEC-1 for this analysis. This 1992 program version is proposed for both the pre- and post-development hydrologic models that will be developed for Rancho Cabrillo. The pre-development model is included in this report.

2.2 Drainage Area Delineations

The Rancho Cabrillo boundaries were superimposed onto both the USGS quadrangle map that was used by WLB to delineate sub-basin boundaries for the Wittman ADMS, as well as onto the HEC-1 routing schematic that was developed by WLB. Plate 1 is a copy of the original WLB HEC-1 routing schematic that also shows the location of the Rancho Cabrillo property boundaries. As shown in Plate 1, the Rancho Cabrillo boundaries encompass portions of WLB Sub-Basins 121, 122, 123 and 125. Accordingly, these sub-basins will require more detailed subdividing in order to provide the hydrologic detail needed along the Rancho Cabrillo boundaries.

Plate 2 is a USGS quadrangle map that illustrates the revisions that were made to the WLB sub-basins for the offsite drainage areas that surround Rancho Cabrillo. The accompanying HEC-1 routing schematic is shown on Plate 3.

Onsite drainage boundaries are shown on Plate 4, while Plate 5 shows the HEC-1 routing schematic for the onsite sub-basins. For reference purposes, the tie-in to the offsite sub-basins are also shown on Plate 5. Accordingly, the reader can look at both Plates 3 and 5 to view the transition from the offsite to the onsite drainage pattern.

As a matter of interest, it should be noted that some of the WLB sub-basin boundaries have been incorrectly drawn on the USGS quadrangle map that was included in the Wittman ADMS report. It is not known whether the sub-basins were originally delineated incorrectly, or, whether there was a drafting error involved when the sub-basin boundary maps were prepared for the final report. All sub-basins that impact the Rancho Cabrillo site have been re-drawn and independently measured as part of this current study.

Sub-basin 121 was divided into Sub-Basins 121A, 121B, and 121C. Sub-Basins 121B and 121C extend slightly further to the east than does the original east WLB boundary for Sub-Basin 121. Sub-Basins 121, 121B, and 121C were traced onto a 1" = 2000' map. That portion of new Sub-Basins 121B and 121C that overlapped into the original Sub-Basin 121 was planimetered, and subsequently deducted from the original WLB area for Sub-Basin 121.

The resulting sub-basin area was designated 121A. The areas of Sub-Basins 121B and 121C were planimetered from a new 1" = 400' topographic map (see Plate 4).

WLB Sub-Basin 122 was sub-divided into Sub-Basins 122A, 122B, 122C, 122D, and 122E. The total planimetered area for these five sub-basins was 1.0856 square miles, which compares favorably with WLB's area of 1.10 square miles for Sub-Basin 122.

A problem was noted with Sub-Basin 123. The WLB HEC-1 file lists Sub-Basins 123, 123A, 123B, and 123C. However, the WLB HEC-1 routing schematic map only shows Sub-Basin 123. FCDMC staff was unable to find any additional WLB maps that would indicate where Sub-Basins 123A, B, and C were located. Accordingly, new sub-basin delineations were prepared and measured for Sub-Basin 123, as shown on the WLB routing schematic map.

WLB Sub-Basin 123 was subdivided into Sub-Basins 123A through N, which have a combined drainage area of 4.8683 square miles. The combined drainage area for WLB basins 123 and 123A-C was 5.42 square miles. There was no way to account for the 0.5517 square mile difference between the WLB area and the new area measured for this study.

As a matter of technical interest, the WLB HEC-1 input file also lists Sub-Basins 124, 124A, and 124B. However, only Sub-Basin 124 is shown on the HEC-1 routing schematic prepared by WLB. FCDMC staff could find no information to explain this discrepancy. No changes were made to the 124 series sub-basins as part of this current study for Rancho Cabrillo.

A small portion of WLB Sub-Basin 125 lies in the northeast corner of Rancho Cabrillo. Accordingly, Sub-Basin 125B was delineated to address this small area. WLB Sub-Basin 125 was then renamed Sub-Basin 125A, and had its drainage area decreased by the amount assigned to Sub-Basin 125B.

The total drainage area in the original WLB model for the Wittman ADMS was 322.99 square miles at Concentration Point C134. With the Rancho Cabrillo sub-basin modifications in-place, the total drainage area at C134 was 322.80 square miles.

2.3 Curve Numbers

The WLB model used the SCS curve number methodology to model rainfall losses within the Wittman ADMS watershed. For consistency, this same method was used for the Rancho Cabrillo revisions presented in this study.

As a matter of technical interest, it should be noted that the Hydrologic Soil Group (HSG) map that was published as part of the WLB report for the Wittman ADMS contains a major typographical error. The Legend for this map has reversed the symbols for HSG B and C, i.e., those areas on the map designated as B soils are really C soils, while the designated C soils are B soils. This error was verified by checking the SCS soil maps from the **Soil Survey of Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona**, April 1986, Soil Conservation Service, USDA, and **Soil Survey of Maricopa County, Arizona, Central Part**, September 1977, Soil Conservation Service, USDA.

New curve numbers were computed for all sub-divided sub-basins used in the Rancho Cabrillo analysis. The new sub-basin delineations were overlaid on the SCS soil maps. The percentage of each HSG within each sub-basin was then recorded and a weighted curve number was calculated. All curve number calculations were based on desert land-use in "POOR" hydrologic condition, which is consistent with the WLB assumptions for this region of the Wittman ADMS watershed. No impervious cover was used for any of the updated sub-basins. Existing development in this area is extremely sparse.

Table 2.1 lists the curve number calculations for the revised sub-basins used in the Rancho Cabrillo analysis.

2.4 Kinematic Wave Overland Flow Parameters (UK Record)

The original WLB Sub-Basins 121, 122, 123, and 125 were modeled with kinematic wave procedures. With three exceptions, the same WLB values for overland flow lengths, slope, and roughness were assigned to the new sub-divided sub-basins that were located within the original, parent WLB sub-basin. For example, Sub-Basins 121A, 121B, and 121C were assigned the same length, slope, and roughness values that were used in WLB Sub-Basin 121.

The three exceptions occurred where the slope and roughness were slightly modified to reflect some mountainous terrain in Sub-Basins 123G, 123H, and 125B.

2.5 Kinematic Wave Channel Routing Parameters (RK Record)

For the new sub-basins delineated for this study, kinematic wave channel parameters (lengths and slopes) were measured from both USGS quadrangle maps and new 1-foot contour interval mapping (Plate 4) that was prepared for Rancho Cabrillo. Channel bottomwidths, side-slopes, and roughness were estimated on the basis of engineering judgement, site inspection observations, and topographic mapping.

The original WLB RK record from Sub-Basin 123 was used for new Sub-Basin 123A.

2.6 Muskingum Channel Routing Parameters (RM Record)

The WLB model used Muskingum routing procedures to route hydrographs between concentration points. For consistency, Muskingum procedures were also used for the routing operations between the new sub-basins that were created for the Rancho Cabrillo study.

The WLB model used a constant Muskingum "X" coefficient of 0.2 for all routing operations in the Wittman ADMS. For consistency, an "X" of 0.2 was also used for all new routing operations for the Rancho Cabrillo modifications. The "X" coefficient affects the amount of hydrograph attenuation through a routing reach. An "X" of zero would cause maximum attenuation in the peak discharge, while an "X" of 0.5 would result in pure translation of the peak discharge, with no attenuation.

The Muskingum "K" coefficient represents travel time through the routing reach and was computed as "length ÷ velocity" (hours). The number of routing steps (variable NSTPS) was

Table 2.1
Summary of Curve Number Calculations
Rancho Cabrillo
Maricopa County, Arizona

Sub-Basin	HSG CN	Percentage Of HSG In Sub-Basin				Composite CN	Assigned Percent Impervious
		A 63	B 77	C 85	D 88		
121A		0	100	0	0	77.0	0
121B		0	100	0	0	77.0	0
121C		0	100	0	0	77.0	0
122A		0	100	0	0	77.0	0
122B		0	100	0	0	77.0	0
122C		0	100	0	0	77.0	0
122D		0	100	0	0	77.0	0
122E		0	100	0	0	77.0	0
123A		0	90	0	10	78.1	0
123B		0	100	0	0	77.0	0
123C		0	100	0	0	77.0	0
123D		0	88	0	12	78.3	0
123E		0	100	0	0	77.0	0
123F		0	50	0	50	82.5	0
123G		0	55	0	45	82.0	0
123H		0	50	10	40	82.2	0
123I		0	100	0	0	77.0	0
123J		0	100	0	0	77.0	0
123K		0	100	0	0	77.0	0
123L		0	100	0	0	77.0	0
123M		0	100	0	0	77.0	0
123N		0	100	0	0	77.0	0
125B		0	5	30	65	86.6	0

CN based on "Desert Shrub" in "POOR" hydrologic condition.

computed as "length ÷ velocity ÷ Δt", where Δt (computation interval) was set at 3 minutes to match that used by WLB. The computed value of "K" was checked against the recommended minimum and maximum limits prescribed in the HEC-1 Users Manual.

Table 2.2 summarizes the Muskingum routing parameters that were used for the Rancho Cabrillo routing modifications.

2.7 Levee Breach

At the present time, an earthen levee extends in a northeasterly direction from the intersection of Padelford Wash and the Beardsley Canal. This levee, which is approximately 4,200-feet long, includes a small channel along the northwest side of the levee.

A site inspection of this levee revealed four locations where the levee had been breached. These breach locations are located in Sub-Basins 123I and 123K. In order to acknowledge these levee breaches, two divert operations have been included in the model to allow water flowing along the levee to pass through the levee at Concentration Points 123I3 and 123K2. For the purpose of this study, the divert ratios at these two points were set at 50/50, i.e., 50% of the flow will continue flowing southwest along the levee while the remaining 50% will pass through the levee. Different diversion ratios could be evaluated during final design in order to define a best and worst-case condition.

These levee breach locations were not modeled in the Wittman ADMS. Any water that flows through the existing breach locations will be intercepted by the Beardsley Canal embankment and directed southwest to Padelford Wash, which is the same location that the non-diverted flows are routed to.

3 SUMMARY OF RESULTS

As stated previously, the original WLB model for the Wittman ADMS was run under a 1985 Haestad Methods version of HEC-1. Due to unresolvable programming errors in this Haestad Methods version, this updated model for Rancho Cabrillo was run under the June 1992 version (4.0.3E) of HEC-1. This updated program version, along with the Rancho Cabrillo modeling update, was used to establish a new pre-development hydrologic baseline for the Wittman ADMS.

For comparison purposes, Table 3.1 presents a hydrologic summary of peak discharges at major concentration points. This table compares data from: 1) the original WLB model run under the 1985 Haestads Methods HEC-1 version; 2) the original WLB model run under the 1992 HEC-1 version; and 3) the Rancho Cabrillo update run under the 1992 HEC-1 version.

A magnetic disk, containing the HEC-1 input and output files RC1.24I and RC1.24O for the pre-development land-use condition with the Rancho Cabrillo sub-basins in-place, is enclosed with this report. It is recommended that the discharges associated with this updated model (RC1, run under the 1992 version 4.0.3E of HEC-1) be used as the baseline condition to measure any post-development increases in discharge that might result from the proposed Rancho Cabrillo development.

Table 2.2
Summary of Muskingum Channel Routing Data
Rancho Cabrillo
Pre-Development Conditions

Muskingum X = 0.2
Computation Interval (NMIN) = 3

Routing Operation	Length (ft)	Velocity (fps)	Routing Environment	Travel Time Muskingum "K" (AMSKK) (hrs)	No. Routing Steps (NSTPS)		Limit Check			AMSKK Limit Status
					Computed	Used	1 / 2(1-X)	AMSKK * 60 / (NMIN * NSTPS)	1 / 2X	
54.1 - 123A1	23,500	5	Desert	1.306	26.1	26.1	0.625	1.000	2.500	OK
123D - 123K1	1,100	5	Desert	0.061	1.2	1.2	0.625	1.019	2.500	OK
123K2A - 123I1	675	5	Levee	0.038	0.8	0.8	0.625	0.938	2.500	OK
123C1 - 123I2	1,560	5	Desert	0.087	1.7	1.7	0.625	1.020	2.500	OK
123I3A - 123J1	425	5	Levee	0.024	0.5	0.5	0.625	0.944	2.500	OK
123C2 - 123J2	1,250	5	Desert	0.069	1.4	1.4	0.625	0.992	2.500	OK
123J3 - 123B1	350	5	Levee	0.019	0.4	0.4	0.625	0.972	2.500	OK
123B2 - 123A3	2,000	5	Levee	0.111	2.2	2.2	0.625	1.010	2.500	OK
123H - 123N1	2,150	5	Desert	0.119	2.4	2.4	0.625	0.995	2.500	OK
123N2 - 123N3	1,400	2	Canal Embankment	0.194	3.9	3.9	0.625	0.997	2.500	OK
123FG - 123N4	2,250	5	Desert	0.125	2.5	2.5	0.625	1.000	2.500	OK
123N5 - 123M1	850	2	Canal Embankment	0.118	2.4	2.4	0.625	0.984	2.500	OK
123E - 123M2	2,450	5	Desert	0.136	2.7	2.7	0.625	1.008	2.500	OK
123M4 - 123L1	1,330	2	Canal Embankment	0.185	3.7	3.7	0.625	0.998	2.500	OK
123IK - 123L2	1,950	5	Desert	0.108	2.2	2.2	0.625	0.985	2.500	OK
123L3 - 123A3	2,800	2	Canal Embankment	0.389	7.8	7.8	0.625	0.997	2.500	OK
123A4 - 121B1	2,360	7	Padelford Wash	0.094	1.9	1.9	0.625	0.986	2.500	OK
121B2 - 121C1	1,200	7	Padelford Wash	0.048	1.0	1.0	0.625	0.952	2.500	OK
121C4 - 122C1	3,600	5	McMicken Channel	0.200	4.0	4.0	0.625	1.000	2.500	OK
122A - 122C2	1,200	5	Desert	0.067	1.3	1.3	0.625	1.026	2.500	OK
122B - 122C4	1,500	5	Desert	0.083	1.7	1.7	0.625	0.980	2.500	OK
122C5 - 122E1	3,400	5	McMicken Channel	0.189	3.8	3.8	0.625	0.994	2.500	OK
122D - 122E2	3,800	5	Desert	0.211	4.2	4.2	0.625	1.005	2.500	OK
122E3 - CP132	10,800	7	Aqua Fria	0.429	8.6	8.6	0.625	0.997	2.500	OK
125B - 125B1	2,500	3	Desert / Canal Embk	0.231	4.6	4.6	0.625	1.006	2.500	OK

File: Rancho Cabrillo HEC-1 Data.xls

Table 3.1
Summary Of Peak Discharge Comparison
Wittman ADMS & Rancho Cabrillo Revisions

100-Year, 24-Hour Storm
SCS Type 2 Rainfall Distribution

HEC-1 Concentration Point	Drainage Area (sq. miles)	Peak Discharge (cfs)		
		1992 HEC-1 Version 4.0.3E		1985 Haestads Methods
		RC1	WTM100YR	WTM100YR
C124	3.07	1,633	1,633	1,448
123A5	9.04	3,027	n/a	n/a
C123	9.34	n/a	3,090	2,718
121C3	303.64	5,122	n/a	n/a
C121	303.82	n/a	5,160	5,064
122E3	304.73	5,173	n/a	n/a
C122	304.92	n/a	5,188	5,087
C134	322.8	7,522	n/a	n/a
C134	322.99	n/a	6,875	6,522

See Plates 3 & 5 for concentration points for model RC1.

See WLB HEC-1 output file for concentration points for WTM100YR.

APPENDIX A2

Dam-Break Analysis for Lake Bonita

DAM-BREAK ANALYSIS
for
Lake Bonita
Maricopa County, Arizona

prepared for:

Stantec Consulting, Inc
8211 South 48th Street
Phoenix, Arizona 85044-5355

prepared by:

Robert L. Ward, P.E.
Consulting Engineer
5345 East McLellan Road, #112
Mesa, Arizona 85205

(480) 924-5962

September 19, 2000

Robert L. Ward

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13505
ROBERT L.
WARD
Date Signed 9/19/00
ARIZONA U.S.A.

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Robert L. Ward

Registered Professional Engineer (Civil)
CERTIFICATE NO.
13505
ROBERT L.
WARD
Date Signed 9/19/00
ARIZONA U.S.A.

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1 PURPOSE OF STUDY

The purpose of this report is to document the engineering analysis that was performed to provide insight into the downstream impact of a possible dam breach in the earth embankment that creates the Lake Bonita reservoir. This dam, which appears to be a stock-pond, is located in the southwest quarter of Section 33, T5N, R1W. The Lake Bonita reservoir intercepts runoff from the Padelford Wash watershed. Due to the ephemeral nature of this wash, the reservoir is frequently dry.

A portion of Padelford Wash passes about 700-feet west of the west boundary of the proposed Rancho Cabrillo development. Rancho Cabrillo is located in portions of Sections 3 and 10, T4N, R1W. The proximity of Padelford wash to Rancho Cabrillo has raised concerns (from the Flood Control District of Maricopa County) about the possible impact of a dam-break in the Lake Bonita embankment. Accordingly, this study was undertaken to provide an assessment of the potential impact that a dam-break might have on the western boundary of Rancho Cabrillo.

The dam-break analysis was performed with both the National Weather Service **Simplified Dam-Break Flood Forecasting Model** (SPMDBK), and, the **Dam-Breach Simulation** option in the Corps of Engineers Flood Hydrograph Package (HEC-1).

The following sections discuss the modeling assumptions and results of this analysis.

2 EXISTING DAM CONFIGURATION

As stated previously, Lake Bonita is an earth dam. It is not known if any design drawings and specifications were ever prepared for this dam.

Stantec Consulting, Inc. performed a ground survey of the dam embankment during August 2000. This survey information was used to develop a topographic contour map for a portion of the embankment. Spot elevations from this survey indicate a low point in the main embankment at approximately elevation 1415.76. The embankment toe elevation at this same location was 1401.39. Accordingly, the embankment height at this location is 14.37-feet.

Based on topographic information from a 4-foot vertical contour map (see Plate 1) presented in the **Wittman Area Drainage Master Study** (ADMS), The WLB Group, Inc. 1998, there appears to be an embankment spillway located about 1300-feet north of the southeast corner of the dam. The spot elevation at this spillway location is 1411.0-feet MSL. The WLB HEC-1 reservoir routing operation for Lake Bonita indicates that the dam begins to discharge when the reservoir water levels exceed elevation 1411.0. This would indicate the presence of a spillway at this location.

The WLB HEC-1 model assumed that Lake Bonita was full to the spillway elevation of 1411.0-ft MSL prior to routing the 100-year, 24-hour storm through the reservoir. The maximum pool elevation achieved during this routing operation was approximately 1413-feet MSL.

Based on the results from the WLB HEC-1 model, the dam-break analyses presented in this report evaluated an embankment breach that could occur with a reservoir pool elevation of 1413-feet MSL. Since the reservoir was assumed to be full to the spillway invert elevation (1411-feet MSL) at the beginning of the storm, a pool elevation of 1413-feet MSL would simulate the occurrence of "back-to-back" 100-year, 24-hour storms.

3 DAM BREACH MODELS & FAILURE ASSUMPTIONS

The following sub-sections discuss the models and dam-break parameters that were used for both the SMPDBK and HEC-1 methods.

3.1 NWS Simplified Dam-Break Model

The following input data is required for the NWS SMPDBK analysis:

1. Reservoir flood-pool elevation when breaching begins
2. Final breach bottom elevation
3. Reservoir storage volume
4. Reservoir surface area
5. Final breach width
6. Time required for breach formation
7. Distance and cross-section geometry for downstream flood wave routing.

3.2 HEC-1 Dam-Break Model

The Lake Bonita watershed was previously modeled as part of the Wittman ADMS that was prepared by The WLB Group, Inc. in 1988 for the Flood Control District of Maricopa County (FCDMC). Based on coordination meetings with FCDMC staff on January 13, 2000 and March 6, 2000, it was agreed that the Wittman ADMS HEC-1 model would be the basis for measuring any post-development hydrologic impacts associated with the proposed development of Rancho Cabrillo.

The WLB HEC-1 model includes a reservoir routing operation for Lake Bonita. The dam breach option in HEC-1 was activated in this existing model by inserting an "SB" record into the reservoir routing data input file. The SB record requires the following input data:

1. Final breach bottom elevation
2. Width at the bottom of the breach
3. Side-slope of breach section, e.g., 0.5H:1V

4. Time required for breach formation

5. Reservoir flood-pool elevation when breach begins

HEC-1 does not require any data on the surface area of the flood-pool at the elevation at which the breach begins. Reservoir storage volume information is included on the SV/SE records, which are a standard part of the reservoir routing input data.

3.3 Failure Assumptions

In the absence of detailed geotechnical studies, and/or physical model simulations, the failure scenario (failure time and geometry) for the Lake Bonita dam embankment is a matter of engineering judgement. However, NWS publishes default values for earth dams that are a function of the breach height (H). These default values, which are listed in Table 3.1, are defined as follows:

Breach Width (B_r) = 3H

Breach Failure Time (t_f) = H/3

Dam-break scenarios were evaluated for these default failure parameters, as well as for different failure times and breach widths. Failure times of 3, 3.87 and 5-minutes were combined with average breach widths of 34.83 and 60.0-feet.

The breach parameters associated with a failure elevation of 1413-ft MSL are summarized in Table 3.1. The reservoir storage volumes in Table 3.1 were taken from the elevation-storage relationship in the WLB HEC-1 model. The surface areas were measured from the 1" = 400' topographic maps presented in the Wittman ADMS.

As discussed in Section 2, the failure elevation of 1413-ft MSL was chosen for this study because that is approximately the maximum reservoir pool elevation that is achieved during the reservoir routing analysis for the 100-year, 24-hour storm, with no dam-break. As stated previously, this Lake Bonita reservoir routing operation is from the HEC-1 model that was previously prepared for the Flood Control District by The WLB Group as part of the Wittman ADMS. The maximum pool elevation predicted by the WLB model is about 1413.2-ft MSL, with an accompanying spillway discharge of approximately 1,454 cfs.

HEC-1 will not initiate a dam-break analysis until the reservoir pool elevation reaches the specified failure elevation. Accordingly, the dam-break option would not be triggered if the failure elevation were to be set above approximately 1413.2. As a result, the failure elevation was set at 1413, thus insuring that the model would initiate an embankment failure.

As a matter of technical interest, it should be noted that the HEC-1 model also simulates spillway flows that would occur if the dam fails during passage of the 100-year, 24-hour storm. Accordingly, the HEC-1 "with spillway flow" scenarios represent the cumulative discharge of flow through both the dam breach and the spillway. Conversely, the SMPDBK model only represents flow that would pass through the dam breach.

Table 3.1
Summary Of Dam Breach Parameters
Lake Bonita

Reservoir Pool Elevation At Beginning Of Dam Failure (ft, MSL)	Final Elevation At Bottom Of Breach (ft, MSL)	(H) Breach Height (ft)	Reservoir Volume (AF)	Reservoir Surface Area (acres)	SMPDBK Default Values	
					Average Breach Width (Br) (ft)	Breach Failure Time (t_f) (minutes)
1413.00	1401.39	11.61	545.81	72.10	34.83	3.87

Note: $Br = 3H$, $t_f = H/3$

In order to analyze the impact of the spillway flows in the HEC-1 dam-break analysis, the WLB discharge record (SQ) was temporarily deleted from the reservoir routing operation. The model was then re-run and the results compared to the "with spillway flow" scenarios.

Figure 3.1 provides a graphical comparison of the SMPDBK versus HEC-1 dam-break results. HEC-1 results are plotted with and without spillway flows being added onto the dam-break discharge. When the spillway flows are removed from the HEC-1 model, the results compare very favorably with the SMPDBK discharges.

For comparison to the dam breach discharges, the natural spillway discharge from Lake Bonita is 1454 cfs during the 100-year, 24-hour storm. This discharge represents non-breach conditions as originally modeled by WLB in the Wittman ADMS.

The discharges plotted in Figure 3.1 are at the dam breach location. Accordingly, they do not reflect attenuation that would occur during routing through the downstream floodplain. The data used to plot Figure 3.1 is presented in Tables 4.1 and 4.2.

4 DOWNSTREAM ROUTING GEOMETRY

Downstream watercourse geometry is required to model the flood wave attenuation and hydraulic characteristics for areas located downstream from the dam-break. A breach of the eastern portion of the Lake Bonita embankment would direct a flood-wave towards Rancho Cabrillo. Flows through an east embankment breach would enter the Padelford Wash floodplain, which is a wide, braided ephemeral watercourse.

No analysis was made of a breach on the south embankment of Lake Bonita. A south embankment breach would present a less severe downstream impact to Rancho Cabrillo.

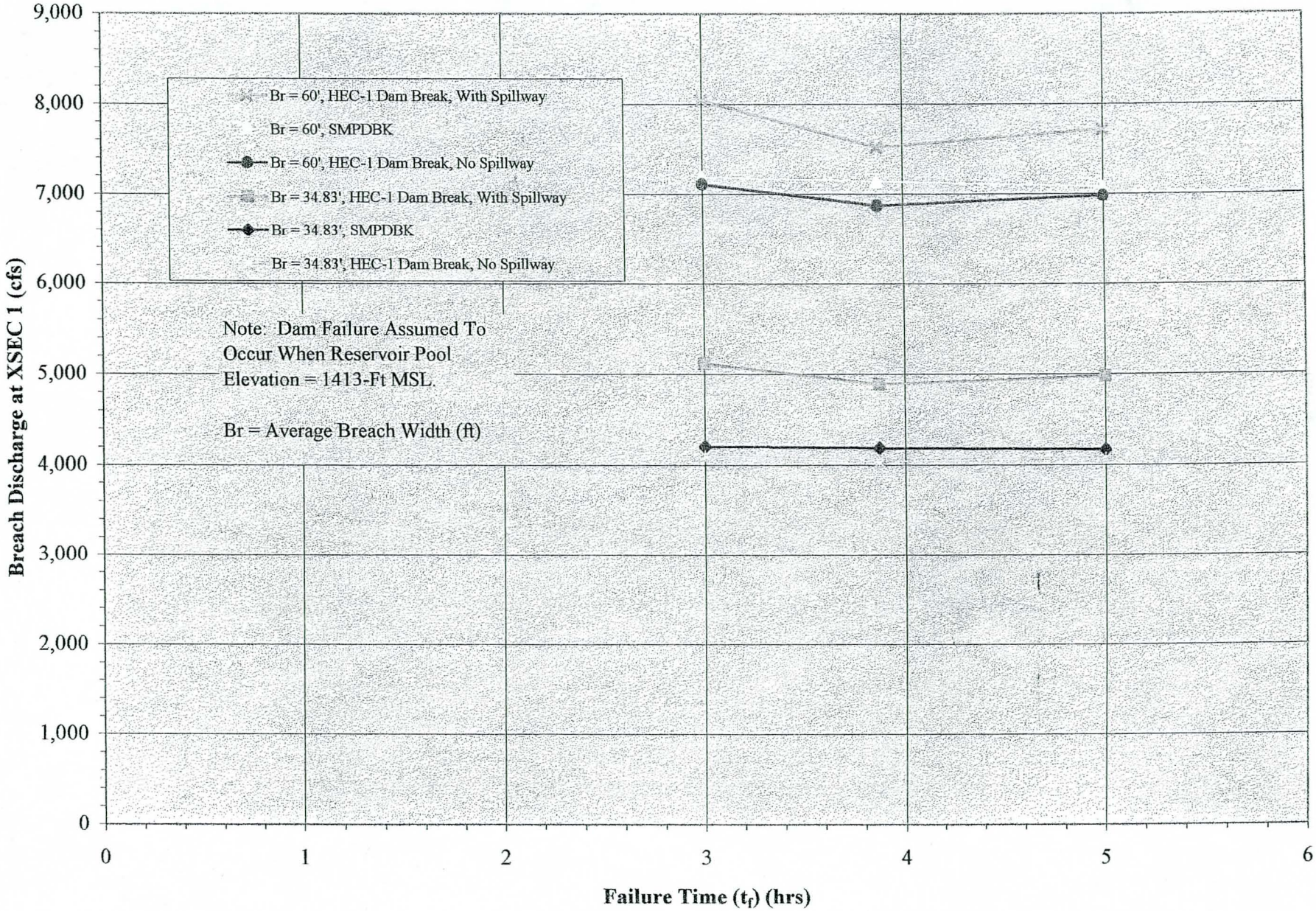
Due to the relatively flat nature of the topography below Lake Bonita, it would be logical to assume that a flood-wave associated with a dam-break would rapidly spread out into a wide area of shallow sheetflow. The following sections discuss the downstream routing operations for both the SMPDBK and HEC-1 dam-break methods.

4.1 SMPDBK Flood Wave Routing

Four cross-sections were used to model the flood-wave characteristics below Lake Bonita for the **SMPDBK** analysis. Geometric data for XSECs 2, 3, and 4 were taken from the 1"= 400' topographic maps presented in the Wittman ADMS. Plate 1 is an excerpt from the Wittman ADMS, which shows the original WLB HEC-2 cross-sections, as well as the four cross-sections that were used for the SMPDBK flood routing.

The SMPDBK cross-sections were centered on Padelford Wash. Conservative boundaries were placed on each cross-section to confine the extent of horizontal spreading, i.e., maximum widths of 870', 1550', and 1674' were used for XSECs 2, 3, and 4 respectively. XSEC 1 is located just beyond the downstream face of the dam breach. A 60-foot wide

Figure 3.1
Comparison Of SMPDBK Results vs HEC-1 Dam-Break Results
Lake Bonita



rectangular section was used for this cross-section. The total distance from Lake Bonita to XSEC 4 is 1.2 miles.

It should be noted that the required format for entering cross-sectional geometry into the SMPDBK model creates a very simple representation of the actual watercourse geometry. Instead of using a detailed elevation/station format as in HEC-2, SMPDBK simply requires that a channel width versus elevation table be used to describe a cross-section. SMPDBK also ignores backwater effects created by downstream flow obstructions.

Table 4.1 summarizes the results of the SMPDBK dam-break and routing analysis. Due to the "crudeness" of the downstream cross-sectional geometry used in the SMPDBK model, an HEC-RAS model was created to provide a more accurate picture of the downstream floodplain characteristics than that depicted in Table 4.1. The HEC-RAS model is discussed in Section 5 of this report.

4.2 HEC-1 Flood Wave Routing

The HEC-1 dam-break model used the original Muskingum routing operation from the Wittman ADMS to route the flood-wave from Lake Bonita (C124) to the Beardsley Canal. The downstream end of this routing operation is Concentration Point C123 in the WLB model, which is at the Beardsley Canal siphon crossing of Padelford Wash. The siphon crossing is near the west boundary of Rancho Cabrillo, and, approximately 1900-feet south of XSEC 4 that was used in the SMPDBK model (see Plate 1).

The results of the HEC-1 dam-break and downstream routing analysis are presented in Table 4.2. Separate columns are used in Table 4.2 to list the discharges that occur with and without spillway flows being added to the dam-break flow.

5 DOWNSTREAM FLOODPLAIN IMPACTS

As stated in Section 4, the downstream cross-sectional geometry used in the SMPDBK flood wave routing analysis is a very simplified representation of the actual watercourse geometry. In an effort to improve the accuracy of the hydraulic (floodplain) analysis that would be associated with a dam-break flood-wave reaching the west boundary of Rancho Cabrillo, a decision was made to use the Wittman ADMS HEC-2 model for Padelford wash. This model is published as part of the previously referenced 1988 WLB report. The Padelford Wash 100-year floodplain boundaries from the Wittman ADMS are shown on Plate 1.

The WLB HEC-2 model lists peak 100-year discharges in the 1400 to 2800 cfs range for the segment of Padelford Wash that lies between Lake Bonita and the McMicken Dam Outlet Channel (XSECs 0.000 to 2.021). These discharges are much lower than those associated with a dam breach of Lake Bonita.

Table 4.1
Summary of SMPDBK Dam Break Analysis
Lake Bonita Dam - Padelford Wash

Rancho Cabrillo
Maricopa County, Arizona

Dam Failure Occurs at Elevation 1413.00

XSEC No.	River Mile (Below Lake Bonita) (miles)	Average Breach Width (ft)	Failure Time (minutes)	Discharge (cfs)	Flow Depth (ft)	Dambreak File
1	0.00	34.83	3	4214	5.51	LB13
2	0.45	34.83	3	4053	2.84	
3	0.84	34.83	3	4028	2.47	
4	1.20	34.83	3	4011	1.79	
1	0.00	34.83	3.87	4198	5.51	LB14
2	0.45	34.83	3.87	4028	2.85	
3	0.84	34.83	3.87	4012	2.49	
4	1.20	34.83	3.87	3997	1.79	
1	0.00	34.83	5	4177	5.50	LB15
2	0.45	34.83	5	3999	2.86	
3	0.84	34.83	5	3992	2.49	
4	1.20	34.83	5	3978	1.78	
1	0.00	60	3	7190	7.65	LB16
2	0.45	60	3	6739	3.45	
3	0.84	60	3	6714	3.00	
4	1.20	60	3	6385	2.10	
1	0.00	60	3.87	7142	7.62	LB17
2	0.45	60	3.87	6683	3.46	
3	0.84	60	3.87	6668	3.01	
4	1.20	60	3.87	6346	2.10	
1	0.00	60	5	7080	7.58	LB18
2	0.45	60	5	6617	3.47	
3	0.84	60	5	6609	3.02	
4	1.20	60	5	6297	2.10	

Table 4.2
Summary of HEC-1 Dam Break Analysis
Lake Bonita Dam - Padelford Wash

Rancho Cabrillo
Maricopa County, Arizona

HEC-1, Dam Failure Occurs at Elevation 1413.00

HEC-1 CP	River Mile (Below Lake Bonita) (miles)	Average Breach Width (ft)	Failure Time (minutes)	Discharge (cfs) With Spillway Flow	Discharge (cfs) Without Spillway Flow	HEC-1 File
C124	0.00	34.83	3	5118	4107	RC2.24I/24O
C123	1.42	34.83	3	2966	2705	
C124	0.00	34.83	3.87	4891	4042	
C123	1.42	34.83	3.87	2931	2689	
C124	0.00	34.83	5	4981	4082	
C123	1.42	34.83	5	2939	2700	
C124	0.00	60	3	8040	7116	
C123	1.42	60	3	3975	3661	
C124	0.00	60	3.87	7521	6876	
C123	1.42	60	3.87	3895	3602	
C124	0.00	60	5	7718	6989	
C123	1.42	60	5	3908	3619	

Note: Q100 from Lake Bonita with no dam-break is 1,454 cfs.

Note: C123 is located at the Beardsley Canal

Table 5.1 presents a summary of the peak dam-break discharges along Padelford wash, between Lake Bonita and the McMicken Dam Outlet channel. The HEC-RAS cross-sections assigned to each concentration point are listed in Table 5.1. For comparison purposes, the 100-year, 24-hour discharges (no dam-break) are also listed in this table.

The HEC-1 concentration points in Table 5.1 correspond to the modified Wittman ADMS HEC-1 model that was previously published in **Hydrology Analysis, Pre-Development, Rancho Cabrillo, Maricopa County, Arizona**, May 11, 2000, Robert L. Ward, P.E. As part of this previous report, revisions were made to the Wittman ADMS HEC-1 model to provide smaller sub-basin delineations into and through the Rancho Cabrillo boundaries. These revisions did not impact the Lake Bonita portion of the watershed.

For general reference purposes, the "123" series of concentration points in Table 5.1 are located on Padelford Wash at the Beardsley Canal. CP 121B2 is approximately halfway between the Beardsley Canal and the McMicken Dam Outlet channel, while CP 121C2 is at the McMicken Dam Outlet channel. CP "123A2 + 123A3" represents the flow in Padelford Wash immediately upstream of the influence of flows being routed along the Beardsley Canal embankment from the east to the canal siphon crossing at Padelford Wash.

A preliminary run of the WLB HEC-2 model, with dam-break discharges, revealed several locations where the dam failure scenarios generated water surface elevations that exceeded the end-point elevations of the WLB cross-sections. Accordingly, the WLB cross-sections were extended to accommodate the wider flow widths that would be expected to accompany a dam-break flood-wave. In order to provide better graphics representation of the model results, the HEC-2 file was converted into an HEC-RAS format.

In the interest of brevity, only two of the dam-break scenarios were evaluated with the HEC-RAS model. These scenarios, which are listed below, represent the worst-case and most-probable scenarios for the HEC-1 dam-break model. These two scenarios assume that the dam will breach during the 100-year, 24-hour storm. Accordingly, the downstream discharges include both breach flow and normal spillway flow.

1. Most probable HEC-1 model, with spillway flow, for default failure parameters (Br = 34.83', t_f = 3.87 minutes) – (HEC-RAS Profile 1)

2. Worst-case HEC-1 model, with spillway flow, for Br = 60' and t_f = 3 minutes (HEC-RAS Profile 2)

Based on a visual review of the 1 = 400' topographic map, and iterative executions of the HEC-RAS models for each profile, encroachment stations were established for each cross-section to reflect the probable effective flow boundaries that would accompany each discharge profile along Padelford Wash. The following list summarizes the changes that were made to the original WLB HEC-2 cross-sections.

- XSEC 0.000 - None
- XSEC 0.203 - None

Table 5.1
Summary of HEC-1 Dam-Break Discharges
Downstream of Lake Bonita, Padelford Wash Floodplain

100-Year, 24-Hour Storm

HEC-1 Concentration Point	HEC-RAS XSEC	Discharge (cfs)						
		Breach Width, Br =34.83'			Breach Width, Br =60'			HEC-1 File: RC1 No Dam Break
		Failure Time, t_f (minutes)			Failure Time, t_f (minutes)			
		3	3.87	5	3	3.87	5	
C124 (at Lake Bonita)	2.021 through 1.818	5118	4891	4981	8040	7521	7718	1454
123		2966	2931	2939	3975	3895	3908	1432
123A2	1.621 through 1.011	4344	4305	4312	5362	5278	5291	2630
123A5	0.614	4493	4454	4459	5517	5433	5443	3027
123BC	0.608 through 0.000	4482	4442	4448	5488	5408	5417	2754
121B2		4476	4437	4443	5465	5386	5395	2760
121C2		4477	4438	4444	5463	5384	5392	2764
123A2 + 123A3	0.884 through 0.741	n/a	4329	n/a	5386	n/a	n/a	n/a

- XSEC 0.371 - None

- XSEC 0.523 - Encroachment stations were set to simulate the effective flow expansion out of the Beardsley Canal siphon crossing. Flow was allowed to cross the expansion boundaries if the water surface elevation was 6-inches above the ground elevations at the encroachment stations. Mannings "n" was set to 0.125 beyond the encroachment stations to prevent large transfers of water from moving to the right or left of the flow expansion boundaries.

- XSEC 0.608 - None (siphon crossing).

- XSEC 0.614 - None (siphon crossing).

- XSEC 0.741 - Extend right end of WLB XSEC to GR station 5810.

- XSEC 0.884 - Extend right end of WLB XSEC to GR station 5860. Set right encroachment station at 5650. Revise GR data on left end to more accurately reflect existing diversion berm and channel.

- XSEC 1.011 - Extend left and right ends. Set left encroachment station at 3905 and right encroachment at 5340.

- XSEC 1.136 - Extend left and right ends. Set right encroachment station at 5600.

- XSEC 1.273 - Extend left and right ends. Set right encroachment station at 5150

- XSEC 1.453 - Extend left and right ends. Set left encroachment station at 3656.

- XSEC 1.621 - Extend left and right ends. Set left encroachment station at 3925.

- XSEC 1.818 - Extend left and right ends. Set left encroachment station at 4560.

- XSEC 2.021 - Extend left and right ends. Set left encroachment station at 4780.

Based on a meeting with representatives from Stantec Consulting, Inc., a decision was made to set an encroachment station along the left (east) side of the 100-year floodplain boundary between the Beardsley Canal and the McMicken Dam Outlet channel (XSECs 0.000 through 0.523). At the present time, specific development plans for this portion of Rancho Cabrillo have not been completed. By setting an encroachment boundary at the edge of the existing 100-year floodplain, Stantec will be provided with water surface profiles which treat the area outside the encroachment boundary as non-effective flow areas. This approach provides Stantec with flexible options to develop this area without being concerned about possible impacts that the development might have on effective flow areas.

The water surface profile summaries, and cross-section plots, for the downstream floodplain (from Lake Bonita to the McMicken Dam Outlet channel) are presented in Appendix A. The floodplain boundaries for each profile are plotted on Plate 2. For comparison purposes, the

original WLB 100-year floodplain delineation (from Plate 1) has been traced onto Plate 2. The 100-year floodplain data is also included as Profile 3 in the HEC-RAS summary Table A1, and, on the cross-section plots in Appendix A.

6 CONCLUSIONS

The downstream floodplain modeling that was performed with the revised WLB HEC-2 model indicates that the worst-case dam-break scenario will probably cause some minor breakouts at the left (east) end of XSEC 1.818 (see Plate 2). The water surface profile at this location overtops the natural ground elevation at the left encroachment station by a few inches. The flow from this minor breakout would be captured by adjacent washs and continue southeasterly towards the west boundary of Rancho Cabrillo.

Ignoring this breakout location, the remaining downstream cross-sections will contain the worst-case flood wave as shown on Plate 2, with the exception of the right (west) end of XSEC 0.741. The worst-case scenario overtops this location by about 2-feet. However, this breakout would immediately become part of the floodplain created by the Beardsley Canal embankment.

Referring to Plate 2, there is very little difference between any of the three floodplain boundaries below the Beardsley Canal.

The most-probable dam-break scenario appears to be naturally contained at all locations except for XSEC 0.741. As with the worst-case scenario, this profile also overtops the right (east end) of this cross-section. However, the overtopping depth is about 1-foot, instead of the 2-feet associated with the worst-case scenario.

In conclusion, it would appear that a dam-break at Lake Bonita would cause relatively widespread, shallow flooding in the overbank areas of the Padelford wash floodplain. At some locations, floodplain widths could be expected in excess of one-quarter mile, although there would high (non-flooded) areas, between washs, within the floodplain. In reviewing the floodplain boundaries on Plate 2, it can be seen that the dam-break floodplains are substantially wider than the 100-year floodplain in some locations, while only minor deviations from the 100-year floodplain are occurring at other locations. The hydraulic summary table and cross-section plots in Appendix A provide specific information on the variation in flow depths and velocities at each floodplain cross-section.

Depending upon the type of drainage plan to be developed by Stantec for the Rancho Cabrillo development, it would seem that the shallow, low velocity flow that would impact the west boundary of Rancho Cabrillo (above the Beardsley Canal) could easily be controlled with diversion berms along the west boundary of Rancho Cabrillo. Below the Beardsley Canal, Stantec has been provided with water surface profiles that reflect an effective flow boundary that coincides with the edge of the existing 100-year floodplain. Accordingly, development plans can proceed in this area without concern as to possible impacts on effective flow areas.

APPENDIX A

Lake Bonita Dam-Break Analysis
Summary of HEC-RAS Modeling Results

Table A1

Cross-Section Plots

Table A1
Summary of HEC-RAS Modeling
Padelford Wash
Maricopa County, Arizona

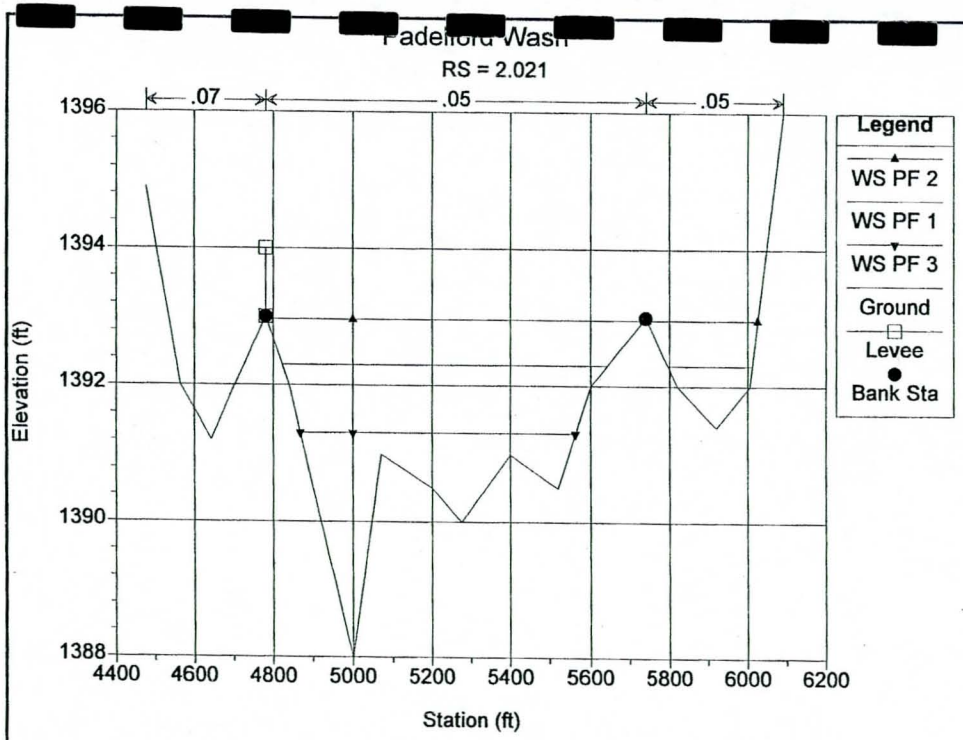
RC	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Top Width (ft)	Left Sta Eff (ft)	Rght Sta Eff (ft)	Mann Wtd Total	Cum Ch Len (ft)	Sta W.S. Lft (ft)	Sta W.S. Rgt (ft)
0	PF 1	4442	1317.00	1319.26	2.26	2.37	1.72	1.25	1752.32	3764.47	6442.20	0.070		3764.47	6442.20
0	PF 2	5488	1317.00	1319.47	2.47	2.52	1.83	1.38	1898.16	3764.47	6513.38	0.070		3764.47	6513.38
	PF 3	2714	1317.00	1318.85	1.85	2.05	1.50	0.96	1457.13	3764.47	6298.13	0.070		3764.47	6298.13
03	PF 1	4442	1324.00	1326.47	2.47	1.96	2.22	2.32	1539.15	4531.66	6070.81	0.070	1070.00	4531.66	6070.81
0.203	PF 2	5488	1324.00	1326.65	2.65	2.16	2.41	2.49	1544.03	4531.66	6075.69	0.070	1070.00	4531.66	6075.69
0.203	PF 3	2714	1324.00	1326.12	2.12	1.54	1.84	1.97	1529.85	4531.66	6061.51	0.070	1070.00	4531.66	6061.51
71	PF 1	4442	1330.00	1332.97	2.97	1.58	2.65	1.33	1657.05	4672.90	6333.51	0.070	1960.00	4672.90	6333.51
0.371	PF 2	5488	1330.00	1333.16	3.16	1.80	2.82	1.54	1682.84	4672.90	6355.74	0.070	1960.00	4672.90	6355.74
0.371	PF 3	2714	1330.00	1332.60	2.60	1.07	2.26	0.85	1574.41	4674.03	6290.47	0.070	1960.00	4674.03	6290.47
23	PF 1	4442	1335.00	1337.68	2.68	1.72	2.88	1.50	1595.21	4277.25	5903.89	0.103	2660.00	4277.25	5903.89
23	PF 2	5488	1335.00	1337.90	2.90	1.89	3.11	1.63	1633.03	4272.25	5915.01	0.103	2660.00	4272.25	5915.01
0.523	PF 3	2714	1335.00	1337.21	2.21	4.87	6.94	3.59	543.19	4660.00	5280.00	0.070	2660.00	4660.00	5280.00
608	PF 1	4442	1337.00	1341.89	4.89		11.26		101.37	4951.19	5052.57	0.050	3110.00	4951.19	5052.57
608	PF 2	5488	1337.00	1342.56	5.56		11.82		107.04	4948.62	5055.66	0.050	3110.00	4948.62	5055.66
0.608	PF 3	2714	1337.00	1342.63	5.63		5.75		107.66	4948.34	5056.00	0.050	3110.00	4948.34	5056.00
614	PF 1	4454	1337.00	1343.66	6.66		7.59		115.00	4945.00	5060.00	0.050	3140.00	4945.00	5060.00
614	PF 2	5517	1337.00	1344.37	7.37		8.24		115.00	4945.00	5060.00	0.050	3140.00	4945.00	5060.00
614	PF 3	2815	1337.00	1342.79	5.79		5.76		108.98	4947.74	5056.72	0.050	3140.00	4947.74	5056.72
0.741	PF 1	4329	1340.00	1345.65	5.65	1.10	1.81	0.85	1220.00	4590.00	5810.00	0.057	3810.00	4590.00	5810.00
741	PF 2	5386	1340.00	1346.35	6.35	1.09	1.77	0.90	1220.00	4590.00	5810.00	0.057	3810.00	4590.00	5810.00
741	PF 3	2567	1340.00	1344.57	4.57	1.09	1.75	0.66	1156.58	4593.12	5810.00	0.054	3810.00	4593.12	5810.00
0.884	PF 1	4329	1346.00	1349.42	3.42	2.28	6.41	3.78	1129.73	4429.98	5559.71	0.060	4570.00	4429.98	5559.71
0.884	PF 2	5386	1346.00	1349.57	3.57	2.74	6.83	4.00	1153.91	4429.11	5583.02	0.060	4570.00	4429.11	5583.02
884	PF 3	2567	1346.00	1349.00	3.00	4.82	5.94	3.55	724.74	4432.38	5495.59	0.059	4570.00	4432.38	5495.59
1.011	PF 1	4305	1350.50	1355.49	4.99	1.66	4.56	1.40	1324.76	3918.11	5323.14	0.064	5310.00	3918.11	5323.14
1.011	PF 2	5362	1350.50	1355.78	5.28	1.78	4.80	1.60	1416.12	3910.75	5332.61	0.064	5310.00	3910.75	5332.61
011	PF 3	2493	1350.50	1354.91	4.41	1.32	3.81	1.31	1106.52	3933.26	5303.67	0.062	5310.00	3933.26	5303.67
136	PF 1	4305	1354.00	1359.20	5.20	2.47	8.47	3.19	900.07	3835.67	5264.10	0.063	5970.00	3835.67	5264.10
1.136	PF 2	5362	1354.00	1359.50	5.50	2.61	8.64	3.30	1038.23	3826.01	5287.02	0.063	5970.00	3826.01	5287.02
1.136	PF 3	2493	1354.00	1358.36	4.36	2.83	8.02	2.86	464.60	4609.92	5199.77	0.060	5970.00	4609.92	5199.77
273	PF 1	4305	1359.00	1364.49	5.49	1.77	5.02	0.58	1258.93	3469.64	5074.48	0.061	6680.00	3469.64	5074.48
1.273	PF 2	5362	1359.00	1364.74	5.74	1.95	5.33	0.77	1336.70	3460.43	5086.76	0.062	6680.00	3460.43	5086.76
1.273	PF 3	2493	1359.00	1363.83	4.83	1.67	4.28		805.52	3543.11	5048.69	0.059	6680.00	3543.11	5048.69
453	PF 1	4305	1366.00	1369.50	3.50	1.95	4.31	2.82	1346.30	3837.44	5183.74	0.062	7630.00	3837.44	5183.74
453	PF 2	5362	1366.00	1369.72	3.72	2.15	4.54	2.89	1380.06	3811.35	5191.41	0.063	7630.00	3811.35	5191.41
1.453	PF 3	2493	1366.00	1369.04	3.04	1.58	3.77	2.65	1160.24	3894.16	5167.04	0.061	7630.00	3894.16	5167.04
621	PF 1	4305	1373.00	1376.58	3.58	2.41	4.48	1.30	1287.51	3964.35	5268.56	0.066	8520.00	3964.35	5268.56
621	PF 2	5362	1373.00	1376.77	3.77	2.64	4.83	1.44	1341.20	3946.66	5287.86	0.066	8520.00	3946.66	5287.86
1.621	PF 3	2493	1373.00	1376.18	3.18	1.89	3.73	1.11	1157.43	4000.98	5228.57	0.065	8520.00	4000.98	5228.57
818	PF 1	4891	1381.00	1385.02	4.02	2.65	4.01	3.87	817.22	4580.92	5398.15	0.057	9560.00	4580.92	5398.15
818	PF 2	8040	1381.00	1385.62	4.62	3.25	4.98	4.57	860.69	4560.00	5420.69	0.057	9560.00	4560.00	5420.69
818	PF 3	2420	1381.00	1384.35	3.35	2.03	3.00	3.18	763.22	4609.87	5373.09	0.056	9560.00	4609.87	5373.09
2.021	PF 1	4891	1388.00	1392.30	4.30		3.32	1.51	1034.62	4822.15	6011.32	0.050	10630.00	4822.15	6011.32
021	PF 2	8040	1388.00	1392.97	4.97		3.68	2.23	1236.21	4782.00	6025.54	0.050	10630.00	4782.00	6025.54
021	PF 3	1409	1388.00	1391.31	3.31		2.06		695.64	4867.58	5563.22	0.050	10630.00	4867.58	5563.22

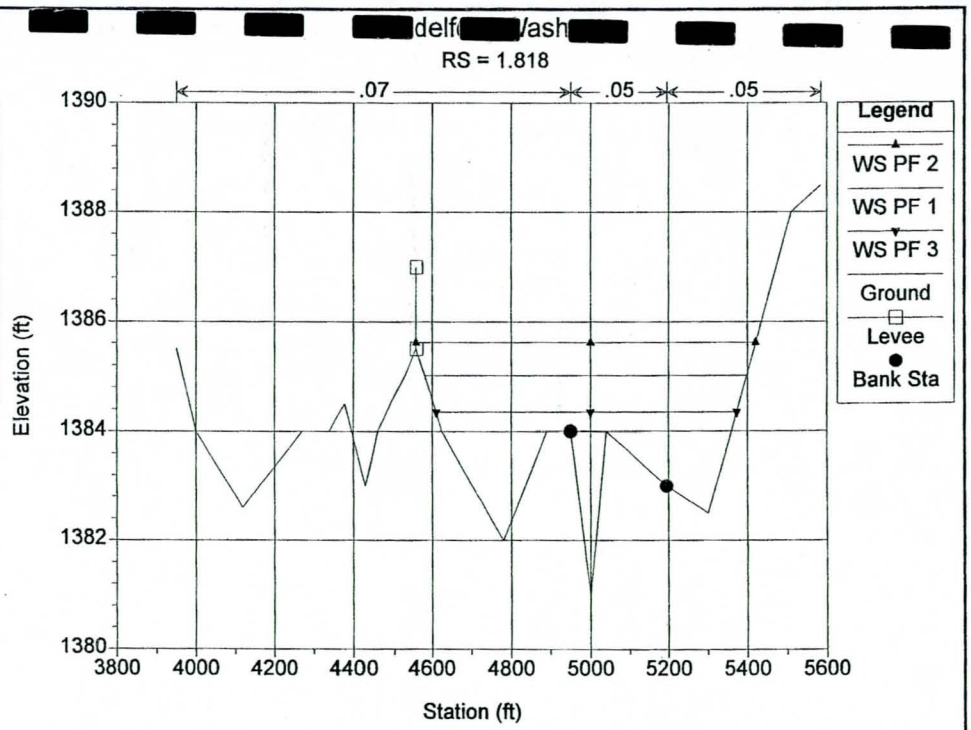
PF 1 = HEC-1 Most Probable Dam-Break, Br = 34.83', t_f = 3.87 minutes, with spillway flow

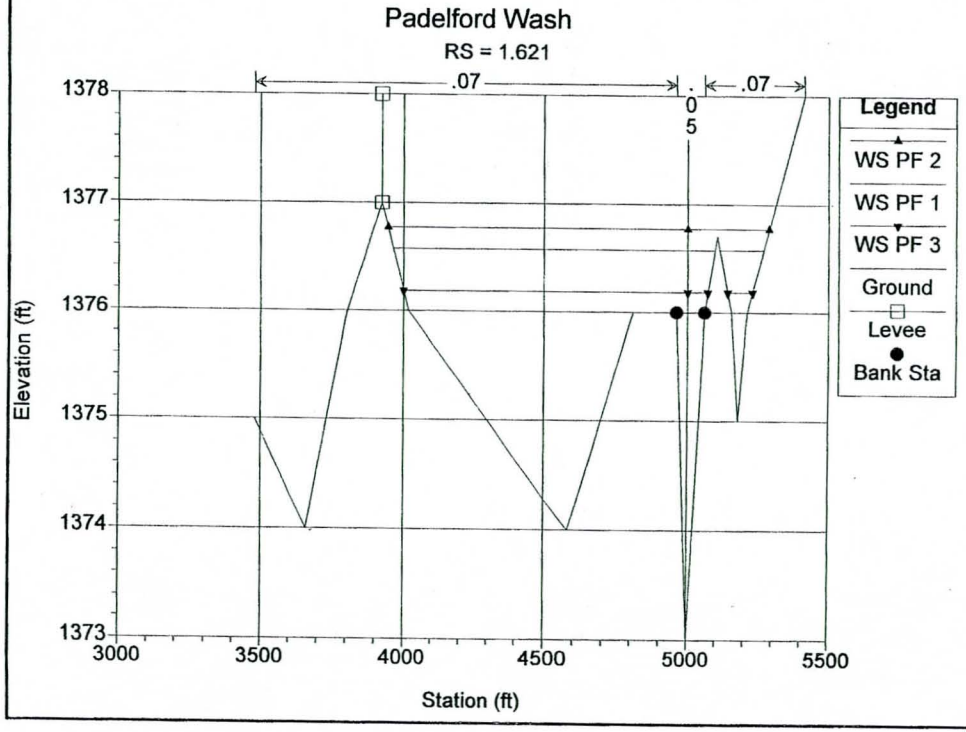
PF 2 = HEC-1 Worst-Case Dam-Break, Br = 60', t_f = 3 minutes, with spillway flow

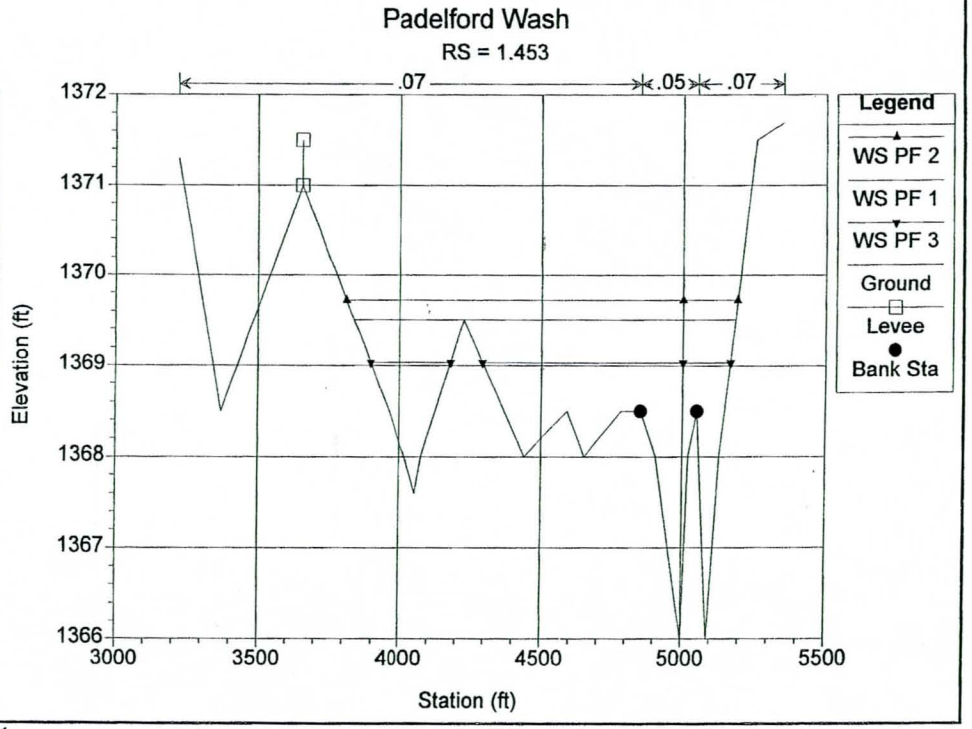
PF 3 = WLB 100-Year Event, No Dam-Break

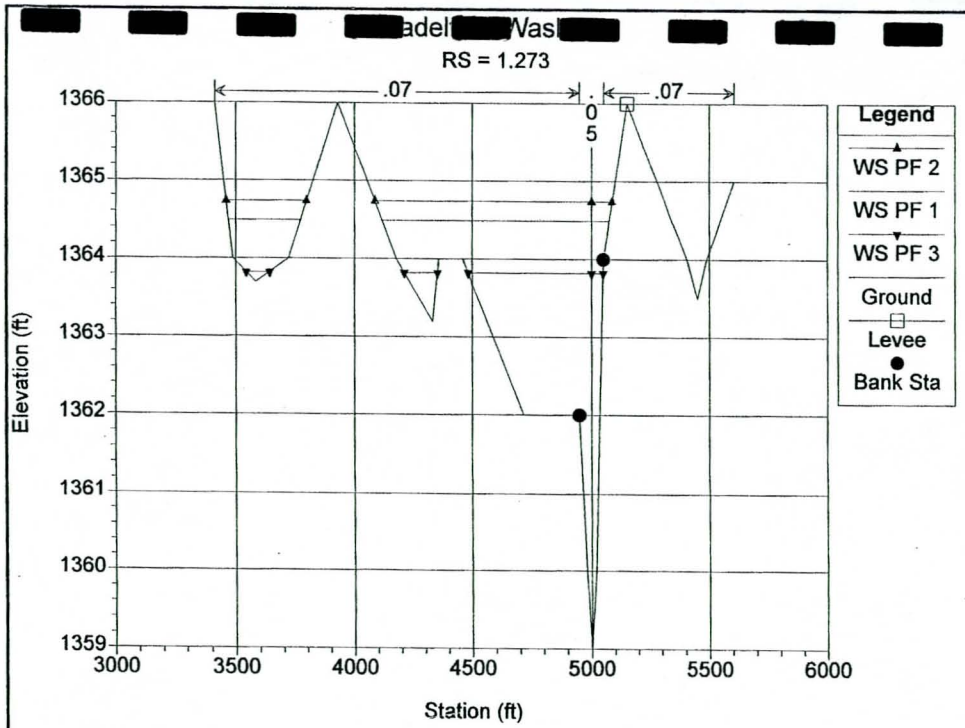
File: Padelford Wash, HEC-RAS Summary.xls

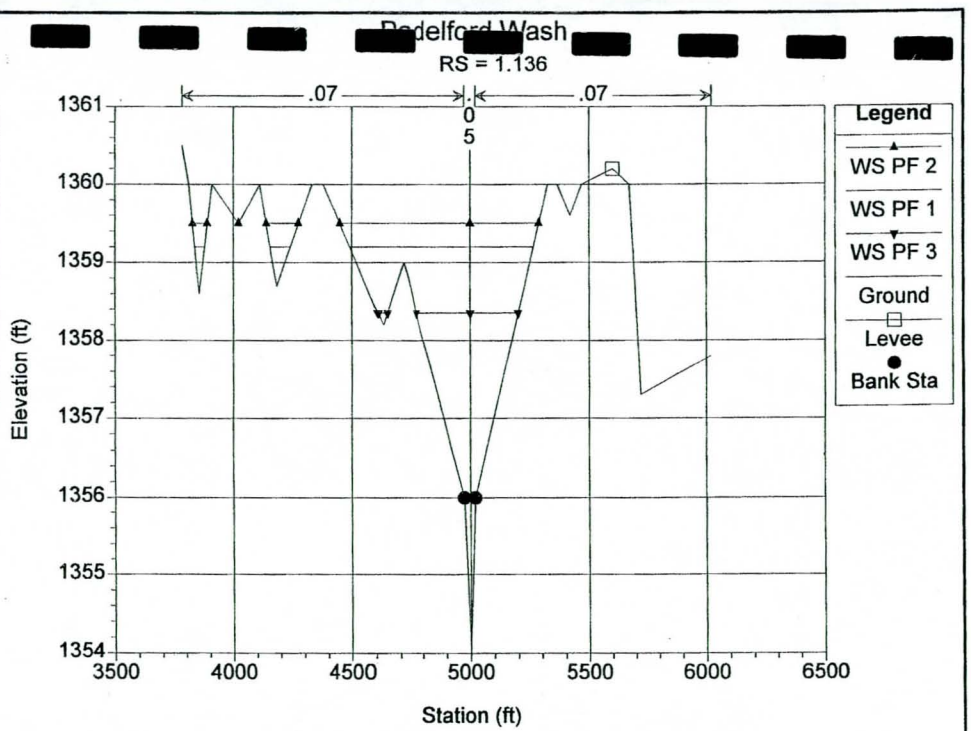

Padelford Wash
RS = 2.021
.07
.05
.05
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
1396
1394
1392
1390
1388
4400
4600
4800
5000
5200
5400
5600
5800
6000
6200
Station (ft)

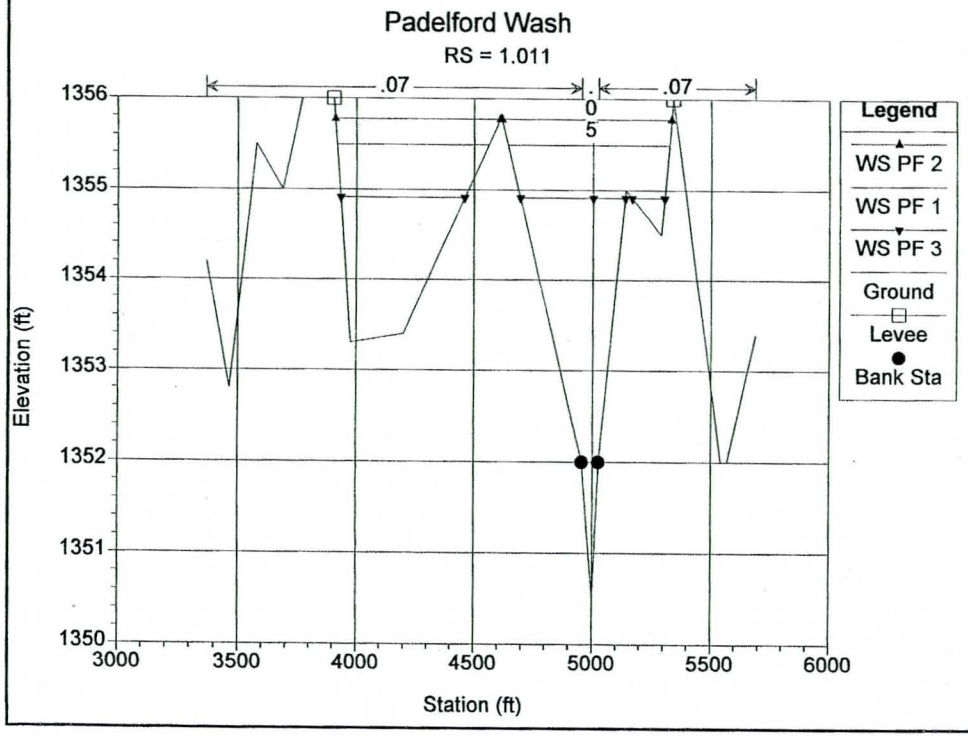

RS = 1.818
.07
.05
.05
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
1390
1388
1386
1384
1382
1380
3800
4000
4200
4400
4600
4800
5000
5200
5400
5600
Station (ft)

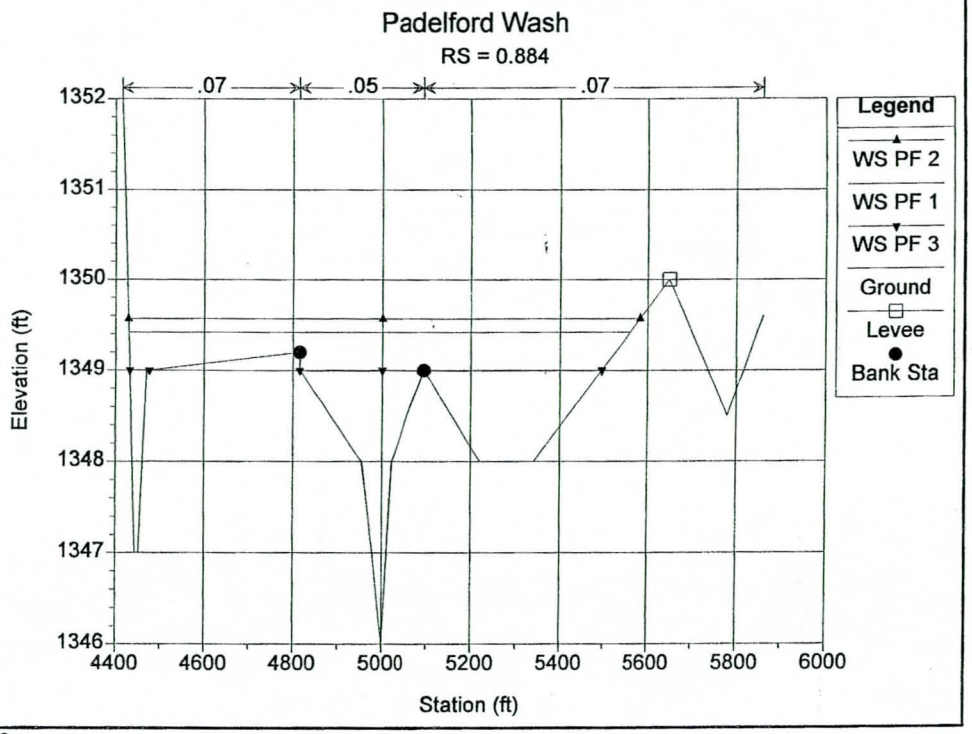

Padelford Wash
RS = 1.621
.07
.07
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
1378
1377
1376
1375
1374
1373
3000
3500
4000
4500
5000
5500
Station (ft)

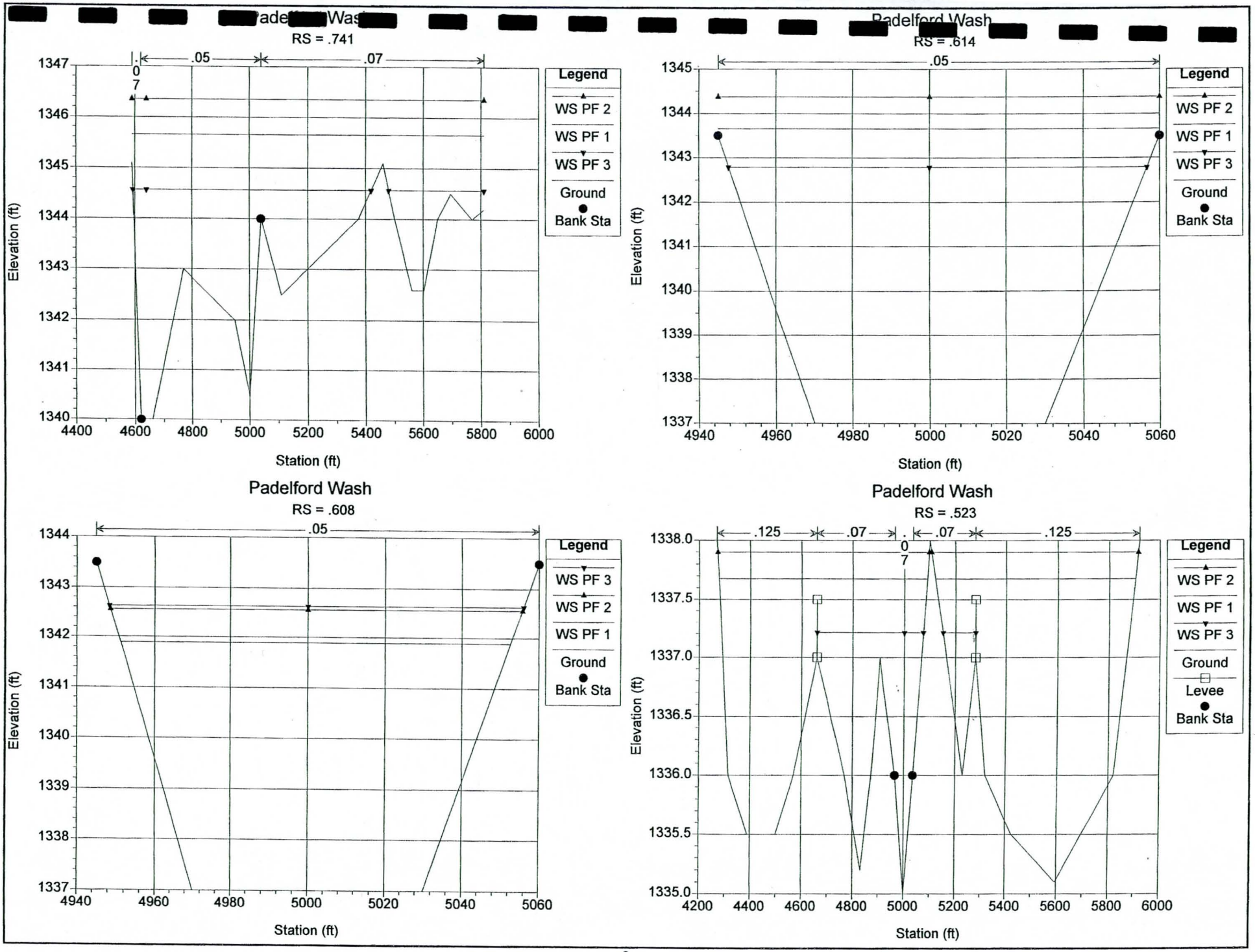

Padelford Wash
RS = 1.453
.07
.05
.07
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
1372
1371
1370
1369
1368
1367
1366
3000
3500
4000
4500
5000
5500
Station (ft)


Padelford Wash
RS = 1.273
.07
.07
0.5
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Padelford Wash
RS = 1.136
.07
.07
0.5
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

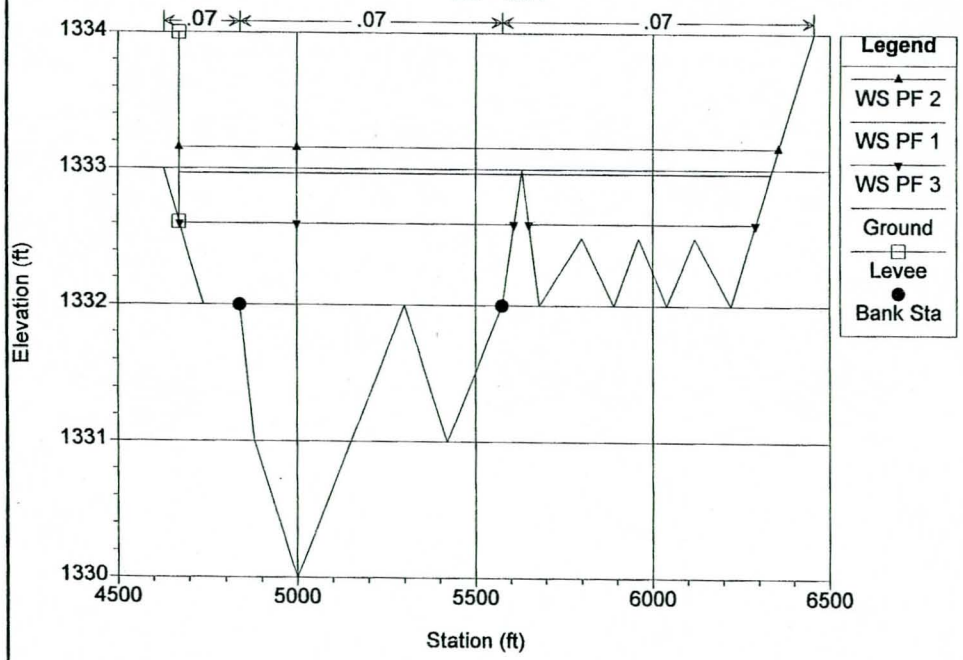

Padelford Wash
RS = 1.011
.07
.07
0.5
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Padelford Wash
RS = 0.884
.07
.05
.07
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Padelford Wash
RS = .741
.05
.07
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Bank Sta
Elevation (ft)
Station (ft)
Padelford Wash
RS = .614
.05
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Bank Sta
Elevation (ft)
Station (ft)
Padelford Wash
RS = .608
.05
Legend
WS PF 3
WS PF 2
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Padelford Wash
RS = .523
.125
.07
.07
.125
Legend
WS PF 2
WS PF 1
WS PF 3
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

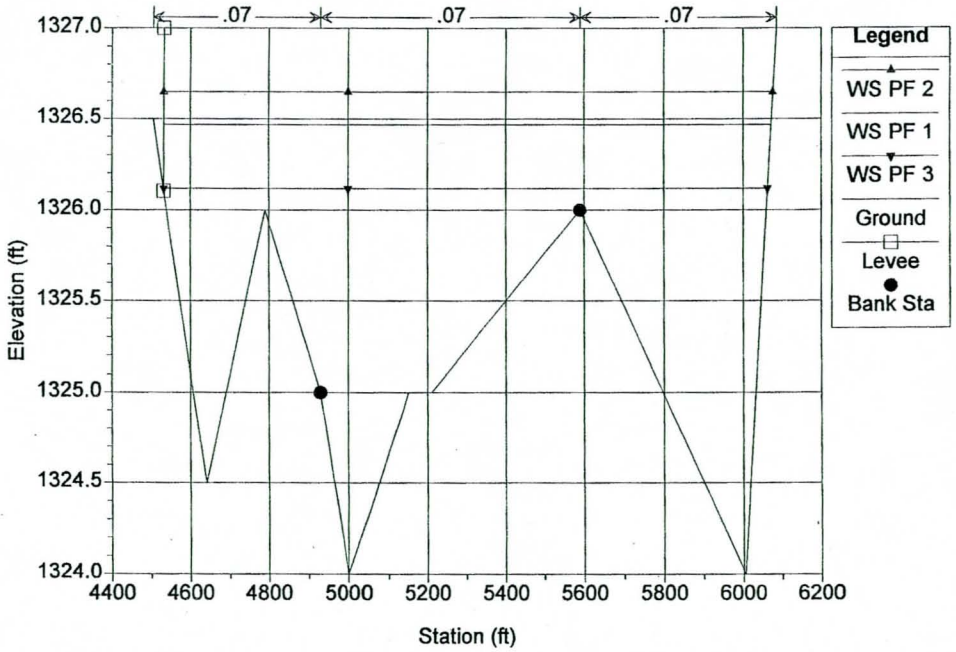
[redacted]adel[redacted]Was[redacted]

RS = .371



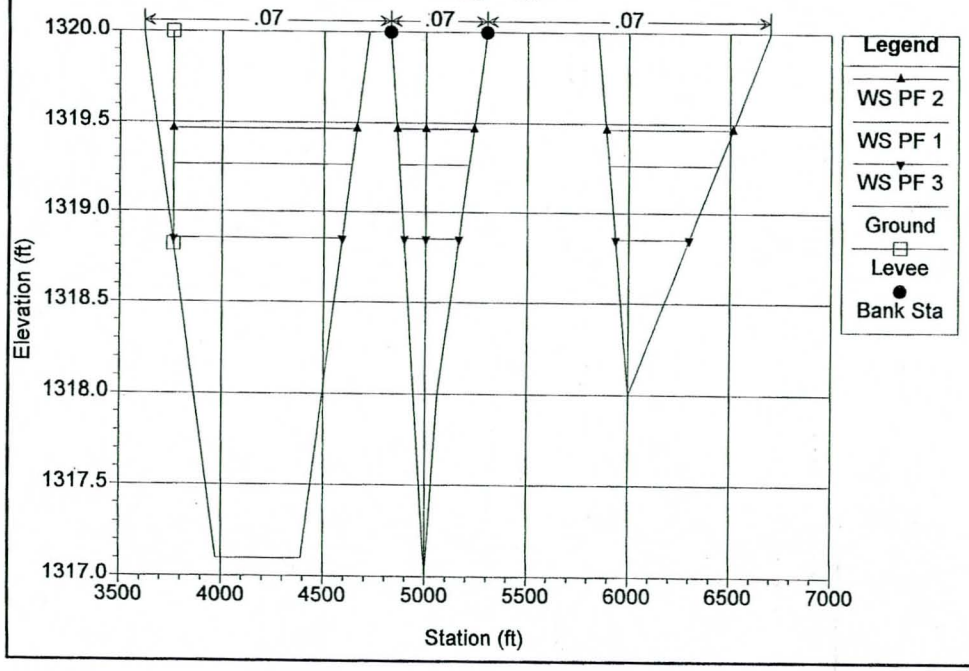
[redacted]delfo[redacted]Wash[redacted]

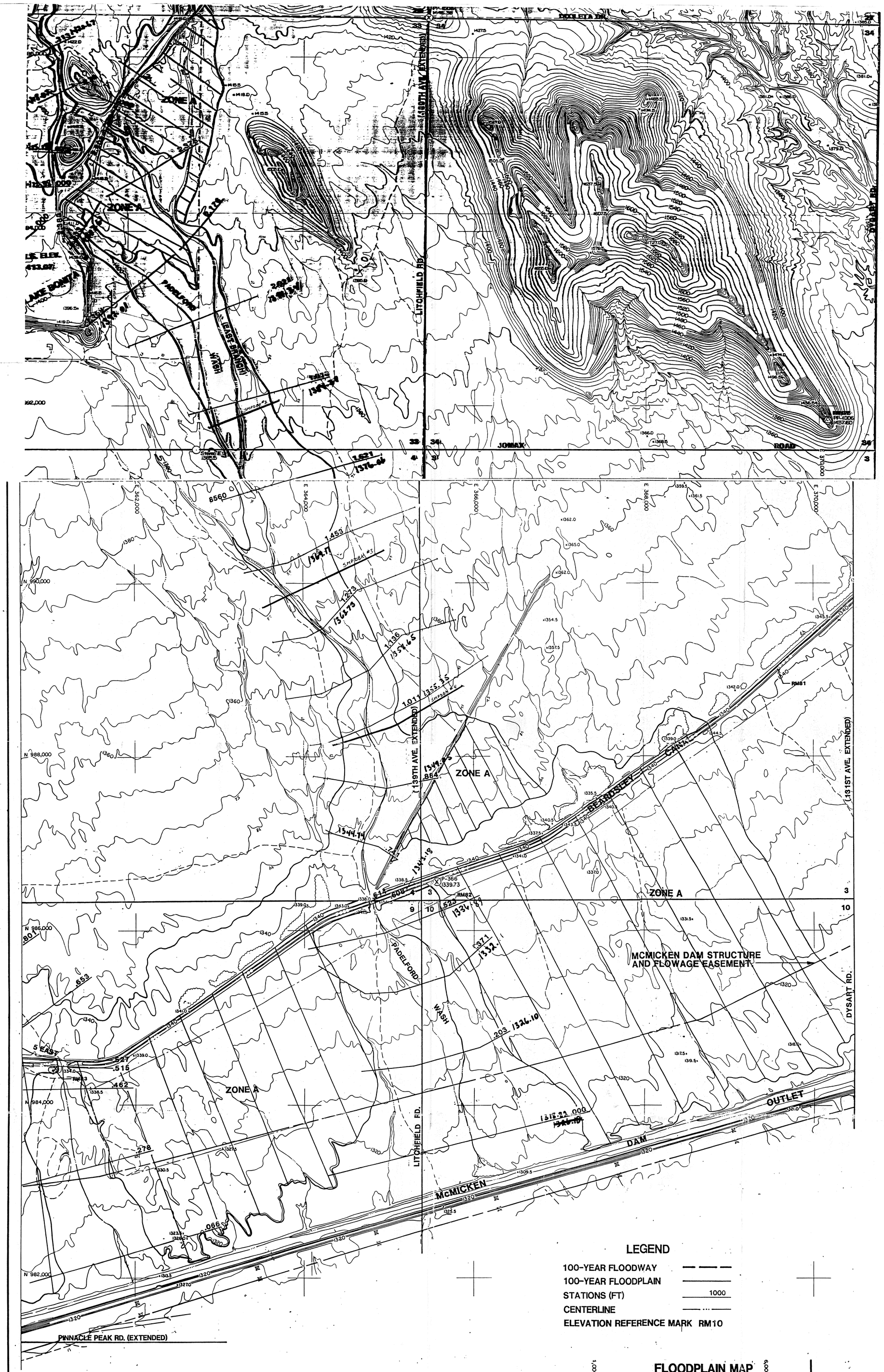
RS = .203



Padelford Wash

RS = 0.0





LEGEND

100-YEAR FLOODWAY	— — —
100-YEAR FLOODPLAIN	———
STATIONS (FT)	1000
CENTERLINE	—··—
ELEVATION REFERENCE MARK	RM10

SCALE : 1"=400'

400 200 0 400 800

CONTOUR INTERVAL 4 FEET

NOTE: SECTION LINE ROADS SHOWN ARE APPROXIMATE LOCATIONS ONLY. SURVEY DID NOT INCLUDE LOCATING SECTION CORNERS.

The WLB Group Inc. **WLB**

Cooper Aerial Survey Co.

FLOODPLAIN MAP

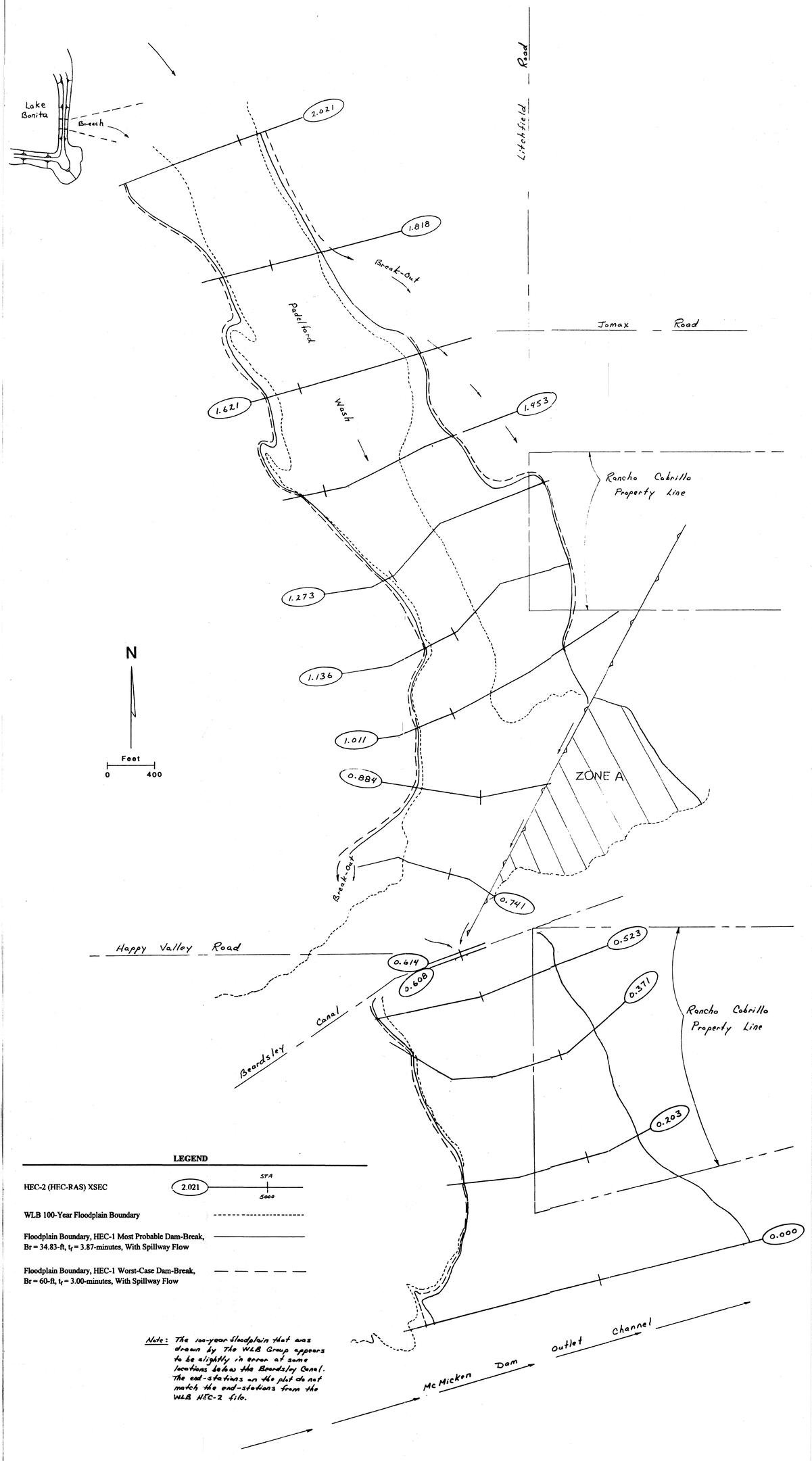
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

AERIAL MAPPING FOR WITTMANN ADMS **MC-26**

AREA BETWEEN McMICKEN DAM & C.A.P.

DATE FLOWN 11-20-86 | SHEET 36 OF 55

PLATE 1



Floodplain Delineations

Lake Bonita Dam-Break Analysis

Padelford Wash

Maricopa County, Arizona

September 2000 **PLATE**

APPENDIX A3

Happy Valley Road Hyrology

Memorandum

To: Ghassan Aouad, P.E.
Stantec Consulting, Inc.

From: Robert L. Ward, P.E.

Date: 08/28/00

Re: Rancho Cabrillo, Culvert Hydrology For Happy Valley Road

Dear Ghassan,

I have re-configured the WLB HEC-1 model to provide a peak discharge at the proposed culvert on Happy Valley Road. The culvert location is about 1750-feet west of El Mirage Road.

The HEC-1 modification required a revision to the original WLB Sub-Basin 132, as well as a change to the routing operation that routed flows through Sub-Basin 132 from the Beardsley Canal siphon crossing. The routing operation revision was required to reflect the shortened routing length through the revised sub-basin.

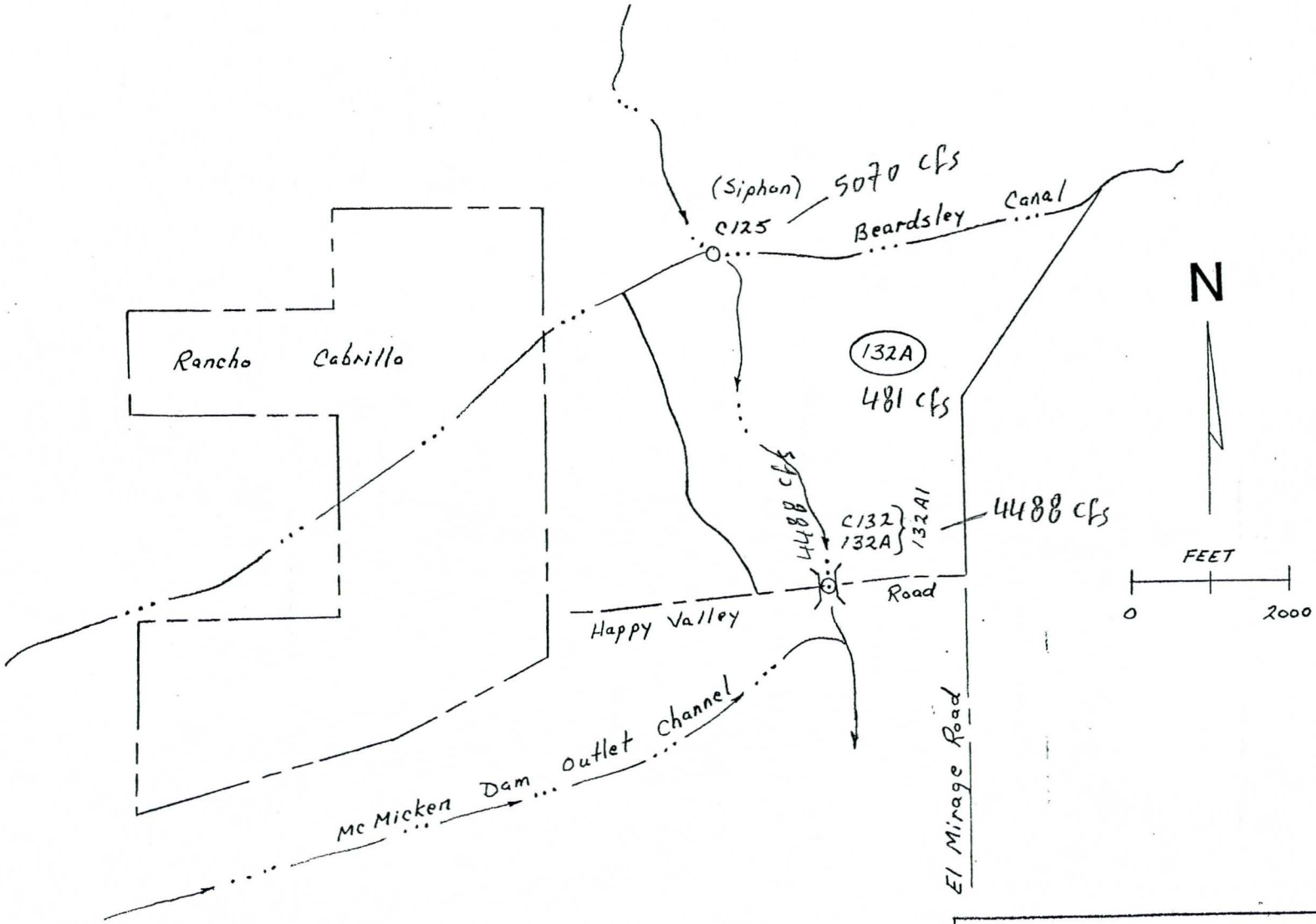
Figure 1 is enclosed which illustrates the revised HEC-1 routing schematic for the culvert location. The culvert is located at CP 132A1. The peak 100-year, 24-hour discharge at the culvert is **4,488 cfs**.

A copy of the USGS quadrangle map, showing the drainage boundaries for Sub-Basin 132A, is also enclosed, along with my worksheet that shows the changes I made to the WLB model.

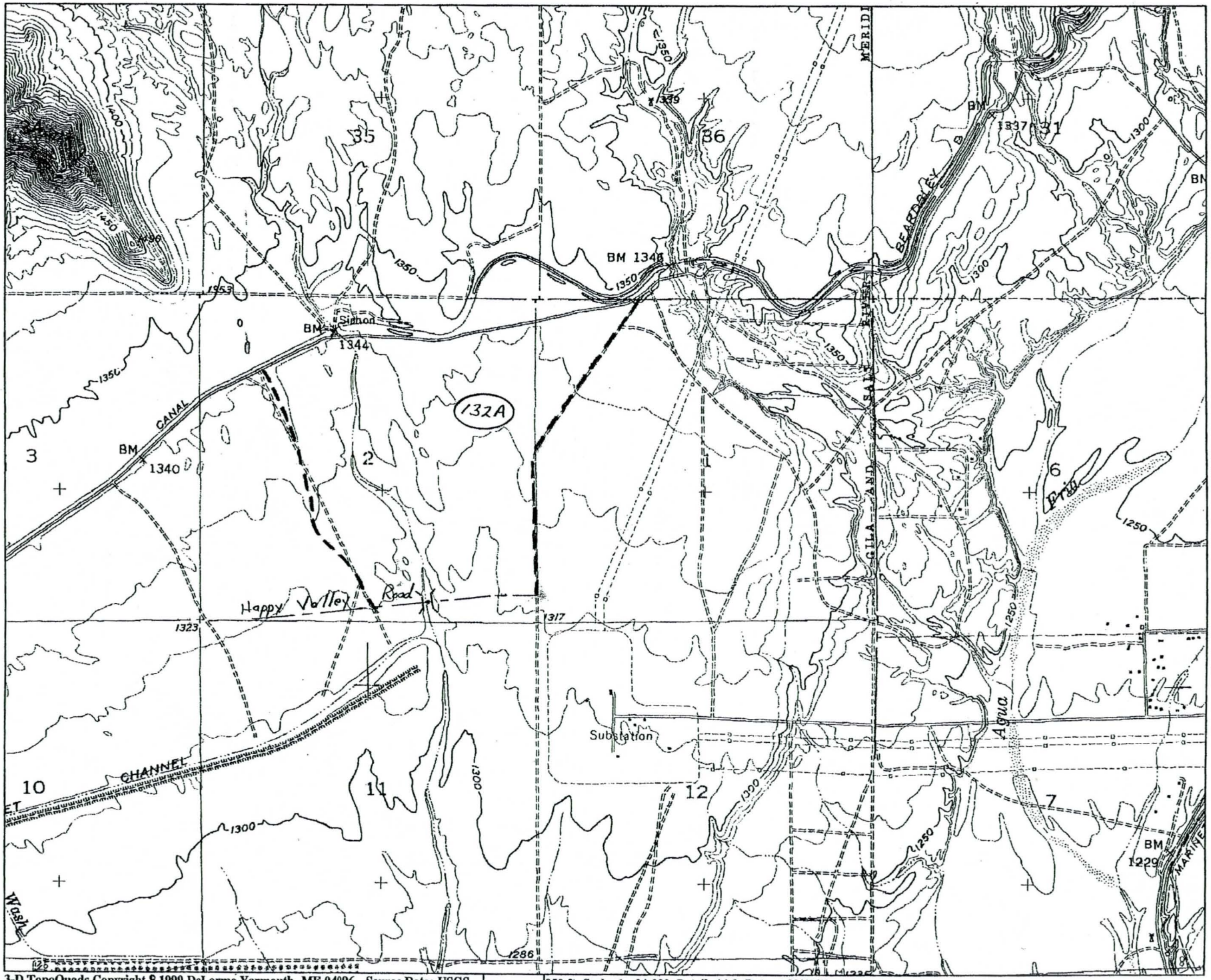
Please call if you have any questions.

Bob

Enclosures: Figure 1
USGS Quadrangle
Worksheet



Happy Valley Road Culvert	
Rancho Cabrillo	
August 2000	Figure 1



3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS 950 ft Scale: 1 : 24,000 Detail: 14-0 Datum: NAD27

Rancho Cabrillo

HEC-1 Update For Roadway Extension
To El Mirage Road

This impacts the original WLB Sub-Basin 132.

8/28/00 Revisions To Sub 132 To Reflect Proposed Roadway

D.A. = 4.06 in.² (@ 1" = 2000') = .5825 mi.²

Sub 132 WLB orig. data

CN =	78						
UK	250	.01	.12	100			
RK	3600	.0061	.06	~~.31~~ .15 to match WLB ratio, i.e., $\frac{.31}{1.23} = .25$ ∴ $.25 \times .5825 = .15$	TRAP	0	20
RK	4700	.0061	.05		TRAP	50	15

Adjusted length to reflect new Sub-Basin boundary

Muskingum Rtg Operation, Beardsley Canal to Happy Valley

Revise the WLB "K" coef. to reflect shortened routing reach.

Revised $K = \left(\frac{4700}{14,500}\right)(0.81) = 0.26$

8/28/00
RLW

APPENDIX B

Hydraulic Calculations

Rancho Cabrillo

Stantec

Offsite Flow Management:

The following are typical cross-sections across the preserved natural washes and proposed channels; see figure 6 & App. A1

Section No.	Q_{100} (cfs)	Contrib. Subbasins
1	262	sub. 123 H
2	388	sub. 123 E, 123 F & 123 G + 35 cfs = 38 + 315 + 35
3	303	sub. 123 D
3A	151.5	(sub. 123 D)/2
4	262	sub. 123 H
5	650	Flow at section 1 + Flow at section 2
6	35	Estimated as ≃ 13% of sub. 123 H
7	314	sub. 123 E + sub 123 F
8	38	sub. 123 E
9	15	Estimated as 5% of sub. 123 D
10	5	Estimated as 5% of sub. 123 C
11	53	sub. 123 C/2
12	1175	Estimated total Flow Along the north side of Beardsley Canal + Flow along Existing Levee

Designed by: Checked by:

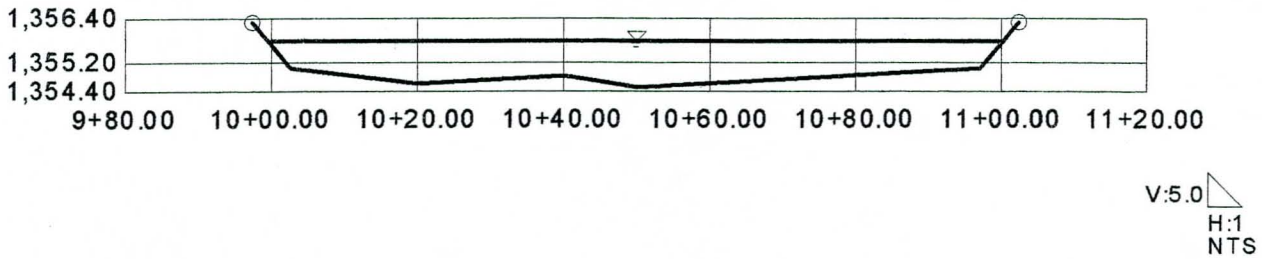
Cross Section
Cross Section for Irregular Channel

1/2

Project Description	
Worksheet	SEC-1
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

section 1, Across wash 1

Section Data		
Mannings Coefficier	0.045	
Slope	0.006700	ft/ft
Water Surface Elev	1,355.75	ft
Elevation Range	54.50 to 1,356.30	
Discharge	262.00	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

2/2

Project Description	
Worksheet	SEC-1
Flow Element	Irregular Chanr
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Slope	006700	ft/ft
Discharg	262.00	cfs

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficier	0.045	
Water Surface Elev:	1,355.75	ft
Elevation Range	54.50 to 1,356.30	
Flow Area	98.5	ft²
Wetted Perimeter	100.84	ft
Top Width	100.64	ft
Actual Depth	1.25	ft
Critical Elevation	1,355.36	ft
Critical Slope	0.034883	ft/ft
Velocity	2.66	ft/s
Velocity Head	0.11	ft
Specific Energy	1,355.86	ft
Froude Number	0.47	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
9+97.50	11+02.50	0.045

Natural Channel Points

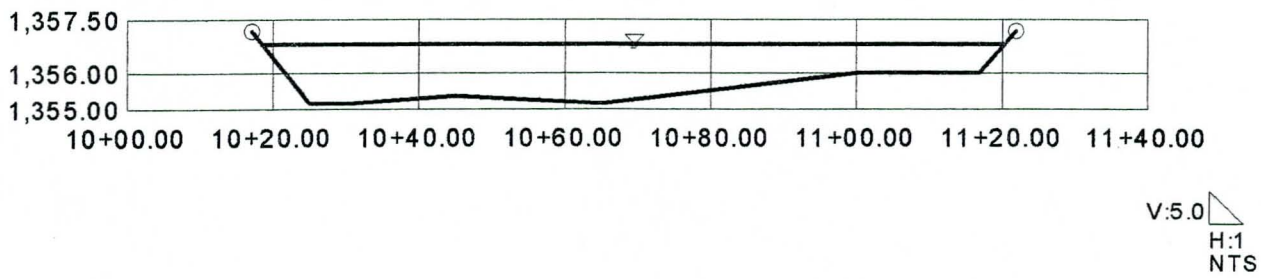
Station (ft)	Elevation (ft)
9+97.50	1,356.30
10+02.70	1,355.00
10+20.00	1,354.60
10+40.00	1,354.80
10+50.00	1,354.50
10+97.30	1,355.00
11+02.50	1,356.30

Cross Section
Cross Section for Irregular Channel

section 2, Across wash 2

Project Description	
Worksheet	SEC-2
Flow Element	Irregular Chann
Method	Manning's Forr
Solve For	Channel Depth

Section Data		
Mannings Coefficier	0.045	
Slope	0.006700	ft/ft
Water Surface Elev:	1,356.83	ft
Elevation Range	55.20 to 1,357.20	
Discharge	388.00	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

Project Description	
Worksheet	SEC-2
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	006700	ft/ft
Discharg	388.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficier	0.045	
Water Surface Elev	1,356.83	ft
Elevation Range	55.20 to 1,357.20	
Flow Area	125.3	ft²
Wetted Perimeter	102.27	ft
Top Width	101.96	ft
Actual Depth	1.63	ft
Critical Elevation	1,356.35	ft
Critical Slope	0.032048	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energy	1,356.98	ft
Froude Number	0.49	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
10+17.00	11+22.00	0.045

Natural Channel Points

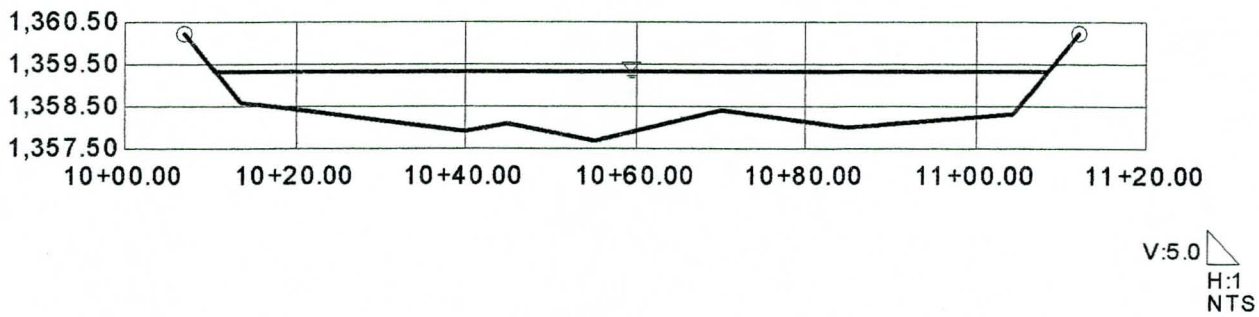
Station (ft)	Elevation (ft)
10+17.00	1,357.20
10+25.00	1,355.20
10+30.00	1,355.20
10+45.00	1,355.40
10+65.00	1,355.20
11+00.00	1,356.00
11+17.00	1,356.00
11+22.00	1,357.20

Cross Section
Cross Section for Irregular Channel

section 3, Across wash 3

Project Description	
Worksheet	SEC-3
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Section Data		
Mannings Coefficier	0.045	
Slope	0.006400	ft/ft
Water Surface Elev	1,359.29	ft
Elevation Range	57.70 to 1,360.20	
Discharge	303.00	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

Project Description	
Worksheet	SEC-3
Flow Element	Irregular Chan
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Slope	006400	ft/ft
Discharg	303.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficier	0.045	
Water Surface Elev	1,359.29	ft
Elevation Range	57.70 to 1,360.20	
Flow Area	107.7	ft²
Wetted Perimeter	97.95	ft
Top Width	97.69	ft
Actual Depth	1.59	ft
Critical Elevation	1,358.84	ft
Critical Slope	0.033531	ft/ft
Velocity	2.81	ft/s
Velocity Head	0.12	ft
Specific Energy	1,359.41	ft
Froude Number	0.47	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
10+07.00	11+12.00	0.045

Natural Channel Points

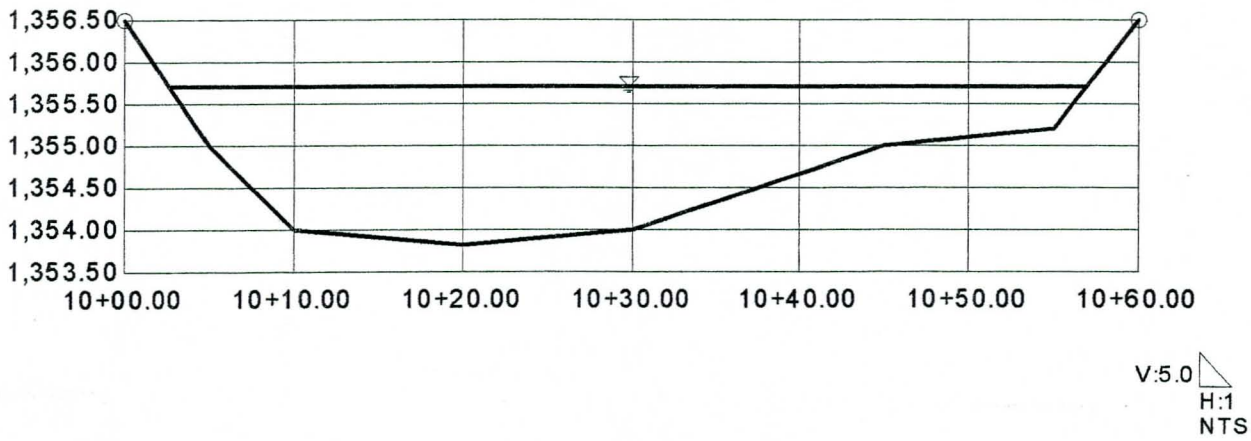
Station (ft)	Elevation (ft)
10+07.00	1,360.20
10+13.40	1,358.60
10+40.00	1,357.90
10+45.00	1,358.10
10+55.00	1,357.70
10+70.00	1,358.40
10+85.00	1,358.00
11+04.40	1,358.30
11+12.00	1,360.20

Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	SEC-3A
Flow Element	Irregular Chan
Method	Manning's Forr
Solve For	Channel Depth

section 3A, Along Existing levee, After split Flow

Section Data		
Mannings Coefficier	0.045	
Slope	0.003600	ft/ft
Water Surface Elev	1,355.69	ft
Elevation Range	53.80 to 1,356.50	
Discharge	151.50	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

Project Description	
Worksheet	SEC-3A
Flow Element	Irregular Chan
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Slope	003600	ft/ft
Discharg	151.50	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficier	0.045	
Water Surface Elev	1,355.69	ft
Elevation Range	53.80 to 1,356.50	
Flow Area	66.8	ft²
Wetted Perimeter	54.49	ft
Top Width	54.19	ft
Actual Depth	1.89	ft
Critical Elevation	1,354.96	ft
Critical Slope	0.032271	ft/ft
Velocity	2.27	ft/s
Velocity Head	0.08	ft
Specific Energy	1,355.77	ft
Froude Number	0.36	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
10+00.00	10+60.00	0.045

Natural Channel Points

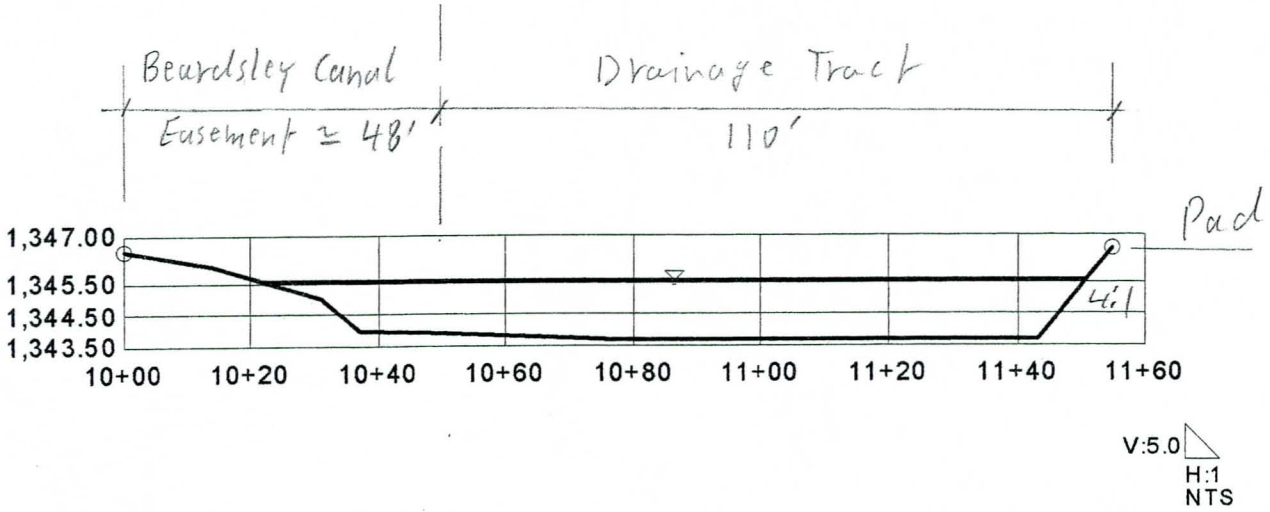
Station (ft)	Elevation (ft)
10+00.00	1,356.50
10+05.00	1,355.00
10+10.00	1,354.00
10+20.00	1,353.80
10+30.00	1,354.00
10+45.00	1,355.00
10+55.00	1,355.20
10+60.00	1,356.50

Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	SEC-4A
Flow Element	Irregular Chanr
Method	Manning's Forr
Solve For	Channel Depth

section 4A, Along the north side of Beardsley Canal

Section Data		
Mannings Coefficier	0.050	
Slope	0.001000	ft/ft
Water Surface Elev:	1,345.54	ft
Elevation Range	43.70 to 1,346.55	
Discharge	262.00	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

Project Description	
Worksheet	SEC-4A
Flow Element	Irregular Chanr
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Slope	001000	ft/ft
Discharg	262.00	cfs

Options	
Current Roughness Methc	ɔved Lotter's Method
Open Channel Weighting	ɔved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficier	0.050	
Water Surface Elev	1,345.54	ft
Elevation Range	43.70 to 1,346.55	
Flow Area	205.0	ft²
Wetted Perimeter	129.29	ft
Top Width	128.98	ft
Actual Depth	1.84	ft
Critical Elevation	1,344.33	ft
Critical Slope	0.044288	ft/ft
Velocity	1.28	ft/s
Velocity Head	0.03	ft
Specific Energy	1,345.57	ft
Froude Number	0.18	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
10+00	11+55	0.050

Natural Channel Points

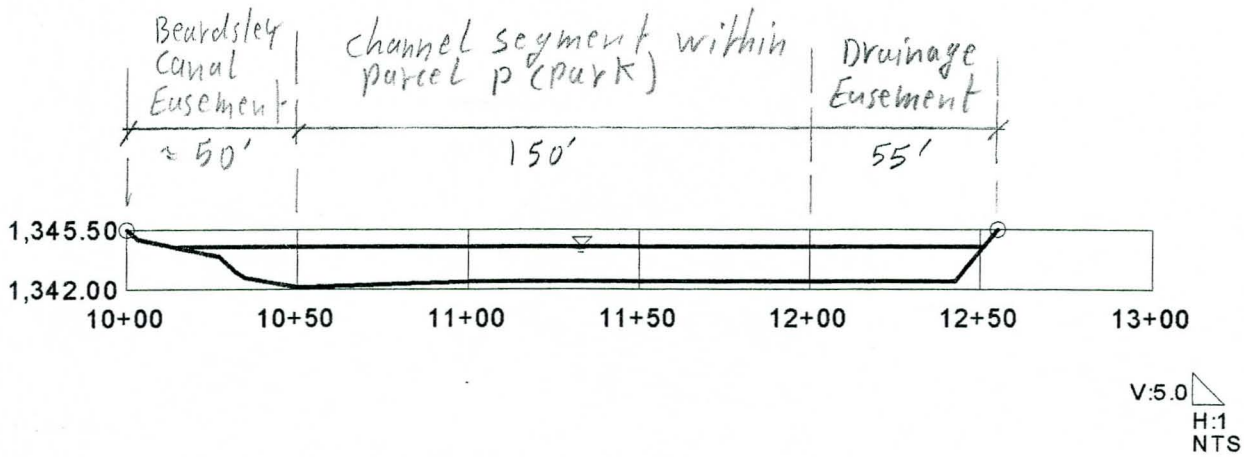
Station (ft)	Elevation (ft)
10+00	1,346.50
10+14	1,346.00
10+31	1,345.00
10+37	1,344.00
10+48	1,343.92
10+78	1,343.70
10+98	1,343.70
11+43	1,343.70
11+55	1,346.55

Cross Section
Cross Section for Irregular Channel

Project Description	
Worksheet	SEC-5A
Flow Element	Irregular Chann
Method	Manning's Forr
Solve For	Channel Depth

Section 5A, Along the north side of Beardsley Canal

Section Data		
Mannings Coefficier	0.050	
Slope	0.001000	ft/ft
Water Surface Elev:	1,344.51	ft
Elevation Range	42.10 to 1,345.50	
Discharge	650.00	cfs



RANCHO CABRILLO
Worksheet for Irregular Channel

Project Description	
Worksheet	SEC-5A
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	001000	ft/ft
Discharg	650.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weighting	Horton's Method

Results		
Mannings Coefficie	0.050	
Water Surface Elev	1,344.51	ft
Elevation Range	42.10 to 1,345.50	
Flow Area	450.3	ft²
Wetted Perimeter	236.61	ft
Top Width	236.22	ft
Actual Depth	2.41	ft
Critical Elevation	1,343.12	ft
Critical Slope	0.041886	ft/ft
Velocity	1.44	ft/s
Velocity Head	0.03	ft
Specific Energy	1,344.54	ft
Froude Number	0.18	
Flow Type	Subcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
10+00	12+55	0.050

Natural Channel Points

Station (ft)	Elevation (ft)
10+00	1,345.50
10+03	1,345.00
10+27	1,344.00
10+32	1,343.00
10+35	1,342.70
10+50	1,342.10
11+00	1,342.50
12+43	1,342.50
12+55	1,345.50

Rancho Cabrillo

section 6

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	35.0
Channel Bottom Slope (feet per foot).....	0.0049
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	5.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	1.20
Flow Velocity (feet per second).....	2.97
Froude Number (Flow is Sub-Critical).....	0.582
Velocity Head (feet).....	0.14
Energy Head (feet).....	1.34
Cross-Sectional Area of Flow (square feet).....	11.80
Top Width of Flow (feet).....	14.62

==========

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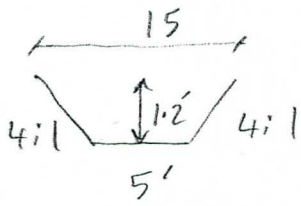

Rancho Cabrillo
Section 7

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	314.0 ~ 27.6 + 38
Channel Bottom Slope (feet per foot).....	0.0046
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	20.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	2.26
Flow Velocity (feet per second).....	4.78
Froude Number (Flow is Sub-Critical).....	0.642
Velocity Head (feet).....	0.35
Energy Head (feet).....	2.62
Cross-Sectional Area of Flow (square feet).....	65.68
Top Width of Flow (feet).....	38.09

==========

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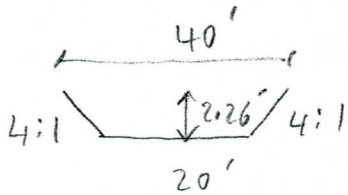

Rancho Cabrillo

Section 8

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	38.0
Channel Bottom Slope (feet per foot).....	0.0046
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	5.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	1.27
Flow Velocity (feet per second).....	2.96
Froude Number (Flow is Sub-Critical).....	0.568
Velocity Head (feet).....	0.14
Energy Head (feet).....	1.41
Cross-Sectional Area of Flow (square feet).....	12.83
Top Width of Flow (feet).....	15.17

==========

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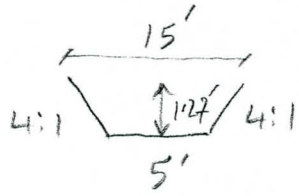

Rancho Cabrillo

Section 9

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	15.0
Channel Bottom Slope (feet per foot).....	0.0010
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	5.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	1.17
Flow Velocity (feet per second).....	1.32
Froude Number (Flow is Sub-Critical).....	0.262
Velocity Head (feet).....	0.03
Energy Head (feet).....	1.20
Cross-Sectional Area of Flow (square feet).....	11.36
Top Width of Flow (feet).....	14.38

==========

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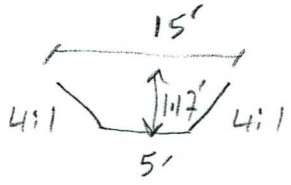

Rancho Cubrillo

Section 10

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	5.0
Channel Bottom Slope (feet per foot).....	0.0029
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	5.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	0.50
Flow Velocity (feet per second).....	1.41
Froude Number (Flow is Sub-Critical).....	0.399
Velocity Head (feet).....	0.03
Energy Head (feet).....	0.53
Cross-Sectional Area of Flow (square feet).....	3.53
Top Width of Flow (feet).....	9.03

==========

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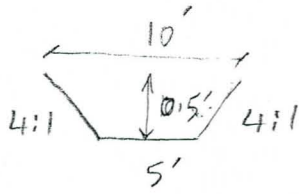

Rancho Cubrillo
Section 11

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 25, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).....	53.0
Channel Bottom Slope (feet per foot).....	0.0062
Manning's Roughness Coefficient (n-value).....	0.0300
Channel Side Slope - Left Side (horizontal/vertical)....	4.00
Channel Side Slope - Right Side (horizontal/vertical)...	4.00
Channel Bottom Width (feet).....	5.0

==========

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....	1.39
Flow Velocity (feet per second).....	3.61
Froude Number (Flow is Sub-Critical).....	0.667
Velocity Head (feet).....	0.20
Energy Head (feet).....	1.59
Cross-Sectional Area of Flow (square feet).....	14.68
Top Width of Flow (feet).....	16.12

==========

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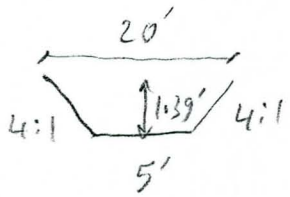

Rancho Cabrillo
preliminary section of the proposed channel Along the South side of Beardsley Canal

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

September 16, 2001

Section # 12

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	1,175.0
Channel Bottom Slope (ft/ft)	0.0005
Manning's Roughness Coefficient (n-value)	0.03
Channel Left Side Slope (horizontal/vertical)	4.0
Channel Right Side Slope (horizontal/vertical)	4.0
Channel Bottom Width (ft)	100.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	3.99
Flow Velocity (fps)	2.54
Froude Number	0.239
Velocity Head (ft)	0.1
Energy Head (ft)	4.09
Cross-Sectional Area of Flow (sq ft)	462.17
Top Width of Flow (ft)	131.89

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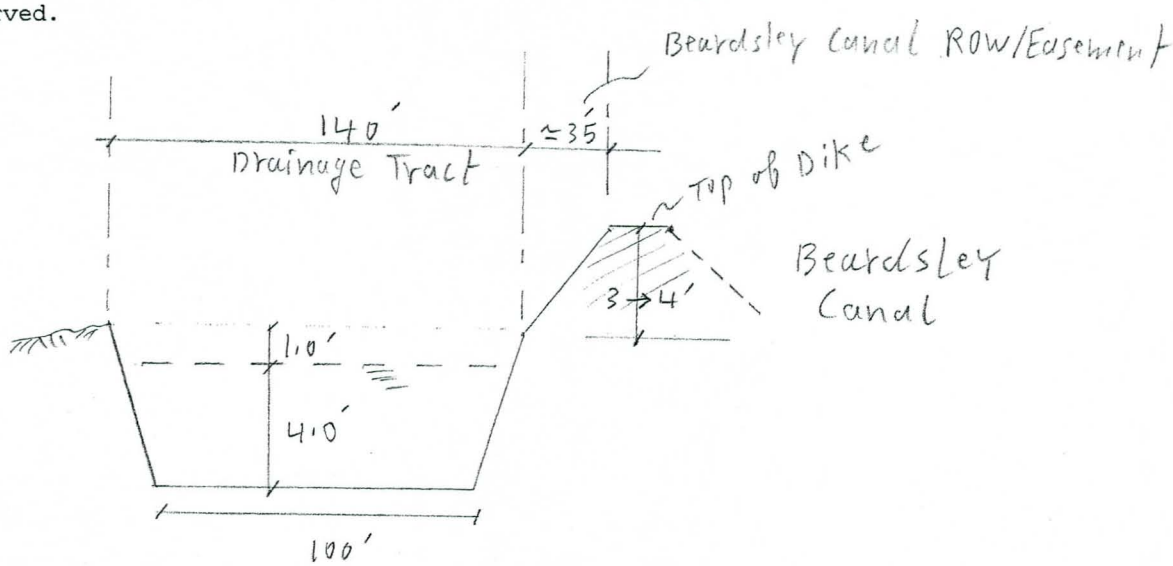

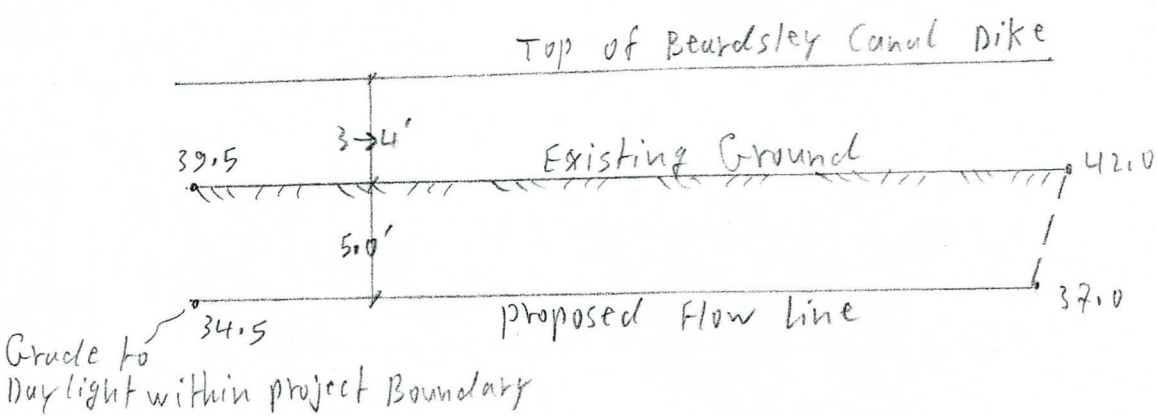

Rancho Cabrillo

Culvert #1

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION 5-36" RCP	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
52.4	3.00	4.20	4.19	2.20	2.35	2.20	9.42

==========

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$Q_{100,total}$ = 262 cfs (fig. 6)

Rancho cubrillo

culv. # 2

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

1-36" RCP

DESCRIPTION	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

	Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
Q_{100} =	35.0	3.00	2.99	3.34	1.64	1.92	3.00	4.95

(Fig. 6)

==========

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Rancho Cabrillo

culv. # 3

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

4-36" RCP

DESCRIPTION	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
42.3	3.00	3.45	3.65	1.85	2.12	3.00	5.98

==========

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Q_{100}, total = 169 cfs (Fig. 6)

Rancho Cabrillo

Culv. # 4

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION (2-10'x3' RCBC)	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0010

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
157.0	2.00	3.19	3.15	2.74	1.97	2.74	5.73

==========

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$Q_{100,total}$ = 314 cfs (Fig. 6)

Rancho Cabrillo

Culv. #5

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

2-36" RCP

DESCRIPTION	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
26.5	3.00	2.47	3.04	1.39	1.66	3.00	3.75

==========

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$Q_{100,total}$ = 53 cfs

Rancho Cabrillio

Culv. #6

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION (2-36" RCP)	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
26.5	3.00	2.47	3.04	1.39	1.66	3.00	3.75

==========

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Q_{100}, total = 53 cfs

Rancho Cabrillo

Culv. #7

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

2-10' x 3' RCBC

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	25.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
151.5	2.00	3.11	2.92	1.38	1.92	1.38	10.94

==========

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$Q_{100,total}$ = 303 cfs

Rancho Cabrillo
Culv. # 8

BOX CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

October 4, 2000

==========

PROGRAM INPUT DATA:

4 - 10' x 3' RCBC

DESCRIPTION	VALUE
Culvert Span (Width of Opening) (feet).....	10.00
Culvert Rise (Height of Opening) (feet).....	3.00
FHWA Chart Number (8,9,10,11,12 or 13).....	8
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0010

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
184.3	3.00	3.63	3.93	3.00	2.19	3.00	6.14

==========

BOX CULVERT ANALYSIS COMPUTER PROGRAM Version 1.6 Copyright (c) 1986
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Q_{100}, total = 737 cfs

Rancho Cabrillio

Stantec

Peak Flow Estimates For Happy Valley Road.

Peak Flow at the major crossing was estimated by a seperate hydrologic analysis using HEC-1 as discussed in section 8.3 of this report. (see Appendix A3.

peak Flow for the other crossings will be estimated by analogy from the estimated peak Flow at subbasin 132 A of the data in Appendix A3. See attached figure next.

100-year peak Flow from subbasin 132 = 481 cfs

Area of subbasin 132 = 0.583 sq. mi

i.e Q_{100} per one sq. mi = 481/0.583 = 825 cfs/sq. mi

Subbasin	Area (sq. mi)	Q_{100} (cfs)
A	0.378	312
B	0.117	97
C	0.110	91

Designed by: Checked by:

(A) [redacted] = [redacted] b [redacted] n [redacted] e [redacted]

(1) = Crossing Number

1" ≃ 1240' ↑

0

A

Rancho Cabrillio

Stantec

Peak Flow Estimates For Happy Valley Road.

Crossing No.	peak Flow at	Q_{100} (cfs)	Proposed * structure
1	sub. A	312	5-36" RCP
2	cp 132A1	4488	Bridge
3	sub B	97	3-36" RCP
4	sub C	91	3-36" RCP
5	sub C	91	3-36" RCP

These are preliminary sizes. Final sizes will be provided as more toppo is available. The Bridge size (or an alternative culvert) will be provided as more topo is available.

Designed by: Checked by:

Rancho Cubrillo;
Happy Valley Road
Crossing No. 1

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 20, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION 5-36" RCP	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
62.4	3.00	5.11	4.84	2.57	2.54	2.57	9.69

==========

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Rancho Cubrillo
Huppy valley Road
Crossing No. 3

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 20, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION 3-36" Rcp	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
32.3	3.00	2.83	3.24	1.56	1.84	3.00	4.57

==========

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Rancho Cabrillo;
Happy Valley Road

Crossing No. 4

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 20, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION 3-36" Rcp	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
30.3	3.00	2.71	3.17	1.50	1.78	3.00	4.29

==========

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Rancho Cubrillo;
Happy Valley Road
Crossing No. 5

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

September 20, 2000

==========

PROGRAM INPUT DATA:

DESCRIPTION 3-36" RCP	VALUE
Culvert Diameter (feet).....	3.00
FHWA Chart Number (1,2 or 3).....	1
Scale Number on Chart (Type of Culvert Entrance).....	1
Manning's Roughness Coefficient (n-value).....	0.0120
Entrance Loss Coefficient of Culvert Opening.....	0.50
Culvert Length (feet).....	50.0
Culvert Slope (feet per foot).....	0.0070

==========

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
30.3	3.00	2.71	3.17	1.50	1.78	3.00	4.29

==========

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APPENDIX C

Erosion Setback Analysis

Rancho Cabrillo

Stantec

Erosion Setback Requirements

Erosion setback requirements apply to watercourses with drainage areas > 1/4 sq.mi or Q_{100} > 500 cfs. These requirements apply at the following locations:

location (1)	Contrib Sub. (2)	Drainage Area (sq. mi) (2)	Combined Q_{100} (cfs) (2)	Applicable level (4)	Erosion setback (each side) (FT) (5)
Wash 3	123D	0.344	303	1	17.4 → use minim. = 20'
Wash 2	123E, 123F, 123G	0.419	388	1	19.7 → "
Paddelford Wash	concept 121C2	28.76 (3)	2765	1	53

Notes:

1- See Fig. 6

2- From the revised HEC-1 model, RC1A.24I (see App. A1)

3- The total area listed at this point in the revised HEC-1 model, RC1A.24I, is 9.25 sq.mi (it was 9.34 sq.mi at concept C123 in the original HEC-1 model of the Wittmann ADMS, WTM100YR). It was estimated that if the contributing area north of the CAP canal, approx. 22.58 sq.mi was added and the contributing area to lake Bonita, approx. 3.07 sq.mi was excluded, then the total contributing area would be 28.76 sq.mi.

4- level 1 applies for Areas < 30 sq.mi

5- Erosion setback requirement per level one = $1.0\,(Q_{100})^{0.5}$ for straight reaches with min. = 20'

Designed by: Checked by:

THIS RUN EXECUTED 28AUG00 08:43:41

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

Original HEC-2 Run For Padelford wash; From Wittmann ADMS

T1 WITTMANN ADMS
T2 HEC-2 FLOODPLAIN ANALYSIS (100 YEAR EVENT)
T3 PADELFORD WASH

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
					.0064		.5	2714	1322	

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1									15

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	38	43	1	53	21	22	54	51	4	8
	42	5	26							
NC	.07	.07	.07	.1	.3					
X1	.000	12	4825	5300						
GR	1320	3620	1317.1	3975	1317.1	4390	1320	4720	1320	4825
GR	1317	5000	1318	5060	1320	5300	1320	5650	1320	5850
GR	1318	6000	1320	6700						
X1	.203	10	4930	5590	1030	1010	1070			
GR	1326.5	4505	1324.5	4640	1326	4790	1325	4930	1324	5000
GR	1325	5150	1325	5210	1326	5590	1324	6005	1327	6085
X1	.371	17	4840	5575	940	960	890			
GR	1333	4630	1332	4740	1332	4840	1331	4880	1330	5000
GR	1332	5300	1331	5420	1332	5575	1333	5630	1332	5680
GR	1332.5	5800	1332	5890	1332.5	5960	1332	6040	1332.5	6120
GR	1332	6220	1334	6455						
NC				.3	.5					
X1	.523	21	4965	5035	750	630	700			
X2	2640									
X3	10									
GR	1338	4270	1336	4315	1335.5	4390	1335.5	4500	1336	4570
GR	1337	4660	1336	4770	1335.2	4830	1336	4870	1337	4905
GR	1336	4965	1335	5000	1336	5035	1338	5100	1336	5230
GR	1337	5280	1336	5320	1335.5	5425	1335.1	5595	1336	5820
GR	1338	5920								

NC	.07	.07	.05							
X1	.608	5	4945	5060	440	460	450			
GR	1343.5	4945	1337	4970	1337	5000	1337	5030	1343.5	5060
X1	.614	5	4945	5060	30	30	30			
X2	2815	1342.15								
GR	1343.5	4945	1337	4970	1337	5000	1337	5030	1343.5	5060
NC				.1	.3					
X1	.741	10	4620	5040	560	800	670			
X2	2567									
GR	1345.1	4590	1340	4620	1340	4660	1343	4770	1342	4950
GR	1340.5	5000	1344	5040	1342.5	5110	1344	5375	1345.1	5460
X1	.884	11	4815	5095	900	650	760			
GR	1349.2	4815	1349	4815	1349	4815	1349	4815	1348	4955
GR	1346	5000	1348	5020	1349	5095	1348	5220	1348	5340
GR	1350	5650								
X1	1.011	7	4955	5025	840	650	740			
GR	1355.8	4615	1352	4955	1350.5	5000	1352	5025	1355	5140
GR	1354.5	5290	1356	5340						
X1	1.136	5	4975	5020	660	660	660			
GR	1359	4720	1356	4975	1354	5000	1356	5020	1360	5325
X1	1.273	8	4950	5050	720	700	710			
X2	2493									
GR	1364	4460	1362	4715	1362	4950	1360	4980	1359	5000
GR	1360	5020	1364	5050	1366	5150				
X1	1.453	13	4850	5050	750	910	950			
GR	1369.5	4225	1368	4440	1368.5	4590	1368	4650	1368.5	4780
GR	1368.5	4850	1368	4905	1366	5000	1368	5020	1368.5	5050
GR	1366	5090	1368	5130	1371.5	5255				
X1	1.621	9	4945	5060	900	880	890			
X2	2420									
GR	1378	3940	1376	4040	1375	4300	1374	4590	1376	4820
GR	1376	4945	1373	5000	1376	5060	1377	5110		
NC	.07	.05	.05							
X1	1.818	13	4950	5195	1040	1050	1040			
GR	1385.5	4560	1384	4625	1382	4780	1382	4780	1382	4780
GR	1384	4890	1384	4950	1381	5000	1384	5040	1383	5195
GR	1382.5	5300	1384	5360	1388	5510				
X1	2.021	10	4780	5740	1100	1040	1070			
X2	1409									
X3	10									
GR	1393	4780	1392	4840	1388	5000	1391	5070	1390.5	5200
GR	1390	5275	1391	5400	1390.5	5520	1392	5600	1393	5740

	.07	.07	.05							
	2.159	7	4835	5130	800	640	730			
GR	1400	4600	1396	4715	1396	4765	1397	4835	1395.5	5000
GR	1396	5130	1400	5490						
XI	2.333	4	4920	5060	990	870	920			
GR	1408	4920	1404	4975	1404	5010	1408	5060		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CHV= .100 CEHV= .300
SECNO .000

3265 DIVIDED FLOW

.000	1.82	1318.82	.00	1322.00	1318.88	.06	.00	.00	1320.00
2714.0	2262.3	318.7	133.0	1063.1	216.1	142.8	.0	.0	1320.00
.00	2.13	1.47	.93	.070	.070	.070	.000	1317.00	3764.47
.006320	0.	0.	0.	0	0	6	.00	1434.20	6286.94

FLOW DISTRIBUTION FOR SECNO= .00 CWSEL= 1318.82

STA=	3764.	3975.	4390.	4586.	5300.	6000.	6287.
PER Q=	10.2	63.7	9.5	11.7	.9	4.0
AREA=	181.0	713.7	168.3	216.1	25.2	117.6
VEL=	1.5	2.4	1.5	1.5	.9	.9
DEPTH=	.9	1.7	.9	.8	.0	.4

*SECNO .203

.203	2.10	1326.10	.00	.00	1326.16	.05	7.27	.00	1325.00
2714.0	471.9	1206.6	1035.5	299.9	649.4	517.7	34.4	35.3	1326.00
.15	1.57	1.86	2.00	.070	.070	.070	.000	1324.00	4531.66
.007829	1030.	1070.	1010.	5	0	0	.00	1529.48	6061.14

FLOW DISTRIBUTION FOR SECNO= .20 CWSEL= 1326.10

STA=	4532.	4640.	4790.	4930.	5590.	6005.	6061.
PER Q=	5.2	8.0	4.2	44.5	33.9	4.2
AREA=	87.0	128.3	84.7	649.4	458.6	59.1
VEL=	1.6	1.7	1.3	1.9	2.0	1.9
DEPTH=	.8	.9	.6	1.0	1.1	1.1

*SECNO .371

3265 DIVIDED FLOW

.371	2.61	1332.61	.00	.00	1332.68	.07	6.52	.00	1332.00
2714.0	91.4	2421.3	201.3	81.5	1085.8	235.8	64.5	68.3	1332.00
.28	1.12	2.23	.85	.070	.070	.070	.000	1330.00	4672.90
.006558	940.	890.	960.	5	0	0	.00	1577.82	6291.67

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= .37 CWSEL= 1332.61

STA=	4673.	4740.	4840.	5575.	5609.	5680.	5800.	5890.	5960.	6040.	6120.	6220.	6292.
PER Q=	.6	2.8	89.2	.3	.3	1.4	1.0	.8	.9	.9	1.2	.6	
AREA=	20.5	61.0	1085.8	10.2	9.3	43.2	32.4	25.2	28.8	28.8	36.0	21.9	
VEL=	.8	1.2	2.2	.8	.8	.9	.9	.9	.9	.9	.9	.8	
DEPTH=	.3	.6	1.5	.3	.1	.4	.4	.4	.4	.4	.4	.3	

CCHV= .300 CEHV= .500
*SECNO .523

3265 DIVIDED FLOW

.523	1.89	1336.89	.00	.00	1336.94	.05	4.26	.01	1336.00
2640.0	961.2	195.4	1483.4	569.5	96.9	781.7	87.0	91.7	1336.00
.38	1.69	2.02	1.90	.070	.070	.070	.000	1335.00	4295.10
.005850	750.	700.	630.	4	0	0	.00	1415.91	5864.23

FLOW DISTRIBUTION FOR SECNO= .52 CWSEL= 1336.89

STA=	4295.	4390.	4500.	4570.	4830.	4870.	4965.	5035.	5425.	5595.	5820.	5864.
PER Q=	6.0	11.6	5.3	8.4	3.7	1.3	7.4	10.6	22.5	22.4	.7	
AREA=	93.9	152.3	79.4	155.3	51.4	37.2	96.9	192.5	269.4	300.3	19.6	
VEL=	1.7	2.0	1.8	1.4	1.9	.9	2.0	1.5	2.2	2.0	.9	
DEPTH=	1.0	1.4	1.1	.6	1.3	.4	1.4	.5	1.6	1.3	.4	

*SECNO .608

1645 INT SEC ADDED BY RAISING SEC .61, -1.333 FT AND MULTIPLYING BY .836

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1.010	3.98	1339.65	1339.65	.00	1341.30	1.65	1.61	.80	1342.17
2640.0	.0	2640.0	.0	.0	255.8	.0	90.0	94.2	1342.17
.38	.00	10.32	.00	.000	.050	.000	.000	1335.67	4953.10
.025356	147.	150.	153.	20	17	0	.00	78.33	5031.43

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1.01 CWSEL= 1339.65

TA= 4953. 5041.
PER Q= 100.0
AREA= 255.8
VEL= 10.3
DEPTH= 3.3

645 INT SEC ADDED BY RAISING SEC 1.01, .667 FT AND MULTIPLYING BY 1.098

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.43

1.020	6.16	1342.50	.00	.00	1342.95	.46	1.29	.36	1342.83
2640.0	.0	2640.0	.0	.0	486.6	.0	91.2	94.6	1342.83
.39	.00	5.43	.00	.000	.050	.000	.000	1336.33	4946.20
.004284	147.	150.	153.	3	0	0	.00	102.93	5049.13

LOW DISTRIBUTION FOR SECNO= 1.02 CWSEL= 1342.50

STA= 4946. 5051.
PER Q= 100.0
AREA= 486.6
VEL= 5.4
DEPTH= 4.7

1645 INT SEC ADDED BY RAISING SEC 1.02, .667 FT AND MULTIPLYING BY 1.089

.608	6.18	1343.18	.00	.00	1343.56	.38	.59	.02	1343.50
2640.0	.0	2640.0	.0	.0	531.2	.0	93.0	94.9	1343.50
.40	.00	4.97	.00	.000	.050	.000	.000	1337.00	4946.27
.003578	147.	150.	153.	1	0	0	.00	112.20	5058.47

```
  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=      .61        CWSEL=   1343.18

STA=    4946.    5060.
 PER Q=    100.0
  AREA=    531.2
   VEL=      5.0
 DEPTH=      4.7

*SECNO  .614
     .614      6.27   1343.27       .00   1342.15   1343.69       .42       .11       .02   1343.50
   2815.0        .0    2815.0        .0        .0     542.7        .0      93.4      95.0   1343.50
      .40       .00      5.19       .00      .000      .050      .000      .000   1337.00   4945.88
  .003828       30.       30.       30.         2         0         0       .00    113.06   5058.94

FLOW DISTRIBUTION FOR SECNO=      .61        CWSEL=   1343.27

STA=    4946.    5060.
 PER Q=    100.0
  AREA=    542.7
   VEL=      5.2
 DEPTH=      4.8

CCHV=     .100 CEHV=     .300
*SECNO  .741

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.00

     .741      4.74   1344.74       .00       .00   1344.78       .04      1.06       .04   1340.00
   2567.0      69.9    2098.3     398.8      66.2    1225.1     522.0     112.2     102.9   1344.00
      .52      1.06      1.71       .76      .070      .050      .070      .000   1340.00   4592.09
  .000797      560.      670.      800.         4         0         0       .00    840.42   5432.51

FLOW DISTRIBUTION FOR SECNO=      .74        CWSEL=   1344.74

STA=    4592.    4620.    5040.    5110.    5375.    5433.
 PER Q=      2.7     81.7      3.2     12.1       .3
  AREA=     66.2   1225.1    104.6    396.0     21.4
   VEL=      1.1      1.7       .8       .8       .3
 DEPTH=      2.4      2.9      1.5      1.5       .4
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO .884
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
693 PROBABLE MINIMUM SPECIFIC ENERGY
720 CRITICAL DEPTH ASSUMED

.884	3.05	1349.05	1349.05	.00	1349.47	.42	1.83	.11	1349.20
2567.0	.0	1503.6	1063.4	.0	250.4	278.6	131.7	115.2	1349.00
.56	.00	6.01	3.82	.000	.050	.070	.000	1346.00	4815.00
.047438	900.	760.	650.	20	17	0	.00	687.13	5502.13

FLOW DISTRIBUTION FOR SECNO= .88 CWSEL= 1349.05

TA=	4815.	5095.	5220.	5340.	5502.
PER Q=	58.6	8.2	23.3	9.9	
AREA=	250.4	68.3	125.5	84.8	
VEL=	6.0	3.1	4.8	3.0	
DEPTH=	.9	.5	1.0	.5	

*SECNO 1.011

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.80

1.011	4.85	1355.35	.00	.00	1355.51	.16	6.02	.03	1352.00
2567.0	852.9	1245.6	468.5	498.0	286.0	310.8	145.5	126.3	1352.00
.63	1.71	4.35	1.51	.070	.050	.070	.000	1350.50	4656.48
.003290	840.	740.	650.	4	0	0	.00	661.40	5317.88

FLOW DISTRIBUTION FOR SECNO= 1.01 CWSEL= 1355.35

TA=	4656.	4955.	5025.	5140.	5290.	5318.
PER Q=	33.2	48.5	15.0	2.9	.3	
AREA=	498.0	286.0	211.2	88.0	11.7	
VEL=	1.7	4.4	1.8	.9	.7	
DEPTH=	1.7	4.1	1.8	.6	.4	

SECNO 1.136

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .58

1.136	4.65	1358.65	.00	.00	1359.04	.38	3.46	.07	1356.00
2567.0	754.3	1136.0	676.7	299.6	164.5	268.7	159.3	134.9	1356.00
.67	2.52	6.91	2.52	.070	.050	.070	.000	1354.00	4749.32
.009643	660.	660.	660.	2	0	0	.00	473.12	5222.45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1.14 CWSEL= 1358.65

STA=	4749.	4975.	5020.	5222.
PER Q=	29.4	44.3	26.4	
AREA=	299.6	164.5	268.7	
VEL=	2.5	6.9	2.5	
DEPTH=	1.3	3.7	1.3	

*SECNO 1.273

1.273	4.73	1363.73	.00	.00	1363.92	.19	4.86	.02	1362.00
2493.0	1139.3	1353.7	.0	595.3	302.8	.0	172.7	143.3	1364.00
.73	1.91	4.47	.00	.070	.050	.000	.000	1359.00	4494.99
.005047	720.	710.	700.	3	0	0	.00	552.95	5047.94

FLOW DISTRIBUTION FOR SECNO= 1.27 CWSEL= 1363.73

STA=	4495.	4715.	4950.	5050.
PER Q=	10.4	35.3	54.3	
AREA=	189.8	405.5	302.8	
VEL=	1.4	2.2	4.5	
DEPTH=	.9	1.7	3.1	

*SECNO 1.453

1.453	3.17	1369.17	.00	.00	1369.31	.14	5.39	.01	1368.50
2493.0	760.6	1202.8	529.6	462.0	329.2	188.9	190.6	156.8	1368.50
.82	1.65	3.65	2.80	.070	.050	.070	.000	1366.00	4271.26
.007783	750.	950.	910.	5	0	0	.00	900.78	5172.04

FLOW DISTRIBUTION FOR SECNO= 1.45 CWSEL= 1369.17

STA=	4271.	4440.	4590.	4650.	4780.	4850.	5050.	5090.	5130.	5172.
PER Q=	5.2	9.9	4.0	8.6	2.7	48.2	9.0	11.0	1.3	
AREA=	99.3	139.1	55.6	120.5	47.4	329.2	77.1	87.1	24.7	
VEL=	1.3	1.8	1.8	1.8	1.4	3.7	2.9	3.1	1.3	
DEPTH=	.6	.9	.9	.9	.7	1.6	1.9	2.2	.6	

*SECNO 1.621

1.621	3.06	1376.06	.00	.00	1376.16	.10	6.84	.00	1376.00
2420.0	1792.9	627.1	.0	857.0	180.4	.1	211.4	176.6	1376.00
.92	2.09	3.48	.19	.070	.050	.070	.000	1373.00	4036.58
.007525	900.	890.	880.	3	0	0	.00	1026.84	5063.42

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1.62 CWSEL= 1376.06

STA=	4037.	4300.	4590.	4820.	4945.	5060.	5063.
PER Q=	7.7	46.7	19.5	.1	25.9	.0	
AREA=	147.9	454.8	245.7	8.5	180.4	.1	
VEL=	1.3	2.5	1.9	.3	3.5	.2	
DEPTH=	.6	1.6	1.1	.1	1.6	.0	

*SECNO 1.818

1.818	3.29	1384.29	.00	.00	1384.42	.13	8.25	.01	1384.00
2420.0	804.7	851.9	763.4	362.0	284.2	226.1	234.2	197.9	1383.00
1.02	2.22	3.00	3.38	.070	.050	.050	.000	1381.00	4612.32
.008356	1040.	1040.	1050.	6	0	0	.00	758.65	5370.97

FLOW DISTRIBUTION FOR SECNO= 1.82 CWSEL= 1384.29

STA=	4612.	4625.	4780.	4890.	4950.	5195.	5300.	5360.	5371.
PER Q=	.0	19.1	13.5	.6	35.2	24.3	7.2	.1	
AREA=	1.9	200.4	142.2	17.6	284.2	162.0	62.6	1.6	
VEL=	.5	2.3	2.3	.9	3.0	3.6	2.8	.8	
DEPTH=	.1	1.3	1.3	.3	1.2	1.5	1.0	.1	

*SECNO 2.021

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1393.00 ELREA= 1393.00

2.021	3.34	1391.34	.00	.00	1391.41	.06	6.98	.01	1393.00
1409.0	.0	1409.0	.0	.0	702.3	.0	253.6	215.9	1393.00
1.17	.00	2.01	.00	.000	.050	.000	.000	1388.00	4866.55
.004521	1100.	1070.	1040.	3	0	0	.00	698.04	5564.60

FLOW DISTRIBUTION FOR SECNO= 2.02 CWSEL= 1391.34

STA=	4867.	5740.
PER Q=	100.0	
AREA=	702.3	
VEL=	2.0	
DEPTH=	1.0	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 2.159

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .52

2.159	1.51	1397.01	.00	.00	1397.20	.19	5.75	.04	1397.00
1409.0	228.3	1100.5	80.1	100.8	289.1	45.9	263.1	226.2	1396.00
1.23	2.27	3.81	1.75	.070	.050	.070	.000	1395.50	4685.98
.016863	800.	730.	640.	3	0	0	.00	534.88	5220.86

FLOW DISTRIBUTION FOR SECNO= 2.16 CWSEL= 1397.01

STA=	4686.	4715.	4765.	4835.	5130.	5221.
PER Q=	1.8	9.9	4.5	78.1	5.7	
AREA=	14.7	50.5	35.7	289.1	45.9	
VEL=	1.7	2.8	1.8	3.8	1.7	
DEPTH=	.5	1.0	.5	1.0	.5	

*SECNO 2.333

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.41

2.333	3.61	1407.61	.00	.00	1407.96	.35	10.71	.05	1408.00
1409.0	.0	1409.0	.0	.0	297.1	.0	270.9	233.3	1408.00
1.28	.00	4.74	.00	.000	.050	.000	.000	1404.00	4925.39
.008454	990.	920.	870.	5	0	0	.00	129.71	5055.10

FLOW DISTRIBUTION FOR SECNO= 2.33 CWSEL= 1407.61

STA=	4925.	5060.
PER Q=	100.0	
AREA=	297.1	
VEL=	4.7	
DEPTH=	2.3	

PROFILE FOR STREAM PADELFORD WASH

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

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ELEVATION  1317.    1327.    1337.    1347.    1357.    1367.    1377.    1387.    1397.    1407.
   SECNO   CUMDIS

   .00      0.  I EL     .        .        .        .        .        .        .        .        .
            100. CI ER    .        .        .        .        .        .        .        .        .
            200. CI EL    .        .        .        .        .        .        .        .        .
            300. C I ER   .        .        .        .        .        .        .        .        .
            400. C  I E   .        .        .        .        .        .        .        .        .
            500. C  I ER  .        .        .        .        .        .        .        .        .
            600. C   I EM .        .        .        .        .        .        .        .        .
            700. C    ILE .        .        .        .        .        .        .        .        .
            800. C    I EM .       .        .        .        .        .        .        .        .
            900. C     ILE .       .        .        .        .        .        .        .        .
           1000. C      ILE.       .        .        .        .        .        .        .        .
   .20     1100. C      ILEM       .        .        .        .        .        .        .        .
           1200. C       ILE       .        .        .        .        .        .        .        .
           1300. C       I LE      .        .        .        .        .        .        .        .
           1400. C        ILEM     .        .        .        .        .        .        .        .
           1500. C         ILE     .        .        .        .        .        .        .        .
           1600. C         I LE    .        .        .        .        .        .        .        .
           1700. C         .I WE   .        .        .        .        .        .        .        .
           1800. C         . I EM  .        .        .        .        .        .        .        .
           1900. C         . I LE  .        .        .        .        .        .        .        .
   .37     2000. C         .  I LE .        .        .        .        .        .        .        .
           2100. C         .   I EM .       .        .        .        .        .        .        .
           2200. C         .   I LE .       .        .        .        .        .        .        .
           2300. C         .    I WE .      .        .        .        .        .        .        .
           2400. C         .     ILEM.      .        .        .        .        .        .        .
           2500. C         .      ILEM      .        .        .        .        .        .        .
           2600. C         .      ILEM      .        .        .        .        .        .        .
   .52     2700. C         .       ILEM     .        .        .        .        .        .        .
           2800. C         .       I . WEM  .        .        .        .        .        .        .
  1.01     2900. .         .        I.  WEL .        .        .        .        .        .        .
  1.02     3000. C         .        I.   WE .        .        .        .        .        .        .
           3100. C         .         I    E .        .        .        .        .        .        .
   .61     3200. C         .         I    WE .       .        .        .        .        .        .
   .61     3300. C         .         I    WE .       .        .        .        .        .        .
           3400. C         .         I    WE .       .        .        .        .        .        .
           3500. C         .         .I  L E .       .        .        .        .        .        .
           3600. C         .         .I  L E .       .        .        .        .        .        .
           3700. C         .         . I L  E .      .        .        .        .        .        .
           3800. C         .         . I L  WE .     .        .        .        .        .        .
   .74     3900. C         .         .  I   RE .     .        .        .        .        .        .
           4000. C         .         .  I   EM.      .        .        .        .        .        .
           4100. C         .         .   I  RE.      .        .        .        .        .        .
           4200. C         .         .   I L WE      .        .        .        .        .        .
           4300. C         .         .    I L E      .        .        .        .        .        .
           4400. C         .         .     I LRE     .        .        .        .        .        .
           4500. C         .         .      I LE     .        .        .        .        .        .
   .88     4600. .         .         .       I. E    .        .        .        .        .        .
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      4700.  C     .     .     I RE    .     .     .     .     .     .     .
      4800.  C     .     .     I  LE   .     .     .     .     .     .     .
      4900.  C     .     .     .I L E  .     .     .     .     .     .     .
      5000.  C     .     .     .I  LWE .     .     .     .     .     .     .
      5100.  C     .     .     . I L WE .     .     .     .     .     .     .
      5200.  C     .     .     . IL  EM .     .     .     .     .     .     .
      5300.  C     .     .     . I L  E .     .     .     .     .     .     .
1.01  5400.  C     .     .     .  IL  WE.     .     .     .     .     .     .
      5500.  C     .     .     .  I L  E.     .     .     .     .     .     .
      5600.  C     .     .     .   IL  WE     .     .     .     .     .     .
      5700.  C     .     .     .   I L  E     .     .     .     .     .     .
      5800.  C     .     .     .    IL  WE    .     .     .     .     .     .
      5900.  C     .     .     .    I L .E    .     .     .     .     .     .
1.14  6000.  C     .     .     .     I L. E   .     .     .     .     .     .
      6100.  C     .     .     .      I L WE  .     .     .     .     .     .
      6200.  C     .     .     .      I .L E  .     .     .     .     .     .
      6300.  C     .     .     .       I. L E .     .     .     .     .     .
      6400.  C     .     .     .        I L RE .     .     .     .     .     .
      6500.  C     .     .     .        .I L EM .     .     .     .     .     .
      6600.  C     .     .     .        .I  L E .     .     .     .     .     .
1.27  6700.  C     .     .     .        . I  L E .     .     .     .     .     .
      6800.  C     .     .     .        .  I  LEM .     .     .     .     .     .
      6900.  C     .     .     .        .  I  L E .     .     .     .     .     .
      7000.  C     .     .     .        .   I  LWE.     .     .     .     .     .
      7100.  C     .     .     .        .    I  LE.     .     .     .     .     .
      7200.  C     .     .     .        .     I LRE     .     .     .     .     .
      7300.  C     .     .     .        .     I  LE     .     .     .     .     .
      7400.  C     .     .     .        .      I  LE    .     .     .     .     .
      7500.  C     .     .     .        .       I LEM   .     .     .     .     .
      7600.  C     .     .     .        .        I.LE   .     .     .     .     .
1.45  7700.  C     .     .     .        .        I. EM  .     .     .     .     .
      7800.  C     .     .     .        .         I LE  .     .     .     .     .
      7900.  C     .     .     .        .         .I LE .     .     .     .     .
      8000.  C     .     .     .        .         .I  LE .     .     .     .     .
      8100.  C     .     .     .        .         . I  EM .     .     .     .     .
      8200.  C     .     .     .        .         .  I  EM .     .     .     .     .
      8300.  C     .     .     .        .         .   I  EM .     .     .     .     .
      8400.  C     .     .     .        .         .    I LE .     .     .     .     .
      8500.  C     .     .     .        .         .    I  EM.     .     .     .     .
1.62  8600.  C     .     .     .        .         .     I  EM     .     .     .     .
      8700.  C     .     .     .        .         .      I  EM    .     .     .     .
      8800.  C     .     .     .        .         .       I REM   .     .     .     .
      8900.  C     .     .     .        .         .       I .WE   .     .     .     .
      9000.  C     .     .     .        .         .        I. EM  .     .     .     .
      9100.  C     .     .     .        .         .         I REM .     .     .     .
      9200.  C     .     .     .        .         .         .I REM .     .     .     .
      9300.  C     .     .     .        .         .         .I  LEM .     .     .     .
      9400.  C     .     .     .        .         .         . I RWEM .     .     .     .
      9500.  C     .     .     .        .         .         .  I REM .     .     .     .
1.82  9600.  C     .     .     .        .         .         .   I RE M.     .     .     .
      9700.  C     .     .     .        .         .         .    I REM.     .     .     .
      9800.  C     .     .     .        .         .         .    I  REM     .     .     .
      9900.  C     .     .     .        .         .         .     I  ELM    .     .     .
     10000.  C     .     .     .        .         .         .      I  EM    .     .     .
     10100.  C     .     .     .        .         .         .      I  .EM   .     .     .
     10200.  C     .     .     .        .         .         .       I .ELM  .     .     .
     10300.  C     .     .     .        .         .         .        I. EL  .     .     .
     10400.  C     .     .     .        .         .         .        I.  EL .     .     .
     10500.  C     .     .     .        .         .         .         I  ERL .     .     .
     10600.  C     .     .     .        .         .         .         .I  ELM .     .     .
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2.02 10700.  C      .    .    .    .    .    .    .I  E L  .    .    .
     10800.  C      .    .    .    .    .    .    . I  ERL  .    .    .
     10900.  C      .    .    .    .    .    .    .  I  ELM .    .    .
     11000.  C      .    .    .    .    .    .    .   I  ELM.    .    .
     11100.  C      .    .    .    .    .    .    .    I WE M    .    .
     11200.  C      .    .    .    .    .    .    .     I EL.M   .    .
     11300.  C      .    .    .    .    .    .    .      IRE. M  .    .
2.16 11400.  C      .    .    .    .    .    .    .       IE  M  .    .
     11500.  C      .    .    .    .    .    .    .       IRE  M .    .
     11600.  C      .    .    .    .    .    .    .        I WE M .    .
     11700.  C      .    .    .    .    .    .    .        .I WE M .    .
     11800.  C      .    .    .    .    .    .    .        . I REM .    .
     11900.  C      .    .    .    .    .    .    .        .  I  EM .    .
     12000.  C      .    .    .    .    .    .    .        .   I  EM .    .
     12100.  C      .    .    .    .    .    .    .        .    I  EM.    .
     12200.  C      .    .    .    .    .    .    .        .     I  WE    .
2.33 12300.  C      .    .    .    .    .    .    .        .      I  .E   .
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THIS RUN EXECUTED 28AUG00 08:43:41

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HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

PADELFORD WASH

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	ELMIN	10*KS	VCH
	.000	2714.00	1318.82	3764.47	4825.00	5300.00	6286.94	.00	1434.20	1.82	1317.00	63.20	1.47
	.203	2714.00	1326.10	4531.66	4930.00	5590.00	6061.14	7.28	1529.48	2.10	1324.00	78.29	1.86
	.371	2714.00	1332.61	4672.90	4840.00	5575.00	6291.67	6.50	1577.82	2.61	1330.00	65.58	2.23
	.523	2640.00	1336.89	4295.10	4965.00	5035.00	5864.23	4.28	1415.91	1.89	1335.00	58.50	2.02
	.608	2640.00	1343.18	4946.27	4945.00	5060.00	5058.47	.68	112.20	6.18	1337.00	35.78	4.97
	.614	2815.00	1343.27	4945.88	4945.00	5060.00	5058.94	.09	113.06	6.27	1337.00	38.28	5.19
	.741	2567.00	1344.74	4592.09	4620.00	5040.00	5432.51	1.47	840.42	4.74	1340.00	7.97	1.71
*	.884	2567.00	1349.05	4815.00	4815.00	5095.00	5502.13	4.30	687.13	3.05	1346.00	474.38	6.01
	1.011	2567.00	1355.35	4656.48	4955.00	5025.00	5317.88	6.30	661.40	4.85	1350.50	32.90	4.35
	1.136	2567.00	1358.65	4749.32	4975.00	5020.00	5222.45	3.31	473.12	4.65	1354.00	96.43	6.91
	1.273	2493.00	1363.73	4494.99	4950.00	5050.00	5047.94	5.07	552.95	4.73	1359.00	50.47	4.47
	1.453	2493.00	1369.17	4271.26	4850.00	5050.00	5172.04	5.45	900.78	3.17	1366.00	77.83	3.65
	1.621	2420.00	1376.06	4036.58	4945.00	5060.00	5063.42	6.89	1026.84	3.06	1373.00	75.25	3.48
	1.818	2420.00	1384.29	4612.32	4950.00	5195.00	5370.97	8.23	758.65	3.29	1381.00	83.56	3.00
	2.021	1409.00	1391.34	4866.55	4780.00	5740.00	5564.60	7.05	698.04	3.34	1388.00	45.21	2.01
*	2.159	1409.00	1397.01	4685.98	4835.00	5130.00	5220.86	5.66	534.88	1.51	1395.50	168.63	3.81
	2.333	1409.00	1407.61	4925.39	4920.00	5060.00	5055.10	10.60	129.71	3.61	1404.00	84.54	4.74

UMMARY OF ERRORS AND SPECIAL NOTES

UTION SECNO= .608 PROFILE= 1 INTERPOLATED X-SECTIONS USED

WARNING SECNO= .741 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= .884 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= .884 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
UTION SECNO= .884 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO= 1.011 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

RNING SECNO= 1.136 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 2.159 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

RNING SECNO= 2.333 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

THIS RUN EXECUTED 03OCT00 08:35:31

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

Revised HEC-2 Run
For Erosion setback
Analysis

T1 WITTMANN ADMS
HEC-2 FLOODPLAIN ANALYSIS (100 YEAR EVENT)
PADELFORD WASH
T4
T5 REVISED RUN. SEE TEXT ABOVE FIRST X1 CARD

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
					.0064		.5	2714	1322	

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1									15

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

38	43	1	53	21	22	54	51	4	8
42	5	26							

NC .07 .07 .07 .1 .3

This run has been modified for the purpose of establishing an erosion setback line for Rancho Cabrillio project.
Erosion setback lines are typically set from the floodway boundary in a natural conveyance system. Floodways can be established at a flood boundary that woud raise the base flood elevation no more than one foot. For this application,there was no attemept to establish any floodway boundaries, instead encroachments stations,that at a minimum coinsided with the required erosion setback width,was incorporated into the original HEC-1 model. The output indicated that the increase in the WSEL is minimal. It can be safely assumed that the erosion setback lines establiesd per the encroachment stations coded would be coservative if compared to the erosion setback line based on the actual limits of the floodway boundaries.
This revised model was prepared by Stantec Conulting Inc. on 8-28-2000
Revised model name: <<<<PADLWSH1.H2I>>>>
****

X1	.000	12	4825	5300						
X3				3818						
GR	1320	3620	1317.1	3975	1317.1	4390	1320	4720	1320	4825
GR	1317	5000	1318	5060	1320	5300	1320	5650	1320	5850
GR	1318	6000	1320	6700						

X1	.203	10	4930	5590	1030	1010	1070			
X3				4585						
GR	1326.5	4505	1324.5	4640	1326	4790	1325	4930	1324	5000
GR	1325	5150	1325	5210	1326	5590	1324	6005	1327	6085
X1	.371	17	4840	5575	940	960	890			
X3				4726						
GR	1333	4630	1332	4740	1332	4840	1331	4880	1330	5000
GR	1332	5300	1331	5420	1332	5575	1333	5630	1332	5680
GR	1332.5	5800	1332	5890	1332.5	5960	1332	6040	1332.5	6120
GR	1332	6220	1334	6455						
NC				.3	.5					
X1	.523	21	4965	5035	750	630	700			
X2	2640									
X3	10			4348						
GR	1338	4270	1336	4315	1335.5	4390	1335.5	4500	1336	4570
GR	1337	4660	1336	4770	1335.2	4830	1336	4870	1337	4905
GR	1336	4965	1335	5000	1336	5035	1338	5100	1336	5230
GR	1337	5280	1336	5320	1335.5	5425	1335.1	5595	1336	5820
GR	1338	5920								
NC	.07	.07	.05							
X1	.608	5	4945	5060	440	460	450			
X3										
GR	1343.5	4945	1337	4970	1337	5000	1337	5030	1343.5	5060
X1	.614	5	4945	5060	30	30	30			
X2	2815	1342.15								
GR	1343.5	4945	1337	4970	1337	5000	1337	5030	1343.5	5060
NC				.1	.3					
X1	.741	10	4620	5040	560	800	670			
X2	2567									
GR	1345.1	4590	1340	4620	1340	4660	1343	4770	1342	4950
GR	1340.5	5000	1344	5040	1342.5	5110	1344	5375	1345.1	5460
X1	.884	11	4815	5095	900	650	760			
GR	1349.2	4815	1349	4815	1349	4815	1349	4815	1348	4955
GR	1346	5000	1348	5020	1349	5095	1348	5220	1348	5340
GR	1350	5650								
X1	1.011	7	4955	5025	840	650	740			
GR	1355.8	4615	1352	4955	1350.5	5000	1352	5025	1355	5140
GR	1354.5	5290	1356	5340						
X1	1.136	5	4975	5020	660	660	660			
GR	1359	4720	1356	4975	1354	5000	1356	5020	1360	5325

	1.273	8	4950	5050	720	700	710			
	2493									
GR	1364	4460	1362	4715	1362	4950	1360	4980	1359	5000
	1360	5020	1364	5050	1366	5150				
X1	1.453	13	4850	5050	750	910	950			
GR	1369.5	4225	1368	4440	1368.5	4590	1368	4650	1368.5	4780
	1368.5	4850	1368	4905	1366	5000	1368	5020	1368.5	5050
GR	1366	5090	1368	5130	1371.5	5255				
	1.621	9	4945	5060	900	880	890			
	2420									
GR	1378	3940	1376	4040	1375	4300	1374	4590	1376	4820
	1376	4945	1373	5000	1376	5060	1377	5110		
NC	.07	.05	.05							
X1	1.818	13	4950	5195	1040	1050	1040			
	1385.5	4560	1384	4625	1382	4780	1382	4780	1382	4780
	1384	4890	1384	4950	1381	5000	1384	5040	1383	5195
GR	1382.5	5300	1384	5360	1388	5510				
	2.021	10	4780	5740	1100	1040	1070			
X2	1409									
X3	10									
	1393	4780	1392	4840	1388	5000	1391	5070	1390.5	5200
GR	1390	5275	1391	5400	1390.5	5520	1392	5600	1393	5740
	.07	.07	.05							
	2.159	7	4835	5130	800	640	730			
GR	1400	4600	1396	4715	1396	4765	1397	4835	1395.5	5000
	1396	5130	1400	5490						
X1	2.333	4	4920	5060	990	870	920			
GR	1408	4920	1404	4975	1404	5010	1408	5060		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CHV= .100 CEHV= .300
*SECNO .000

265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS= 3818.0 6700.0 TYPE= 1 TARGET= -3818.000

.000	1.81	1318.81	.00	1322.00	1318.88	.07	.00	.00	1320.00
2714.0	2269.0	315.2	129.8	1045.4	214.0	140.1	.0	.0	1320.00
.00	2.17	1.47	.93	.070	.070	.070	.000	1317.00	3818.00
.006336	0.	0.	0.	0	0	6	.00	1375.06	6284.20

FLOW DISTRIBUTION FOR SECNO= .00 CWSEL= 1318.81

STA=	3818.	3975.	4390.	4585.	5300.	6000.	6284.
PER Q=	10.9	63.3	9.4	11.6	.8	3.9	
AREA=	168.1	710.5	166.8	214.0	24.7	115.4	
VEL=	1.8	2.4	1.5	1.5	.9	.9	
DEPTH=	1.1	1.7	.9	.8	.0	.4	

*SECNO .203

3470 ENCROACHMENT STATIONS= 4585.0 6085.0 TYPE= 1 TARGET= -4585.000

.203	2.10	1326.10	.00	.00	1326.16	.06	7.28	.00	1325.00
2714.0	469.7	1207.8	1036.5	279.1	649.9	518.1	33.9	33.9	1326.00
.15	1.68	1.86	2.00	.070	.070	.070	.000	1324.00	4585.00
.007823	1030.	1070.	1010.	5	0	0	.00	1476.16	6061.16

FLOW DISTRIBUTION FOR SECNO= .20 CWSEL= 1326.10

STA=	4585.	4640.	4790.	4930.	5590.	6005.	6061.
PER Q=	5.1	8.0	4.2	44.5	34.0	4.2	
AREA=	65.9	128.4	84.8	649.9	459.0	59.1	
VEL=	2.1	1.7	1.3	1.9	2.0	1.9	
DEPTH=	1.2	.9	.6	1.0	1.1	1.1	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO .371

265 DIVIDED FLOW

470 ENCROACHMENT STATIONS= 4726.0 6455.0 TYPE= 1 TARGET= -4726.000

.371	2.61	1332.61	.00	.00	1332.68	.07	6.52	.00	1332.00
2714.0	84.4	2426.8	202.8	68.8	1086.9	236.8	63.7	65.8	1332.00
.27	1.23	2.23	.86	.070	.070	.070	.000	1330.00	4726.00
.006566	940.	890.	960.	5	0	0	.00	1525.05	6291.85

LOW DISTRIBUTION FOR SECNO= .37 CWSEL= 1332.61

STA=	4726.	4740.	4840.	5575.	5609.	5680.	5800.	5890.	5960.	6040.	6120.	6220.	6292.
PER Q=	.3	2.8	89.4	.3	.3	1.4	1.0	.8	.9	.9	1.2	.6	
AREA=	7.7	61.1	1086.9	10.3	9.3	43.4	32.5	25.3	28.9	28.9	36.1	22.0	
VEL=	1.1	1.2	2.2	.8	.8	.9	.9	.9	.9	.9	.9	.8	
DEPTH=	.5	.6	1.5	.3	.1	.4	.4	.4	.4	.4	.4	.3	

CCHV= .300 CEHV= .500

*SECNO .523

265 DIVIDED FLOW

470 ENCROACHMENT STATIONS= 4348.0 5920.0 TYPE= 1 TARGET= -4348.000

.523	1.90	1336.90	.00	.00	1336.96	.05	4.27	.01	1336.00
2640.0	922.7	199.6	1517.7	536.6	98.0	792.4	85.9	88.3	1336.00
.38	1.72	2.04	1.92	.070	.070	.070	.000	1335.00	4348.00
.005889	750.	700.	630.	4	0	0	.00	1371.00	5864.98

LOW DISTRIBUTION FOR SECNO= .52 CWSEL= 1336.90

STA=	4348.	4390.	4500.	4570.	4830.	4870.	4965.	5035.	5425.	5595.	5820.	5865.
PER Q=	3.7	11.9	5.4	8.7	3.8	1.4	7.6	10.9	23.0	22.9	.7	
AREA=	52.9	153.9	80.5	158.9	52.0	38.4	98.0	196.6	271.9	303.6	20.2	
VEL=	1.9	2.0	1.8	1.4	1.9	1.0	2.0	1.5	2.2	2.0	1.0	
DEPTH=	1.3	1.4	1.1	.6	1.3	.4	1.4	.5	1.6	1.3	.4	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO .608

01 HV CHANGED MORE THAN HVINS

02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .53

.608	3.81	1340.81	.00	.00	1342.10	1.29	4.52	.62	1343.50
2640.0	.0	2640.0	.0	.0	289.6	.0	94.8	95.9	1343.50
.39	.00	9.12	.00	.000	.050	.000	.000	1337.00	4955.36
.020716	440.	450.	460.	4	0	0	.00	92.20	5047.56

LOW DISTRIBUTION FOR SECNO= .61 CWSEL= 1340.81

TA= 4955. 5060.
PER Q= 100.0
AREA= 289.6
VEL= 9.1
DEPTH= 3.1

*SECNO .614

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.54

.614	4.84	1341.84	.00	1342.15	1342.65	.81	.41	.14	1343.50
2815.0	.0	2815.0	.0	.0	389.1	.0	95.0	96.0	1343.50
.39	.00	7.24	.00	.000	.050	.000	.000	1337.00	4951.40
.009951	30.	30.	30.	4	0	0	.00	100.92	5052.32

FLOW DISTRIBUTION FOR SECNO= .61 CWSEL= 1341.84

TA= 4951. 5060.
PER Q= 100.0
AREA= 389.1
VEL= 7.2
DEPTH= 3.9

CHV= .100 CEHV= .300

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO .741

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.69

.741	4.48	1344.48	.00	.00	1344.53	.05	1.81	.08	1340.00
2567.0	72.0	2150.6	344.3	59.2	1116.3	422.9	110.9	103.6	1344.00
.50	1.22	1.93	.81	.070	.050	.070	.000	1340.00	4593.62
.001142	560.	670.	800.	3	0	0	.00	818.89	5412.51

FLOW DISTRIBUTION FOR SECNO= .74 CWSEL= 1344.48

STA=	4594.	4620.	5040.	5110.	5375.	5413.
PER Q=	2.8	83.8	2.8	10.5	.1	
AREA=	59.2	1116.3	86.5	327.4	9.1	
VEL=	1.2	1.9	.8	.8	.3	
DEPTH=	2.2	2.7	1.2	1.2	.2	

*SECNO .884

3685 20 TRIALS ATTEMPTED WSEL,CWSEL

3693 PROBABLE MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

.884	3.07	1349.07	1349.07	.00	1349.47	.40	2.48	.10	1349.20
2567.0	.0	1500.4	1066.6	.0	256.3	287.2	128.7	115.8	1349.00
.54	.00	5.85	3.71	.000	.050	.070	.000	1346.00	4815.00
.043720	900.	760.	650.	20	18	0	.00	690.39	5505.39

FLOW DISTRIBUTION FOR SECNO= .88 CWSEL= 1349.07

STA=	4815.	5095.	5220.	5340.	5505.
PER Q=	58.4	8.4	23.1	10.0	
AREA=	256.3	70.9	128.0	88.2	
VEL=	5.9	3.0	4.6	2.9	
DEPTH=	.9	.6	1.1	.5	

*SECNO 1.011

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.61

1.011	4.83	1355.33	.00	.00	1355.50	.17	6.00	.02	1352.00
2567.0	851.6	1250.6	464.8	493.8	285.1	306.7	142.5	126.9	1352.00
.61	1.72	4.39	1.52	.070	.050	.070	.000	1350.50	4657.74
.003355	840.	740.	650.	4	0	0	.00	659.68	5317.41

FLOW DISTRIBUTION FOR SECNO= 1.01 CWSEL= 1355.33

STA=	4658.	4955.	5025.	5140.	5290.	5317.
PER Q=	33.2	48.7	15.0	2.8	.3	
AREA=	493.8	285.1	209.6	85.9	11.3	
VEL=	1.7	4.4	1.8	.8	.7	
DEPTH=	1.7	4.1	1.8	.6	.4	

*SECNO 1.136

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .59

1.136	4.66	1358.66	.00	.00	1359.04	.38	3.48	.06	1356.00
2567.0	756.2	1132.5	678.3	301.9	164.9	270.8	156.3	135.5	1356.00
.65	2.50	6.87	2.50	.070	.050	.070	.000	1354.00	4748.46
.009495	660.	660.	660.	2	0	0	.00	474.76	5223.22

FLOW DISTRIBUTION FOR SECNO= 1.14 CWSEL= 1358.66

STA=	4748.	4975.	5020.	5223.
PER Q=	29.5	44.1	26.4	
AREA=	301.9	164.9	270.8	
VEL=	2.5	6.9	2.5	
DEPTH=	1.3	3.7	1.3	

*SECNO 1.273

1.273	4.71	1363.71	.00	.00	1363.91	.20	4.85	.02	1362.00
2493.0	1137.7	1355.3	.0	593.5	302.4	.0	169.7	143.9	1364.00
.71	1.92	4.48	.00	.070	.050	.000	.000	1359.00	4495.50
.005078	720.	710.	700.	2	0	0	.00	552.41	5047.91

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1.27 CWSEL= 1363.71

STA=	4496.	4715.	4950.	5050.
PER Q=	10.4	35.3	54.4	
AREA=	188.9	404.6	302.4	
VEL=	1.4	2.2	4.5	
DEPTH=	.9	1.7	3.1	

*SECNO 1.453

1.453	3.17	1369.17	.00	.00	1369.31	.14	5.40	.01	1368.50
2493.0	761.2	1202.4	529.4	462.7	329.4	189.1	187.7	157.3	1368.50
.79	1.65	3.65	2.80	.070	.050	.070	.000	1366.00	4271.09
.007759	750.	950.	910.	5	0	0	.00	901.00	5172.09

FLOW DISTRIBUTION FOR SECNO= 1.45 CWSEL= 1369.17

STA=	4271.	4440.	4590.	4650.	4780.	4850.	5050.	5090.	5130.	5172.
PER Q=	5.2	9.9	4.0	8.6	2.8	48.2	9.0	11.0	1.3	
AREA=	99.5	139.3	55.7	120.7	47.5	329.4	77.1	87.1	24.8	
VEL=	1.3	1.8	1.8	1.8	1.4	3.6	2.9	3.1	1.3	
DEPTH=	.6	.9	.9	.9	.7	1.6	1.9	2.2	.6	

*SECNO 1.621

1.621	3.06	1376.06	.00	.00	1376.16	.10	6.84	.00	1376.00
2420.0	1792.7	627.3	.0	856.1	180.2	.1	208.4	177.2	1376.00
.89	2.09	3.48	.19	.070	.050	.070	.000	1373.00	4036.63
.007544	900.	890.	880.	3	0	0	.00	1026.74	5063.37

FLOW DISTRIBUTION FOR SECNO= 1.62 CWSEL= 1376.06

STA=	4037.	4300.	4590.	4820.	4945.	5060.	5063.
PER Q=	7.7	46.7	19.5	.1	25.9	.0	
AREA=	147.6	454.5	245.5	8.4	180.2	.1	
VEL=	1.3	2.5	1.9	.3	3.5	.2	
DEPTH=	.6	1.6	1.1	.1	1.6	.0	

*SECNO 1.818

1.818	3.29	1384.29	.00	.00	1384.42	.13	8.26	.01	1384.00
2420.0	804.7	851.9	763.3	362.2	284.4	226.3	231.3	198.5	1383.00
1.00	2.22	3.00	3.37	.070	.050	.050	.000	1381.00	4612.28
.008337	1040.	1040.	1050.	6	0	0	.00	758.72	5371.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1.82 CWSEL= 1384.29

STA=	4612.	4625.	4780.	4890.	4950.	5195.	5300.	5360.	5371.
PER Q=	.0	19.1	13.5	.6	35.2	24.3	7.2	.1	
AREA=	1.9	200.5	142.3	17.6	284.4	162.1	62.6	1.6	
VEL=	.5	2.3	2.3	.9	3.0	3.6	2.8	.8	
DEPTH=	.1	1.3	1.3	.3	1.2	1.5	1.0	.1	

*SECNO 2.021

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1393.00 ELREA= 1393.00

2.021	3.34	1391.34	.00	.00	1391.40	.06	6.97	.01	1393.00
1409.0	.0	1409.0	.0	.0	701.8	.0	250.6	216.5	1393.00
1.14	.00	2.01	.00	.000	.050	.000	.000	1388.00	4866.58
.004531	1100.	1070.	1040.	3	0	0	.00	697.98	5564.56

FLOW DISTRIBUTION FOR SECNO= 2.02 CWSEL= 1391.34

STA=	4867.	5740.
PER Q=	100.0	
AREA=	701.8	
VEL=	2.0	
DEPTH=	1.0	

*SECNO 2.159

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .52

2.159	1.51	1397.01	.00	.00	1397.20	.19	5.76	.04	1397.00
1409.0	228.4	1100.4	80.2	100.9	289.3	45.9	260.2	226.8	1396.00
1.20	2.26	3.80	1.75	.070	.050	.070	.000	1395.50	4685.95
.016810	800.	730.	640.	3	0	0	.00	534.98	5220.93

FLOW DISTRIBUTION FOR SECNO= 2.16 CWSEL= 1397.01

STA=	4686.	4715.	4765.	4835.	5130.	5221.
PER Q=	1.8	9.9	4.5	78.1	5.7	
AREA=	14.7	50.5	35.7	289.3	45.9	
VEL=	1.7	2.8	1.8	3.8	1.7	
DEPTH=	.5	1.0	.5	1.0	.5	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 2.333

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.41

2.333	3.61	1407.61	.00	.00	1407.96	.35	10.71	.05	1408.00
1409.0	.0	1409.0	.0	.0	296.9	.0	268.0	233.9	1408.00
1.26	.00	4.75	.00	.000	.050	.000	.000	1404.00	4925.41
.008470	990.	920.	870.	5	0	0	.00	129.67	5055.08

FLOW DISTRIBUTION FOR SECNO= 2.33 CWSEL= 1407.61

STA= 4925. 5060.
PER Q= 100.0
AREA= 296.9
VEL= 4.7
DEPTH= 2.3

OFILE FOR STREAM PADELFORD WASH

OTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

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EVATION  1317.    1327.    1337.    1347.    1357.    1367.    1377.    1387.    1397.    1407.
  SECNO  CUMDIS

  .00      0.  I EL      .        .        .        .        .        .        .        .        .
          100.  CIWER    .        .        .        .        .        .        .        .        .
          200.  CI EL    .        .        .        .        .        .        .        .        .
          300.  C I ER   .        .        .        .        .        .        .        .        .
          400.  C  I EM  .        .        .        .        .        .        .        .        .
          500.  C  I ER  .        .        .        .        .        .        .        .        .
          600.  C   I EM .        .        .        .        .        .        .        .        .
          700.  C    ILEM.        .        .        .        .        .        .        .        .
          800.  C    I EM.        .        .        .        .        .        .        .        .
          900.  C     ILEM.       .        .        .        .        .        .        .        .
         1000.  C      ILEM       .        .        .        .        .        .        .        .
  .20    1100.  C      ILEM       .        .        .        .        .        .        .        .
         1200.  C       ILEM      .        .        .        .        .        .        .        .
         1300.  C       I LEM     .        .        .        .        .        .        .        .
         1400.  C        ILEM     .        .        .        .        .        .        .        .
         1500.  C         ILEM    .        .        .        .        .        .        .        .
         1600.  C         I LEM   .        .        .        .        .        .        .        .
         1700.  C         .I WEM  .        .        .        .        .        .        .        .
         1800.  C         . I E M .        .        .        .        .        .        .        .
         1900.  C         . I LEM .        .        .        .        .        .        .        .
  .37    2000.  C         .  I LEM.        .        .        .        .        .        .        .
         2100.  C         .   I E M.       .        .        .        .        .        .        .
         2200.  C         .   I LEM.       .        .        .        .        .        .        .
         2300.  C         .    I WEM.      .        .        .        .        .        .        .
         2400.  C         .     ILEM.      .        .        .        .        .        .        .
         2500.  C         .      ILEM      .        .        .        .        .        .        .
         2600.  C         .      ILEM      .        .        .        .        .        .        .
  .52    2700.  C         .       ILEM     .        .        .        .        .        .        .
         2800.  C         .       I .EM    .        .        .        .        .        .        .
         2900.  C         .        I. EM   .        .        .        .        .        .        .
         3000.  C         .        I.  ELM .        .        .        .        .        .        .
         3100.  C         .         I  W EL.        .        .        .        .        .        .
  .61    3200.  C         .         I   WE L.       .        .        .        .        .        .
  .61    3300.  C         .         I    WEL.       .        .        .        .        .        .
         3400.  C         .         I    WER.       .        .        .        .        .        .
         3500.  C         .         .I   LER.       .        .        .        .        .        .
         3600.  C         .         .I   LER.       .        .        .        .        .        .
         3700.  C         .         . I L WE.       .        .        .        .        .        .
         3800.  C         .         . I L  EM.      .        .        .        .        .        .
  .74    3900.  C         .         . I   WE.       .        .        .        .        .        .
         4000.  C         .         .  I   EM.      .        .        .        .        .        .
         4100.  C         .         .   I  RE.      .        .        .        .        .        .
         4200.  C         .         .   I L EM      .        .        .        .        .        .
         4300.  C         .         .    I L E      .        .        .        .        .        .
         4400.  C         .         .     I LRE     .        .        .        .        .        .
         4500.  C         .         .      I LE     .        .        .        .        .        .
  .88    4600.  .         .         .       I. E    .        .        .        .        .        .
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      4700.  C     .     .     I RE    .     .     .     .     .     .     .
      4800.  C     .     .     I  LE   .     .     .     .     .     .     .
      4900.  C     .     .     .I L E  .     .     .     .     .     .     .
      5000.  C     .     .     .I  LWE .     .     .     .     .     .     .
      5100.  C     .     .     . I L WE .     .     .     .     .     .     .
      5200.  C     .     .     .  IL  EM .     .     .     .     .     .     .
      5300.  C     .     .     .  I L  E .     .     .     .     .     .     .
 1.01 5400.  C     .     .     .   IL  WE.     .     .     .     .     .     .
      5500.  C     .     .     .   I L  E.     .     .     .     .     .     .
      5600.  C     .     .     .    IL  WE     .     .     .     .     .     .
      5700.  C     .     .     .    I L  E     .     .     .     .     .     .
      5800.  C     .     .     .     IL  WE    .     .     .     .     .     .
      5900.  C     .     .     .     I L .E    .     .     .     .     .     .
 1.14 6000.  C     .     .     .      I L. E   .     .     .     .     .     .
      6100.  C     .     .     .       I L WE  .     .     .     .     .     .
      6200.  C     .     .     .       I .L E  .     .     .     .     .     .
      6300.  C     .     .     .        I. L E .     .     .     .     .     .
      6400.  C     .     .     .         I L RE .     .     .     .     .     .
      6500.  C     .     .     .         .I L EM .     .     .     .     .     .
      6600.  C     .     .     .         .I  L E .     .     .     .     .     .
 1.27 6700.  C     .     .     .         . I  L E .     .     .     .     .     .
      6800.  C     .     .     .         .  I  LEM .     .     .     .     .     .
      6900.  C     .     .     .         .  I  L E .     .     .     .     .     .
      7000.  C     .     .     .         .   I  LWE.     .     .     .     .     .
      7100.  C     .     .     .         .    I  LE.     .     .     .     .     .
      7200.  C     .     .     .         .     I LRE     .     .     .     .     .
      7300.  C     .     .     .         .     I  LE     .     .     .     .     .
      7400.  C     .     .     .         .      I  LE    .     .     .     .     .
      7500.  C     .     .     .         .       I LEM   .     .     .     .     .
      7600.  C     .     .     .         .        I.LE   .     .     .     .     .
 1.45 7700.  C     .     .     .         .        I. EM  .     .     .     .     .
      7800.  C     .     .     .         .         I LE  .     .     .     .     .
      7900.  C     .     .     .         .         .I LE .     .     .     .     .
      8000.  C     .     .     .         .         .I  LE .     .     .     .     .
      8100.  C     .     .     .         .         . I  EM .     .     .     .     .
      8200.  C     .     .     .         .         .  I  EM .     .     .     .     .
      8300.  C     .     .     .         .         .   I  EM .     .     .     .     .
      8400.  C     .     .     .         .         .    I LE .     .     .     .     .
      8500.  C     .     .     .         .         .    I  EM.     .     .     .     .
 1.62 8600.  C     .     .     .         .         .     I  EM     .     .     .     .
      8700.  C     .     .     .         .         .      I  EM    .     .     .     .
      8800.  C     .     .     .         .         .       I REM   .     .     .     .
      8900.  C     .     .     .         .         .       I .WE   .     .     .     .
      9000.  C     .     .     .         .         .        I. EM  .     .     .     .
      9100.  C     .     .     .         .         .         I REM .     .     .     .
      9200.  C     .     .     .         .         .         .I REM .     .     .     .
      9300.  C     .     .     .         .         .         .I  LEM .     .     .     .
      9400.  C     .     .     .         .         .         . I RWEM .     .     .     .
      9500.  C     .     .     .         .         .         .  I REM .     .     .     .
 1.82 9600.  C     .     .     .         .         .         .   I RE M.     .     .     .
      9700.  C     .     .     .         .         .         .    I REM.     .     .     .
      9800.  C     .     .     .         .         .         .    I  REM     .     .     .
      9900.  C     .     .     .         .         .         .     I  ELM    .     .     .
     10000.  C     .     .     .         .         .         .      I  EM    .     .     .
     10100.  C     .     .     .         .         .         .      I  .EM   .     .     .
     10200.  C     .     .     .         .         .         .       I .ELM  .     .     .
     10300.  C     .     .     .         .         .         .        I. EL  .     .     .
     10400.  C     .     .     .         .         .         .        I.  EL .     .     .
     10500.  C     .     .     .         .         .         .         I  ERL .     .     .
     10600.  C     .     .     .         .         .         .         .I  ELM .     .     .
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2.02 10700.  C        .         .         .         .         .         .I  E L   .         .         .
     10800.  C        .         .         .         .         .         . I  ERL  .         .         .
     10900.  C        .         .         .         .         .         .  I  ELM .         .         .
     11000.  C        .         .         .         .         .         .   I  ELM.         .         .
     11100.  C        .         .         .         .         .         .    I WE M         .         .
     11200.  C        .         .         .         .         .         .     I EL.M        .         .
     11300.  C        .         .         .         .         .         .      IRE. M       .         .
2.16 11400.  C        .         .         .         .         .         .        IE  M      .         .
     11500.  C        .         .         .         .         .         .        IRE  M     .         .
     11600.  C        .         .         .         .         .         .         I WE M    .         .
     11700.  C        .         .         .         .         .         .         .I WE M   .         .
     11800.  C        .         .         .         .         .         .         . I REM   .         .
     11900.  C        .         .         .         .         .         .         .  I  EM  .         .
     12000.  C        .         .         .         .         .         .         .   I  EM .         .
     12100.  C        .         .         .         .         .         .         .    I  EM.         .
     12200.  C        .         .         .         .         .         .         .     I  WE         .
2.33 12300.  C        .         .         .         .         .         .         .      I  .E        .
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THIS RUN EXECUTED 03OCT00 08:35:32

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HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

PADELFORD WASH

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	SSTA	STCHL	STCHR	ENDST	DIFWSX	TOPWID	DEPTH	ELMIN	10*KS	VCH
	.000	2714.00	1318.81	3818.00	4825.00	5300.00	6284.20	.00	1375.06	1.81	1317.00	63.36	1.47
	.203	2714.00	1326.10	4585.00	4930.00	5590.00	6061.16	7.29	1476.16	2.10	1324.00	78.23	1.86
	.371	2714.00	1332.61	4726.00	4840.00	5575.00	6291.85	6.51	1525.05	2.61	1330.00	65.66	2.23
	.523	2640.00	1336.90	4348.00	4965.00	5035.00	5864.98	4.29	1371.00	1.90	1335.00	58.89	2.04
*	.608	2640.00	1340.81	4955.36	4945.00	5060.00	5047.56	3.90	92.20	3.81	1337.00	207.16	9.12
*	.614	2815.00	1341.84	4951.40	4945.00	5060.00	5052.32	1.03	100.92	4.84	1337.00	99.51	7.24
*	.741	2567.00	1344.48	4593.62	4620.00	5040.00	5412.51	2.65	818.89	4.48	1340.00	11.42	1.93
*	.884	2567.00	1349.07	4815.00	4815.00	5095.00	5505.39	4.58	690.39	3.07	1346.00	437.20	5.85
*	1.011	2567.00	1355.33	4657.74	4955.00	5025.00	5317.41	6.26	659.68	4.83	1350.50	33.55	4.39
*	1.136	2567.00	1358.66	4748.46	4975.00	5020.00	5223.22	3.34	474.76	4.66	1354.00	94.95	6.87
	1.273	2493.00	1363.71	4495.50	4950.00	5050.00	5047.91	5.05	552.41	4.71	1359.00	50.78	4.48
	1.453	2493.00	1369.17	4271.09	4850.00	5050.00	5172.09	5.46	901.00	3.17	1366.00	77.59	3.65
	1.621	2420.00	1376.06	4036.63	4945.00	5060.00	5063.37	6.89	1026.74	3.06	1373.00	75.44	3.48
	1.818	2420.00	1384.29	4612.28	4950.00	5195.00	5371.00	8.23	758.72	3.29	1381.00	83.37	3.00
	2.021	1409.00	1391.34	4866.58	4780.00	5740.00	5564.56	7.05	697.98	3.34	1388.00	45.31	2.01
*	2.159	1409.00	1397.01	4685.95	4835.00	5130.00	5220.93	5.67	534.98	1.51	1395.50	168.10	3.80
*	2.333	1409.00	1407.61	4925.41	4920.00	5060.00	5055.08	10.60	129.67	3.61	1404.00	84.70	4.75

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO=	.608	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	.614	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	.741	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO=	.884	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	.884	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	.884	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	1.011	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	1.136	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	2.159	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	2.333	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

APPENDIX D

Retention Calculations

RANCHO CABRILLIO

RETENTION REQUIREMENTS

Phase	Parcel	Land* Use	Gross Area (ac)	C	P (inch)	Vreq. (ac-ft)	Max. Density	% Imp.**	pre-Dev CN***
I	L	SR	28.00	0.44	2.72	2.79	2.00	28	77
	M	UR/VL	30.00	0.56	2.72	3.81	4.00	43	"
	O	Utility;SR	3.00	0.90	2.72	0.61	—	85	"
	Total		61.00			7.21			
II	F	UR/L	35.00	0.63	2.72	5.00	6.00	54	"
	G	UR/M	40.00	0.69	2.72	6.26	12.00	82	"
	H	UR/L	48.00	0.63	2.72	6.85	6.00	54	"
	Q	Fire;UR/M	0.70	0.90	2.72	0.14	—	85	"
	Total		123.70			18.25			
III	J	UR/VL	26.00	0.56	2.72	3.30	4.00	43	"
	K	SR	35.00	0.44	2.72	3.49	2.00	28	"
	Total		61.00			6.79			
IV	I	UR/VL	46.00	0.56	2.72	5.84	4.00	43	"
	Total		46.00			5.84			
V	D	UR/L	64.00	0.63	2.72	9.14	6.00	54	"
	Total		64.00			9.14			
VI	A	UR/VL	29.00	0.56	2.72	3.68	4.00	43	"
	B	UR/L	60.00	0.63	2.72	8.57	6.00	54	"
	C	Sch;UR/VL	16.00	0.69	2.72	2.50	—	85	"
	P	Park	6.00	0.44	2.72	0.60	—	10	"
	Total		111.00			15.35			
VII	E	UR/H	31.00	0.69	2.72	4.85	25.00	90	79.9 ~ 70% sub 123N, 30% sub 125B (CN=77, CN=86.1)
	Total		31.00			4.85			
VIII	N	NC	17.00	0.81	2.72	3.12	—	85	77
	Total		17.00			3.12			
	TOTAL		514.70			70.55			

* Land Use:		C,used
SR	Suburban Residential-Single Family	0.44
UR	Urban Residential-Single Family	
VL	Very Low Density	0.56
L	Low Density	0.63
H	High Density	0.69
M	Multi Family	0.69
NC	Neighborhood Commercial	0.81

RCHCB-R2.xls

** See attached Fig. 2-2-16
*** " " CN summary sheet

Stantec

Retention Requirements

$$V_{req} = C \times \frac{P}{12} \times A$$

V_{req} = Retention volume Required (ac-ft)
C = Runoff coefficient
P = 100-yr, 2-hr Rainfall Depth (inch)
A = contributing Drainage Area (ac)

See included calcs & Charts

Designed by: Checked by:

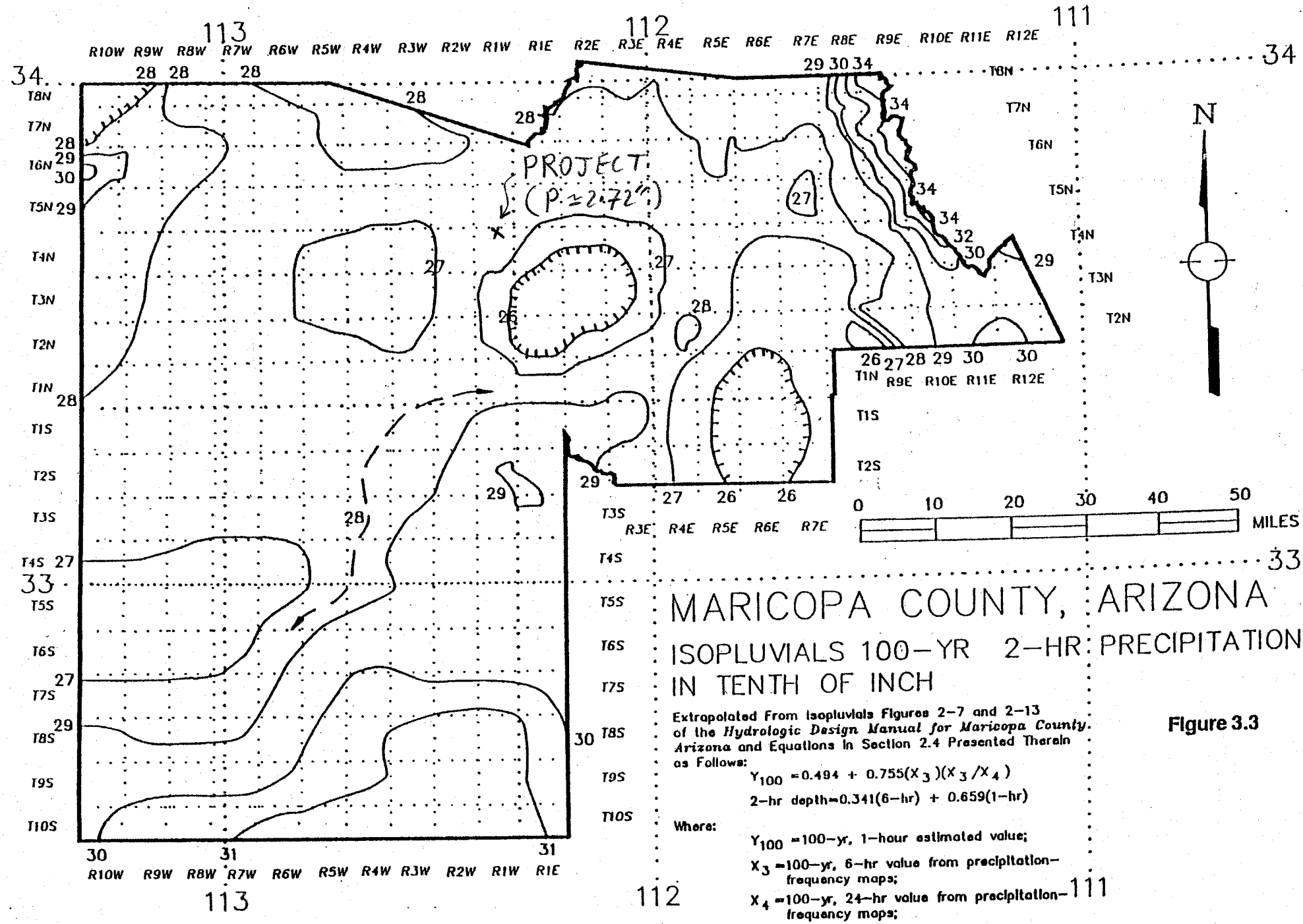
MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 2-HR PRECIPITATION
IN TENTH OF INCH
Extrapolated From Isopluvials Figures 2-7 and 2-13 of the Hydrologic Design Manual for Maricopa County Arizona and Equations in Section 2.4 Presented Therein as Follows:
$Y_{100} = 0.494 + 0.755(X_3)(X_3/X_4)$
2-hr depth=0.341(6-hr) + 0.659(1-hr)
Where:
Y_{100} =100-yr, 1-hour estimated value;
X_3 =100-yr, 6-hr value from precipitation-frequency maps;
X_4 =100-yr, 24-hr value from precipitation-frequency maps;
6-hr=isopluvial values from figure 2.7;
1-hr=Y_{100} value as computed above.
PROJECT (P ≈ 2.72")
N
MILES
0 10 20 30 40 50
R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W R1E R2E R3E R4E R5E R6E R7E R8E R9E R10E R11E R12E
T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S T7S T8S T9S T10S
113 112 111
34 33

Figure 3.3

Table 3.2
C Coefficients for Use with the Rational Method

Land Use	Return Period			
	2-10 Year	25 Year	50 Year	100 Year
Streets and Roads				
Paved Roads	0.75 – 0.85	0.83 – 0.94	0.90 – 0.95	0.94 – 0.95
Gravel Roadways & Shoulders	0.60 – 0.70	0.66 – 0.77	0.72 – 0.84	0.75 – 0.88
Industrial Areas				
Heavy	0.70 – 0.80	0.77 – 0.88	0.84 – 0.95	0.88 – 0.95
Light	0.60 – 0.70	0.66 – 0.77	0.72 – 0.84	0.75 – 0.88
Business Areas				
Downtown	0.75 – 0.85	0.83 – 0.94	0.90 – 0.95	0.94 – 0.95
Neighborhood	0.55 – 0.65	0.61 – 0.72	0.66 – 0.78	0.69 – 0.81
Residential Areas				
Lawns – Flat	0.10 – 0.25	0.11 – 0.28	0.12 – 0.30	0.13 – 0.31
– Steep	0.25 – 0.40	0.28 – 0.44	0.30 – 0.48	0.31 – 0.50
Suburban	0.30 – 0.40	0.33 – 0.44	0.36 – 0.48	0.38 – 0.50
Single Family	0.45 – 0.55	0.50 – 0.61	0.54 – 0.66	0.56 – 0.69
Multi-Unit	0.50 – 0.60	0.55 – 0.66	0.60 – 0.72	0.63 – 0.75
Apartments	0.60 – 0.70	0.66 – 0.77	0.72 – 0.84	0.75 – 0.88
Parks/Cemetaries	0.10 – 0.25	0.11 – 0.28	0.12 – 0.30	0.13 – 0.31
Playgrounds	0.40 – 0.50	0.44 – 0.55	0.48 – 0.60	0.50 – 0.63
Agricultural Areas	0.10 – 0.20	0.11 – 0.22	0.12 – 0.24	0.13 – 0.25
Bare Ground	0.20 – 0.30	0.22 – 0.33	0.24 – 0.36	0.25 – 0.38
Undeveloped Desert	0.30 – 0.40	0.33 – 0.44	0.36 – 0.48	0.38 – 0.50
Mountain Terrain (Slopes > 10%)	0.60 – 0.80	0.66 – 0.88	0.72 – 0.95	0.75 – 0.95

Note: Values of C for 25, 50 and 100 Year were derived using frequency adjustment factors of 1.10, 1.20, and 1.25, respectively, with an upper limit of 0.95 for C for the 2-10 Year values.

APPENDIX E

Post-Development Hydrologic Model

Stantec

Project: Project Number:

Notes: Scale:

Page of Page(s)

Computed By: Date: Checked By: Date:

Post-Development HEC-1 Model Parameter Estimate

- A % impervious was estimated for each parcel per proposed land use
- A pre-development Curve Number "CN" was estimated for each parcel from the values of the drainage subbasins the parcel fall in.
- 100-year, 2-hour retention required for each parcel was estimated per proposed land use
- For the Area north of Beardsley Canal, the corresponding curve number and % impervious of each parcel was used to generate the runoff hydrograph. The corresponding retention volume required for that parcel was diverted to generate the remaining hydrograph. The SCS Curve Number method was used to generate the runoff hydrograph
- For the area south of the Beardsley Canal, A weighted average % impervious and a proportional retention volume required was estimated for each applicable subbasin that include portions of the proposed parcels. The average values were used to generate the runoff and retention hydrographs.

RANCHO CABRILLIO

RETENTION REQUIREMENTS

Phase	Parcel	Land* Use	Gross Area (ac)	C	P (inch)	Vreq. (ac-ft)	Max. Density	% Imp.**	Pre-Dev CN***
I	L	SR	28.00	0.44	2.72	2.79	2.00	28	77
	M	UR/VL	30.00	0.56	2.72	3.81	4.00	43	"
	O	Utility;SR	3.00	0.90	2.72	0.61	—	85	"
	Total		61.00			7.21			
II	F	UR/L	35.00	0.63	2.72	5.00	6.00	54	"
	G	UR/M	40.00	0.69	2.72	6.26	12.00	82	"
	H	UR/L	48.00	0.63	2.72	6.85	6.00	54	"
	Q	Fire;UR/M	0.70	0.90	2.72	0.14	—	85	"
	Total		123.70			18.25			
III	J	UR/VL	26.00	0.56	2.72	3.30	4.00	43	"
	K	SR	35.00	0.44	2.72	3.49	2.00	28	"
	Total		61.00			6.79			
IV	I	UR/VL	46.00	0.56	2.72	5.84	4.00	43	"
	Total		46.00			5.84			
V	D	UR/L	64.00	0.63	2.72	9.14	6.00	54	"
	Total		64.00			9.14			
VI	A	UR/VL	29.00	0.56	2.72	3.68	4.00	43	"
	B	UR/L	60.00	0.63	2.72	8.57	6.00	54	"
	C	Sch;UR/VL	16.00	0.69	2.72	2.50	—	85	"
	P	Park	6.00	0.44	2.72	0.60	—	10	"
	Total		111.00			15.35			
VII	E	UR/H	31.00	0.69	2.72	4.85	25.00	90	79.9 ✓ 70% sub 123N, 30% sub 125E, CN=86.
	Total		31.00			4.85			
VIII	N	NC	17.00	0.81	2.72	3.12	—	85	77
	Total		17.00			3.12			
	TOTAL		514.70			70.55			

CN=77

* Land Use:		C,used
SR	Suburban Residential-Single Family	0.44
UR	Urban Residential-Single Family	
VL	Very Low Density	0.56
L	Low Density	0.63
H	High Density	0.69
M	Multi Family	0.69
NC	Neighborhood Commercial	0.81

RCHCB-R2.xls

** See attached fig. 2-2-16
*** " " CN summary sheet

Stantec

Project: Rancho Cabrillo Project Number:

Notes: Scale:

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Computed By: G.A Date: Checked By: Date:

Parcel	Area (ac)	CN	% Imp	Vrey (ac-ft)
A	29	77	43	3.68
B	60	"	54	8.57
C	16	"	85	2.50
D	64	"	54	9.14
E	31	79.9	90	4.85
P	6	77	10	0.60
	206			29.34
F	35	77	54	5.00
G	40	"	82	6.26
H	48	"	54	6.85
I	46	"	43	5.84
J	26	"	43	3.30
K	35	"	28	3.49
L	28	"	28	2.79
M	30	"	43	3.81
N	17	"	85	3.12
O	3	"	85	0.61
~~P~~	~~6~~	~~"~~	~~10~~	~~0.60~~
Q	0.7	"	85	0.14
	308.7		Avg = 51	41.21
	514.7			70.55

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Project: Rancho Cabrillo | Project Number:

Notes: | Scale:

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Sub	Area (sq.mi/ac)	Pre-Dev CN	% Imp	V_{req} (1) (ac-ft)
121 B	.1406/89.98 (30.30) (2)	77	17 (3)	3.73
122 A	.1818/116.35	"	51	14.34
122 B	.2159/138.18	"	51	17.03
122 D	.0775/49.60	"	51	6.11
	(334.43)			41.21 (= V_{req} from parcels south of Beardsley Canal)

(1) $V_{req} = \frac{A_{sub}}{A_{total,improved}} \times V_{req,total}$

$A_{total,improved} = 334.43$, $V_{req,total} = 41.21$

(2) 30.30 ac is improved within sub 121B

3 % Imp @ sub 121B $= [(89.98 - 30.3) \times 0 + 30.30 \times 51] / 89.98$

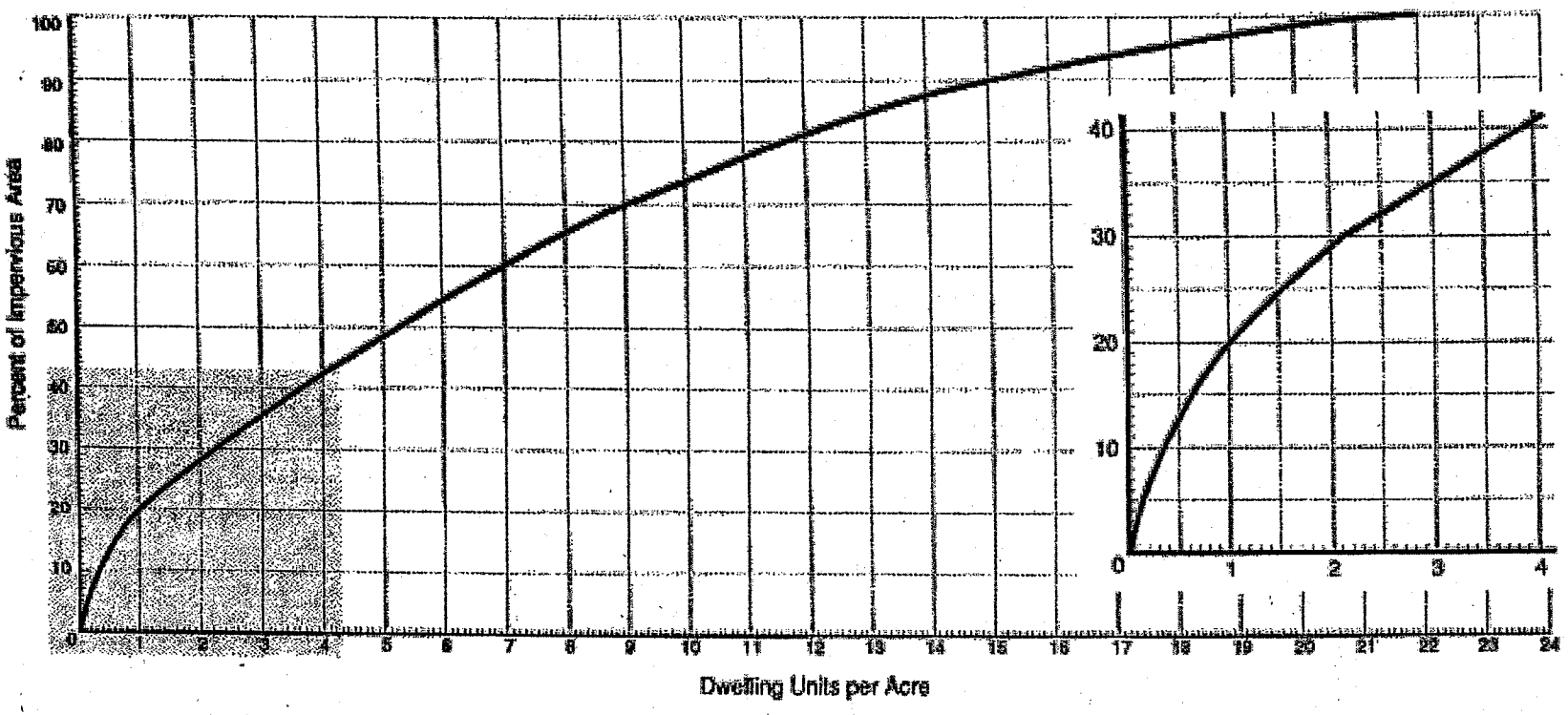

FIGURE 2.2-16

Percent of Impervious Area vs. Dwelling Density

Developed by Water Resources Associates, Inc. from data in Table 2.2a of TR-55, Urban Hydrology For Small Watersheds, and from discussions with Scottsdale city staff.

City of Scottsdale Drainage Design Standards

Maricopa County, Arizona

Sub-Basin	HSG CN	Percentage Of HSG In Sub-Basin				Composite CN	Assigned Percent Impervious
		A 63	B 77	C 85	D 88		
121A		0	100	0	0	77.0	0
121B		0	100	0	0	77.0	0
121C		0	100	0	0	77.0	0
122A		0	100	0	0	77.0	0
122B		0	100	0	0	77.0	0
122C		0	100	0	0	77.0	0
122D		0	100	0	0	77.0	0
122E		0	100	0	0	77.0	0
123A		0	90	0	10	78.1	0
123B		0	100	0	0	77.0	0
123C		0	100	0	0	77.0	0
123D		0	88	0	12	78.3	0
123E		0	100	0	0	77.0	0
123F		0	50	0	50	82.5	0
123G		0	55	0	45	82.0	0
123H		0	50	10	40	82.2	0
123I		0	100	0	0	77.0	0
123J		0	100	0	0	77.0	0
123K		0	100	0	0	77.0	0
123L		0	100	0	0	77.0	0
123M		0	100	0	0	77.0	0
123N		0	100	0	0	77.0	0
125B		0	5	30	65	86.6	0

Copied from App. A1 of this report

Excerpts

```
ID      RANCHO CABRILLO DEVELOPMENT
ID      post-development conditions -septemper 2001
ID      PREPARED BY STANTEC CONSULTING INC.
ID
ID      MODEL RNCHCAB.24I
ID
ID      THIS MODEL WAS PREPARED TO EVALUATE THE 100-YR,24-HR PEAK FLOWS IN THE
ID      POST DEVELOPMENT CONDITIONS, WITH INCORPORATING THE 100-YR,2-HR
ID      ONSITE STORMWATER STORAGE REQUIREMNTS.
ID
ID------TEXT OF BASE MODEL FOLLOWS:
ID
ID      RANCHO CABRILLO DEVELOPMENT
ID      PRE-DEVELOPMENT CONDITIONS  -  APRIL 2000
ID      PREPARED BY ROBERT L. WARD, P.E.
ID
ID      MODEL RC1.24I
ID
ID      THIS MODEL IS BASED ON LOCALIZED REVISIONS TO THE WITTMAN ADMS MODEL
ID      (WTM100YR) THAT WAS PREPARED BY THE WLB GROUP, INC. IN 1988.
ID      THESE REVISIONS WERE MADE TO ADD CONCENTRATION POINTS ALONG THE
ID      PERIMETER OF THE PROPOSED RANCHO CABRILLO DEVELOPMENT.
ID
ID
ID      THE FOLLOWING COMMENT RECORDS ARE FROM THE ORIGINAL WLB HEC-1 MODEL.
ID
ID       "THIS IS THE HEC-1 COMPUTER MODEL FOR THE WITTMANN AREA DRAINAGE MASTER
ID        STUDY.  THIS STUDY IS PREPARED FOR THE FLOOD CONTROL DISTRICT OF
ID        MARICOPA COUNTY BY THE WLB GROUP, INC."
ID
ID       "THIS IS THE 100 YEAR MODEL FOR THE STUDY AREA AND INCLUDES STORAGE
ID        ROUTING AND DIVERSIONS ALONG THE A.T. & S.F. RAILROAD, THE CAP CANAL,
ID        AND THE BEARDSLEY CANAL."
ID
ID
ID
*DIAGRAM
IT     3 26JAN87    1200     640
IN    15 26JAN87    1200
IO     5
JD  4.21    .001
PC  .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
PC  .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
PC  .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
PC  .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
PC  .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
PC  .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
PC  .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
PC  .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
PC  .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
PC  .983    .986    .989    .992    .995    .998    1.00    1.000   1.000   1.000
JD  4.17      10
JD  4.00      50
JD  3.93     100
```

```
JD  3.82     350
KK     1
KM      RUNOFF FROM SUBWATERSHED 1.
KM      UNIT HYDROGRAPHS HAVE BEEN COMPUTED FOR EACH SUBWATERSHED USING THE
KM      CORPS OF ENGINEERS S-GRAPH COMPUTATIONS FOR UNIT HYDROGRAPHS.  THE
KM      S-GRAPH PROGRAM HAS BEEN DEVELOPED FOR THE PHOENIX MOUNTAIN AND PHOENIX
KM      VALLEY AREAS.  THIS SHOULD GIVE A MORE RELIABLE UNIT HYDROGRAPH FOR THE
KM      HEC-1 PROGRAM TO UTILIZE WITHIN THE WITTMANN ADMS AREA.
BA  .088
LS     0      81       0
UK   200   .0160     .11     100
RK  2900   .0132     .05             TRAP       0      15
```

```
KK  123D     SUB
KM      RUNOFF FROM SUB 123D
BA .3444
LS          78.3
UK   250    .011     .11     100
RK  7400   .0091     .05           TRAP      40      10
*
KK 123K1      CP
KM      ROUTE SUB 123D TO CP 123K1
RM   1.2    .061      .2
*
KK123K2A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123K2B
DI     0    5000
DQ     0    2500
*
KK 123I1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123K2A) ALONG LEVEE TO CP 123I1
RM    .8    .038      .2
*
KKPARC A
KM      RUNOF FROM PARCEL A
BA .0453
LS            77      43
UD    .2
*
KK  RMPA     DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS PARCEL
DT  DVPA    3.68
DI     0   10000
DQ     0   10000
*
KK 123I2      CP
KM      COMBINE REMAINDER AT PARCEL A AND CP 123I1
HC     2
*
KK  123C     SUB
KM      RUNOFF FROM SUB 123C
BA .1205
LS            77
UK   250    .011     .11     100
RK  5000   .0089     .05           TRAP      30      10
*
KK 123C1     DIV
KM      RATIO FLOW FROM SUB 123C TO SUB 123I
DT 123C2
DI     0    5000
DQ     0    2500
*
KK 123I2      CP
KM      ROUTE DIV 123C1 TO CP 123I2
RM   1.7    .087      .2
*
```

```
KK 123I3      CP
KM      COMBINE 123C1 & 123I2
HC     2
*
KK123I3A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123I3B
DI     0    5000
DQ     0    2500
*
KK 123J1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123I3A) ALONG LEVEE TO CP 123J1
RM    .5    .024      .2
*
KK 123C2     RET
KM      RETRIEVE REMAINING FLOW FROM SUB 123C
DR 123C2
*
KK 123J2      CP
KM      ROUTE RET 123C2 TO CP 123J2
RM   1.4    .069      .2
*
KK  123J     SUB
KM      RUNOFF FROM SUB 123J
BA .0163
LS            77
UK   250    .011     .11     100
RK  1250   .0081     .05           TRAP      30      10
*
KK 123J3      CP
KM      COMBINE SUB 123J, CP 123J1 & 123J2
HC     3
*
KK 123B1      CP
KM      ROUTE CP 123J3 ALONG LEVEE TO CP 123B1
RM    .4    .019      .2
*
KK  123B     SUB
KM      RUNOFF FROM SUB 123B (RLW BASIN, NOT WLB)
BA .0933
LS            77
UK   250    .011     .11     100
RK  4300   .0074     .05           TRAP      25      10
*
KK 123B2      CP
KM      COMBINE SUB 123B & CP 123B1
HC     2
*
KK 123A3      CP
KM      ROUTE CP 123B2 ALONG LEVEE TO CP 123A3
RM   2.2    .111      .2
*
KK  123H     SUB
KM      RUNOF FROM SUB 123H
```

```
BA .1220
LS          82.2
UK   250   .2250     .15     100
RK  2700   .2250     .05            TRAP      35      10
*
KK 123N1      CP
KM      ROUTE SUB 123H TO CP 123N1
RM   2.4    .119      .2
*
KKPARC E
KM      RUNOF FROM PARCEL E
BA .0484
LS          79.9      90
UD    .2
*
KK  RMPE     DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS PARCEL
DT  DVPE    4.85
DI     0   10000
DQ     0   10000
*
KK 123N2      CP
KM      COMBINE SUB 123H & REMAINDER AT PARCEL E
HC     2
*
KK123N3       CP
KM      ROUTE CP 123N2 TO CP 123N3
RM   3.9    .194      .2
*
KK  123G     SUB
KM      RUNOFF FROM SUB 123G
BA .0803
LS            82
UK   250   .2250     .15     100
RK  3200   .2250     .05            TRAP      35      10
*
KK  123F     SUB
KM      RUNOFF FROM SUB 123F
BA .2898
LS          82.5
UK   250    .011     .11     100
RK  8400   .0092     .05            TRAP      40      10
*
KK 123FG      CP
KM      COMBINE SUB 123F & 123G
HC     2
*
KK  123E     SUB
KM      RUNOFF FROM SUB 123E
BA .0488
LS            77
UK   250    .011     .11     100
RK  5000   .0092     .05            TRAP      20      10
*
```

```
KK123FGE      CP
KM      COMBINE SUB "123F & 123G" & 123E
HC     2
*
KK123N4       CP
KM      ROUTE CP 123FGE TO CP 123N4
RM   2.5    .125      .2
*
KKPARC D
KM      RUNOF FROM PARCEL D
BA0.1000
LS            77      54
UD    .2
*
KK  RMPD      DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  PARCEL
DT  DVPD    9.14
DI     0   10000
DQ     0   10000
*
KK123N5       CP
KM      COMBINE CP 123N3  & 123N4  & THE REMAINDER AT PARCEL D
HC     3
*
KK123M1       CP
KM      ROUTE CP 123N5 TO CP 123M1
RM   2.4    .118      .2
*
KKPAR BC     SUB
KM      RUNOFF FROM PARCELS B&C AND APORTION OF SUB 123M
BA .1339
LS            77    53.7
UD   0.2
*
KK RMPBC      DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  PARCEL
DT DVPBC   11.07
DI     0   10000
DQ     0   10000
*
KK123M4       CP
KM      COMBINE CP 123M1 & SUBS B&C +
HC     2
*
KK 123L1      CP
KM      ROUTE CP 123M4 TO CP 123L1
RM   3.7    .185      .2
*
KK  123L     SUB
KM      RUNOFF FROM SUB 123L
BA .1956
LS            77
UK   250    .011     .11     100
RK  2150   .0081     .05           TRAP      40      20
```

```
*
KK123K2B     RET
KM     RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123K2
DR123K2B
*
KK123I3B     RET
KM     RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123I3
DR123I3B
*
KK 123IK     CP
KM     COMBINE RET 123K2B & 123I3B
HC     2     .25
*
KK 123L2     CP
KM     ROUTE CP 123IK TO CP 123L2
RM   2.2    .108      .2
*
KK 123L3     CP
KM     COMBINE SUB 123L, CP 123L1 & 123L2
HC     3
*
KK 123A4     CP
KM     ROUTE CP 123L3 TO CP 123A4
RM   7.8    .389      .2
*
KK 123A5     CP
KM     COMBINE CP 123A2, 123A3 & 123A4
KM     THIS IS THE TOTAL INFLOW TO THE PADELFORD WASH CROSSING OF
KM     THE BEARDSLEY CANAL SIPHON
HC     3
*
KK 123BC
KM     STORAGE ROUTE THROUGH 123BC.  58' WIDE SIPHON ON THE BEARDSLEY CANAL.
RS     1    STOR       0       0
SV     0   34.78  148.48     190
SQ     0     493    1392    8712
SE  1338    1340    1342    1343
*
KK 121B1     CP
KM     ROUTE C123 TO CP 121B1
RM   1.9    .094      .2
*
KK  121B     SUB
KM     RUNOFF FROM SUB 121B
BA .1406
LS            77       7
UK   250    .011     .11     100
RK  2360   .0069     .05           TRAP      40      10
*
KK 121BR     DIV
KM     DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  SUBBASIN
DT 121BD    3.73
DI     0   10000
DQ     0   10000
```

```
*
KK 121B2      CP
KM      COMBINE SUB 121B & CP 121B1
HC      2
*
KK 121C1      CP
KM      ROUTE CP 121B2 TO CP 121C1
RM   1.0    .048      .2
*
KK  121C     SUB
KM      RUNOFF FROM SUB 121C
BA .0759
LS            77
UK   250    .011      .11     100
RK  1200   .0071      .05            TRAP       0      10
*
KK 121C2      CP
KM      COMBINE SUB 121C & CP 121C1
HC      2
*
KK 121C3      CP
KM      COMBINE CP 121.1 & 121C3
HC      2
*
KK 122C1      CP
KM      ROUTE CP 121C3 TO CP 122C1
RM   4.0    .200      .2
*
KK  122A     SUB
KM      RUNOFF FROM SUB 122A
BA .1818
LS            77      51
UK   200    .011      .11     100
RK  2650   .0071      .05            TRAP      40      10
*
KK 122AR      DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  SUBBASIN
DT 122AD   14.34
DI     0   10000
DQ     0   10000
*
KK 122C2      CP
KM      ROUTE SUB 122A TO CP 122C2
RM   1.3    .067      .2
*
KK  122C     SUB
KM      RUNOFF FROM SUB 122C
BA .2216
LS            77
UK   200    .011      .11     100
RK  1350   .0077      .05            TRAP       0      15
*
KK 122C3      CP
KM      COMBINE SUB 122C, CP 122C1 & 122C2
```

```
HC      3
*
KK  122B     SUB
KM      RUNOFF FROM SUB 122B
BA .2159
LS            77      51
UK   200    .011     .11     100
RK  2950   .0071     .05            TRAP      40      10
*
KK 122BR      DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  SUBBASIN
DT 122BD   17.03
DI     0   10000
DQ     0   10000
*
KK 122C4      CP
KM      ROUTE SUB 122B TO CP 122C4
RM   1.7    .083      .2
*
KK 122C5      CP
KM      COMBINE CP 122C3 & 122C4
HC      2
*
KK 122E1      CP
KM      ROUTE CP 122C5 TO CP 122E1
RM   3.8    .189      .2
*
KK  122D     SUB
KM      RUNOFF FROM SUB 122D
BA .0775
LS            77      51
UK   200    .011     .11     100
RK  1400   .0071     .05            TRAP      30      10
*
KK 122DR      DIV
KM      DIVERT 100YR,2HR RET VOLUME REQ FROM THIS  SUBBASIN
DT 122DD    6.11
DI     0   10000
DQ     0   10000
*
KK 122E2      CP
KM      ROUTE SUB 122D TO CP 122E2
RM   4.2    .211      .2
*
KK  122E     SUB
KM      RUNOFF FROM SUB 122E
BA .3888
LS            77
UK   200    .011     .11     100
RK  5200   .0063     .05            TRAP      40      10
*
KK 122E3      CP
KM      COMBINE SUB 122E, CP 122E1 & 122E2
HC      3
```

```
*
*
*                END OF APRIL 2000 RANCHO CABRILLO REVISIONS
*
*
KK  C132
KM      ROUTE FLOW AT CP 122E3 TO C132 (USE ORIGINAL WLB ROUTING DATA)
RM     1     .44      .2
```

```
3583                    123D
                         V
                         V
3589                    123K1
                         .
                         .
3594                     .-------> 123K2B
3592                    123K2A
                         V
                         V
3597                    123I1
                         .
                         .
3600                     .      PARC A
                         .          .
                         .          .
3607                     .          .-------> DVPA
3605                     .       RMPA
                         .          .
                         .          .
3610                    123I2............
                         .
                         .
3613                     .       123C
                         .          .
                         .          .
3621                     .          .-------> 123C2
3619                     .      123C1
                         .          V
                         .          V
3624                     .      123I2
                         .          .
                         .          .
3627                    123I3............
                         .
                         .
3632                     .-------> 123I3B
3630                    123I3A
                         V
                         V
3635                    123J1
                         .
                         .
3640                     .          .<------- 123C2
3638                     .      123C2
                         .          V
                         .          V
3641                     .      123J2
                         .          .
                         .          .
3644                     .          .       123J
                         .          .         .
                         .          .         .
3650                    123J3........................
```

```
                 .         .         V
                 .         .         V
3653             .         .      123B1
                 .         .         .
                 .         .         .
3656             .         .         .        123B
                 .         .         .          .
                 .         .         .          .
3662             .         .      123B2............
                 .         .         V
                 .         .         V
3665             .         .      123A3
                 .         .         .
                 .         .         .
3668             .         .         .        123H
                 .         .         .          V
                 .         .         .          V
3674             .         .         .       123N1
                 .         .         .          .
                 .         .         .          .
3677             .         .         .          .      PARC E
                 .         .         .          .         .
                 .         .         .          .         .
3684             .         .         .          .         .-------->    DVPE
3682             .         .         .          .       RMPE
                 .         .         .          .         .
                 .         .         .          .         .
3687             .         .         .       123N2............
                 .         .         .          V
                 .         .         .          V
3690             .         .         .      123N3
                 .         .         .          .
                 .         .         .          .
3693             .         .         .          .       123G
                 .         .         .          .         .
                 .         .         .          .         .
3699             .         .         .          .         .        123F
                 .         .         .          .         .          .
                 .         .         .          .         .          .
3705             .         .         .          .      123FG............
                 .         .         .          .         .
                 .         .         .          .         .
3708             .         .         .          .         .        123E
                 .         .         .          .         .          .
                 .         .         .          .         .          .
3714             .         .         .          .      123FGE............
                 .         .         .          .         V
                 .         .         .          .         V
3717             .         .         .          .      123N4
                 .         .         .          .         .
                 .         .         .          .         .
3720             .         .         .          .         .      PARC D
                 .         .         .          .         .          .
                 .         .         .          .         .          .
```

```
3727                                                  .------->  DVPD
3725                                              RMPD
                                                     .
                                                     .
3730                                 123N5 ......................
                                        V
                                        V
3733                                 123M1
                                        .
                                        .
3736                                        PAR BC
                                           .
                                           .
3743                                       .------->  DVPBC
3741                                        RMPBC
                                           .
                                           .
3746                                 123M4 ............
                                        V
                                        V
3749                                 123L1
                                        .
                                        .
3752                                        123L
                                           .
                                           .
3760                                           .<-------  123K2B
3758                                       123K2B
                                                .
                                                .
3763                                            .<-------  123I3B
3761                                          123I3B
                                                .
                                                .
3764                                       123IK............
                                                V
                                                V
3767                                       123L2
                                                .
                                                .
3770                                 123L3......................
                                        V
                                        V
3773                                 123A4
                                        .
                                        .
3776                         123A5......................
                                V
                                V
3781                         123BC
                                V
                                V
3787                         121B1
                                .
```

```
                .          .
3790            .          .        121B
                .          .          .
                .          .          .
3798            .          .          .-------> 121BD
3796            .          .       121BR
                .          .          .
                .          .          .
3801            .       121B2............
                .          V
                .          V
3804            .       121C1
                .          .
                .          .
3807            .          .        121C
                .          .          .
                .          .          .
3813            .       121C2............
                .          .
                .          .
3816         121C3............
                V
                V
3819         122C1
                .
                .
3822            .        122A
                .          .
                .          .
3830            .          .-------> 122AD
3828            .       122AR
                .          V
                .          V
3833            .       122C2
                .          .
                .          .
3836            .          .        122C
                .          .          .
                .          .          .
3842         122C3........................
                .
                .
3845            .        122B
                .          .
                .          .
3853            .          .-------> 122BD
3851            .       122BR
                .          V
                .          V
3856            .       122C4
                .          .
                .          .
3859         122C5............
                V
```

```
                V
3862        122E1
                .
                .
3865            .        122D
                .          .
                .          .
3873            .          .-------->   122DD
3871            .      122DR
                .          V
                .          V
3876            .      122E2
                .          .
                .          .
3879            .          .        122E
                .          .          .
                .          .          .
3885        122E3.......................
                V
                V
3888         C132
                .
                .
```

+ HYDROGRAPH AT	123D	303.	12.35	61.	19.	14.	0.34
+ ROUTED TO	123K1	298.	12.40	61.	19.	14.	0.34
+ DIVERSION TO	123K2B	149.	12.40	30.	9.	7.	0.34
+ HYDROGRAPH AT	123K2A	149.	12.40	30.	9.	7.	0.34
+ ROUTED TO	123I1	148.	12.45	30.	9.	7.	0.34
+ HYDROGRAPH AT	PARC A	79.	12.10	11.	4.	3.	0.05
+ DIVERSION TO	DVPA	79.	12.10	7.	2.	1.	0.05
+ HYDROGRAPH AT	RMPA	42.	12.30	5.	2.	1.	0.05
+ 2 COMBINED AT	123I2	175.	12.35	36.	11.	8.	0.39
+ HYDROGRAPH AT	123C	107.	12.30	20.	6.	5.	0.12
+ DIVERSION TO	123C2	53.	12.30	10.	3.	2.	0.12
+ HYDROGRAPH AT	123C1	53.	12.30	10.	3.	2.	0.12
+ ROUTED TO	123I2	51.	12.40	10.	3.	2.	0.12
+ 2 COMBINED AT	123I3	226.	12.40	46.	14.	11.	0.51
+ DIVERSION TO	123I3B	113.	12.40	23.	7.	5.	0.51
+ HYDROGRAPH AT	123I3A	113.	12.40	23.	7.	5.	0.51
+ ROUTED TO	123J1	113.	12.40	23.	7.	5.	0.51
+ HYDROGRAPH AT	123C2	53.	12.30	10.	3.	2.	0.12

ROUTED TO	123J2	52.	12.35	10.	3.	2.	0.12
HYDROGRAPH AT	123J	20.	12.10	3.	1.	1.	0.02
3 COMBINED AT	123J3	174.	12.35	36.	11.	8.	0.53
ROUTED TO	123B1	174.	12.40	36.	11.	8.	0.53
HYDROGRAPH AT	123B	85.	12.30	16.	5.	4.	0.09
2 COMBINED AT	123B2	255.	12.35	51.	16.	12.	0.62
ROUTED TO	123A3	244.	12.50	51.	16.	12.	0.62
HYDROGRAPH AT	123H	262.	12.00	25.	8.	6.	0.12
ROUTED TO	123N1	232.	12.10	25.	8.	6.	0.12
HYDROGRAPH AT	PARC E	109.	12.10	15.	5.	4.	0.05
DIVERSION TO	DVPE	106.	12.05	8.	2.	2.	0.05
HYDROGRAPH AT	RMPE	100.	12.15	9.	3.	2.	0.05
2 COMBINED AT	123N2	328.	12.10	34.	11.	8.	0.17
ROUTED TO	123N3	260.	12.30	34.	11.	8.	0.17
HYDROGRAPH AT	123G	169.	12.00	17.	5.	4.	0.08
HYDROGRAPH AT	123F	276.	12.35	60.	19.	14.	0.29
2 COMBINED AT	123FG	315.	12.05	76.	24.	18.	0.37
HYDROGRAPH AT	123E	38.	12.40	8.	3.	2.	0.05

2 COMBINED AT	123FGE	342.	12.35	84.	26.	20.	0.42
ROUTED TO	123N4	338.	12.45	84.	26.	20.	0.42
HYDROGRAPH AT	PARC D	186.	12.10	25.	9.	6.	0.10
DIVERSION TO	DVPD	186.	12.10	16.	5.	3.	0.10
HYDROGRAPH AT	RMPD	97.	12.30	12.	4.	3.	0.10
3 COMBINED AT	123N5	681.	12.30	130.	41.	31.	0.69
ROUTED TO	123M1	640.	12.45	130.	41.	31.	0.69
HYDROGRAPH AT	PAR BC	249.	12.10	33.	11.	9.	0.13
DIVERSION TO	DVPBC	249.	12.10	20.	6.	4.	0.13
HYDROGRAPH AT	RMPBC	199.	12.20	19.	6.	4.	0.13
2 COMBINED AT	123M4	720.	12.40	148.	46.	35.	0.82
ROUTED TO	123L1	685.	12.60	148.	46.	35.	0.82
HYDROGRAPH AT	123L	246.	12.10	33.	10.	8.	0.20
HYDROGRAPH AT	123K2B	149.	12.40	30.	9.	7.	0.34
HYDROGRAPH AT	123I3B	113.	12.40	23.	7.	5.	0.51
2 COMBINED AT	123IK	262.	12.40	53.	17.	13.	0.25
ROUTED TO	123L2	257.	12.50	53.	17.	13.	0.25
3 COMBINED AT	123L3	994.	12.55	234.	73.	55.	1.27

ROUTED TO	123A4	932.	12.95	234.	73.	55.	1.27
3 COMBINED AT	123A5	2984.	13.05	2546.	1145.	860.	9.02
ROUTED TO	123BC	2754.	15.55	2455.	1138.	854.	9.02
ROUTED TO	121B1	2752.	15.65	2452.	1137.	854.	9.02
HYDROGRAPH AT	121B	181.	12.10	25.	8.	6.	0.14
DIVERSION TO	121BD	181.	12.10	7.	2.	1.	0.14
HYDROGRAPH AT	121BR	159.	12.20	19.	6.	5.	0.14
2 COMBINED AT	121B2	2760.	15.65	2460.	1143.	858.	9.16
ROUTED TO	121C1	2760.	15.70	2460.	1142.	858.	9.16
HYDROGRAPH AT	121C	107.	12.05	13.	4.	3.	0.08
2 COMBINED AT	121C2	2764.	15.70	2464.	1146.	861.	9.24
2 COMBINED AT	121C3	5122.	15.30	4958.	3628.	2725.	303.63
ROUTED TO	122C1	5120.	15.55	4957.	3596.	2701.	303.63
HYDROGRAPH AT	122A	351.	12.05	44.	15.	11.	0.18
DIVERSION TO	122AD	351.	12.05	26.	7.	5.	0.18
HYDROGRAPH AT	122AR	198.	12.25	24.	8.	6.	0.18
ROUTED TO	122C2	150.	12.35	24.	8.	6.	0.18
HYDROGRAPH AT	122C	334.	12.05	38.	12.	9.	0.22

3 COMBINED AT	122C3	5142.	15.50	4975.	3612.	2713.	304.03
HYDROGRAPH AT	122B	409.	12.05	52.	18.	13.	0.22
DIVERSION TO	122BD	409.	12.05	31.	9.	6.	0.22
HYDROGRAPH AT	122BR	223.	12.25	29.	9.	7.	0.22
ROUTED TO	122C4	166.	12.35	29.	9.	7.	0.22
2 COMBINED AT	122C5	5155.	15.50	4986.	3619.	2719.	304.24
ROUTED TO	122E1	5153.	15.70	4984.	3589.	2696.	304.24
HYDROGRAPH AT	122D	164.	12.05	19.	6.	5.	0.08
DIVERSION TO	122DD	164.	12.05	11.	3.	2.	0.08
HYDROGRAPH AT	122DR	87.	12.20	11.	3.	3.	0.08
ROUTED TO	122E2	59.	12.45	10.	3.	3.	0.08
HYDROGRAPH AT	122E	389.	12.25	66.	20.	15.	0.39
3 COMBINED AT	122E3	5177.	15.70	5004.	3609.	2711.	304.71
ROUTED TO	C132	5152.	16.55	4983.	3537.	2657.	304.71

Excerpts

```
ID      RANCHO CABRILLO DEVELOPMENT
ID      PRE-DEVELOPMENT CONDITIONS - APRIL 2000
ID      PREPARED BY ROBERT L. WARD, P.E.
ID
ID      MODEL RC1.24I
ID
ID      THIS MODEL IS BASED ON LOCALIZED REVISIONS TO THE WITTMAN ADMS MODEL
ID      (WTM100YR) THAT WAS PREPARED BY THE WLB GROUP, INC. IN 1988.
ID      THESE REVISIONS WERE MADE TO ADD CONCENTRATION POINTS ALONG THE
ID      PERIMETER OF THE PROPOSED RANCHO CABRILLO DEVELOPMENT.
ID
ID
ID      THE FOLLOWING COMMENT RECORDS ARE FROM THE ORIGINAL WLB HEC-1 MODEL.
ID
ID       "THIS IS THE HEC-1 COMPUTER MODEL FOR THE WITTMANN AREA DRAINAGE MASTER
ID        STUDY.  THIS STUDY IS PREPARED FOR THE FLOOD CONTROL DISTRICT OF
ID        MARICOPA COUNTY BY THE WLB GROUP, INC."
ID
ID       "THIS IS THE 100 YEAR MODEL FOR THE STUDY AREA AND INCLUDES STORAGE
ID        ROUTING AND DIVERSIONS ALONG THE A.T. & S.F. RAILROAD, THE CAP CANAL,
ID        AND THE BEARDSLEY CANAL."
ID
ID
ID
*DIAGRAM
IT     3 26JAN87    1200     640
IN    15 26JAN87    1200
IO     5
JD  4.21    .001
PC  .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
PC  .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
PC  .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
PC  .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
PC  .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
PC  .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
PC  .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
PC  .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
PC  .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
PC  .983    .986    .989    .992    .995    .998    1.00   1.000   1.000   1.000
JD  4.17      10
JD  4.00      50
JD  3.93     100
JD  3.82     350
KK     1
KM      RUNOFF FROM SUBWATERSHED 1.
KM      UNIT HYDROGRAPHS HAVE BEEN COMPUTED FOR EACH SUBWATERSHED USING THE
KM      CORPS OF ENGINEERS S-GRAPH COMPUTATIONS FOR UNIT HYDROGRAPHS.  THE
KM      S-GRAPH PROGRAM HAS BEEN DEVELOPED FOR THE PHOENIX MOUNTAIN AND PHOENIX
KM      VALLEY AREAS.  THIS SHOULD GIVE A MORE RELIABLE UNIT HYDROGRAPH FOR THE
KM      HEC-1 PROGRAM TO UTILIZE WITHIN THE WITTMANN ADMS AREA.
BA  .088
LS    0      81       0
UK  200    .0160     .11     100
RK 2900    .0132     .05            TRAP      0      15
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```
KK  123D     SUB
KM      RUNOFF FROM SUB 123D
BA .3444
LS          78.3
UK   250    .011     .11     100
RK  7400   .0091     .05            TRAP      40      10
*
KK 123K1      CP
KM      ROUTE SUB 123D TO CP 123K1
RM   1.2    .061      .2
*
KK  123K     SUB
KM      RUNOFF FROM SUB 123K
BA .0293
LS            77
UK   250    .011     .11     100
RK  1100   .0081     .05            TRAP      40      10
*
KK 123K2      CP
KM      COMBINE SUB 123K & CP 123K1
HC     2
*
KK123K2A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123K2B
DI     0    5000
DQ     0    2500
*
KK 123I1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123K2A) ALONG LEVEE TO CP 123I1
RM    .8    .038      .2
*
KK  123C     SUB
KM      RUNOFF FROM SUB 123C
BA .1205
LS            77
UK   250    .011     .11     100
RK  5000   .0089     .05            TRAP      30      10
*
KK 123C1     DIV
KM      RATIO FLOW FROM SUB 123C TO SUB 123I
DT 123C2
DI     0    5000
DQ     0    2500
*
KK 123I2      CP
KM      ROUTE DIV 123C1 TO CP 123I2
RM   1.7    .087      .2
*
KK  123I     SUB
KM      RUNOFF FROM SUB 123I
BA .0324
LS            77
UK   250    .011     .11     100
```

```
RK  1560   .0081     .05            TRAP      30      10
*
KK 123I3      CP
KM      COMBINE SUB 123I, CP 123I1 & 123I2
HC     3
*
KK123I3A     DIV
KM      DIVERT FLOW THROUGH LEVEE BREACH
DT123I3B
DI     0    5000
DQ     0    2500
*
KK 123J1      CP
KM      ROUTE NON-DIVERTED FLOW (CP 123I3A) ALONG LEVEE TO CP 123J1
RM    .5    .024      .2
*
KK 123C2     RET
KM      RETRIEVE REMAINING FLOW FROM SUB 123C
DR 123C2
*
KK 123J2      CP
KM      ROUTE RET 123C2 TO CP 123J2
RM   1.4    .069      .2
*
KK  123J     SUB
KM      RUNOFF FROM SUB 123J
BA .0163
LS            77
UK   250    .011     .11     100
RK  1250   .0081     .05            TRAP      30      10
*
KK 123J3      CP
KM      COMBINE SUB 123J, CP 123J1 & 123J2
HC     3
*
KK 123B1      CP
KM      ROUTE CP 123J3 ALONG LEVEE TO CP 123B1
RM    .4    .019      .2
*
KK  123B     SUB
KM      RUNOFF FROM SUB 123B (RLW BASIN, NOT WLB)
BA .0933
LS            77
UK   250    .011     .11     100
RK  4300   .0074     .05            TRAP      25      10
*
KK 123B2      CP
KM      COMBINE SUB 123B & CP 123B1
HC     2
*
KK 123A3      CP
KM      ROUTE CP 123B2 ALONG LEVEE TO CP 123A3
RM   2.2    .111      .2
*
```

```
KK  123H     SUB
KM      RUNOF FROM SUB 123H
BA .1220
LS          82.2
UK   250   .2250     .15     100
RK  2700   .2250     .05            TRAP      35      10
*
KK 123N1      CP
KM      ROUTE SUB 123H TO CP 123N1
RM   2.4    .119      .2
*
KK  123N     SUB
KM      RUNOFF FROM SUB 123N
BA .1880
LS            77
UK   250    .011     .11     100
RK  2450   .0081     .05            TRAP      45      10
*
KK 123N2      CP
KM      COMBINE SUB 123N & CP 123N1
HC     2
*
KK 123N3      CP
KM      ROUTE CP 123N2 TO CP 123N3
RM   3.9    .194      .2
*
KK  123G     SUB
KM      RUNOFF FROM SUB 123G
BA .0803
LS            82
UK   250   .2250     .15     100
RK  3200   .2250     .05            TRAP      35      10
*
KK  123F     SUB
KM      RUNOFF FROM SUB 123F
BA .2898
LS          82.5
UK   250    .011     .11     100
RK  8400   .0092     .05            TRAP      40      10
*
KK 123FG      CP
KM      COMBINE SUB 123F & 123G
HC     2
*
KK 123N4      CP
KM      ROUTE CP 123FG TO CP 123N4
RM   2.5    .125      .2
*
KK 123N5      CP
KM      COMBINE CP 123N3 & 123N4
HC     2
*
KK 123M1      CP
KM      ROUTE CP 123N5 TO CP 123M1
```

```
RM   2.4    .118      .2
*
KK  123E     SUB
KM      RUNOFF FROM SUB 123E
BA .0488
LS            77
UK   250    .011     .11     100
RK  5000   .0092     .05           TRAP      20      10
*
KK 123M2      CP
KM      ROUTE SUB 123E TO CP 123M2
RM   2.7    .136      .2
*
KK  123M     SUB
KM      RUNOFF FROM SUB 123M
BA .0935
LS            77
UK   250    .011     .11     100
RK  2450   .0081     .05           TRAP      25      10
*
KK 123M4      CP
KM      COMBINE SUB 123M, CP 123M1 & 123M2
HC     3
*
KK 123L1      CP
KM      ROUTE CP 123M4 TO CP 123L1
RM   3.7    .185      .2
*
KK  123L     SUB
KM      RUNOFF FROM SUB 123L
BA .1956
LS            77
UK   250    .011     .11     100
RK  2150   .0081     .05           TRAP      40      20
*
KK123K2B     RET
KM      RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123K2
DR123K2B
*
KK123I3B     RET
KM      RETRIEVE FLOW THROUGH LEVEE BREACH AT CP 123I3
DR123I3B
*
KK 123IK      CP
KM      COMBINE RET 123K2B & 123I3B
HC     2     .25
*
KK 123L2      CP
KM      ROUTE CP 123IK TO CP 123L2
RM   2.2    .108      .2
*
KK 123L3      CP
KM      COMBINE SUB 123L, CP 123L1 & 123L2
HC     3
```

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*
KK 123A4      CP
KM      ROUTE CP 123L3 TO CP 123A4
RM   7.8    .389      .2
*
KK 123A5      CP
KM      COMBINE CP 123A2, 123A3 & 123A4
KM      THIS IS THE TOTAL INFLOW TO THE PADELFORD WASH CROSSING OF
KM      THE BEARDSLEY CANAL SIPHON
HC     3
*
KK 123BC
KM      STORAGE ROUTE THROUGH 123BC.  58' WIDE SIPHON ON THE BEARDSLEY CANAL.
RS     1    STOR       0       0
SV     0   34.78  148.48     190
SQ     0     493    1392    8712
SE  1338    1340    1342    1343
*
KK 121B1      CP
KM      ROUTE C123 TO CP 121B1
RM   1.9    .094      .2
*
KK  121B     SUB
KM      RUNOFF FROM SUB 121B
BA .1406
LS            77
UK   250    .011     .11     100
RK  2360   .0069     .05            TRAP      40      10
*
KK 121B2      CP
KM      COMBINE SUB 121B & CP 121B1
HC     2
*
KK 121C1      CP
KM      ROUTE CP 121B2 TO CP 121C1
RM   1.0    .048      .2
*
KK  121C     SUB
KM      RUNOFF FROM SUB 121C
BA .0759
LS            77
UK   250    .011     .11     100
RK  1200   .0071     .05            TRAP       0      10
*
KK 121C2      CP
KM      COMBINE SUB 121C & CP 121C1
HC     2
*
KK 121C3      CP
KM      COMBINE CP 121.1 & 121C3
HC     2
*
KK 122C1      CP
KM      ROUTE CP 121C3 TO CP 122C1
```

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RM   4.0    .200      .2
*
KK  122A     SUB
KM      RUNOFF FROM SUB 122A
BA .1818
LS            77
UK   200    .011     .11     100
RK  2650   .0071     .05            TRAP      40      10
*
KK 122C2      CP
KM      ROUTE SUB 122A TO CP 122C2
RM   1.3    .067      .2
*
KK  122C     SUB
KM      RUNOFF FROM SUB 122C
BA .2216
LS            77
UK   200    .011     .11     100
RK  1350   .0077     .05            TRAP       0      15
*
KK 122C3      CP
KM      COMBINE SUB 122C, CP 122C1 & 122C2
HC     3
*
KK  122B     SUB
KM      RUNOFF FROM SUB 122B
BA .2159
LS            77
UK   200    .011     .11     100
RK  2950   .0071     .05            TRAP      40      10
*
KK 122C4      CP
KM      ROUTE SUB 122B TO CP 122C4
RM   1.7    .083      .2
*
KK 122C5      CP
KM      COMBINE CP 122C3 & 122C4
HC     2
*
KK 122E1      CP
KM      ROUTE CP 122C5 TO CP 122E1
RM   3.8    .189      .2
*
KK  122D     SUB
KM      RUNOFF FROM SUB 122D
BA .0775
LS            77
UK   200    .011     .11     100
RK  1400   .0071     .05            TRAP      30      10
*
KK 122E2      CP
KM      ROUTE SUB 122D TO CP 122E2
RM   4.2    .211      .2
*
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KK  122E     SUB
KM      RUNOFF FROM SUB 122E
BA .3888
LS            77
UK   200    .011     .11     100
RK  5200   .0063     .05           TRAP      40      10
*
KK 122E3     CP
KM      COMBINE SUB 122E, CP 122E1 & 122E2
HC     3
*
*
*                END OF APRIL 2000 RANCHO CABRILLO REVISIONS
*
*
KK  C132
KM      ROUTE FLOW AT CP 122E3 TO C132 (USE ORIGINAL WLB ROUTING DATA)
RM     1     .44      .2
```

```
3571          .          .        123D
              .          .          V
              .          .          V
3577          .          .       123K1
              .          .          .
              .          .          .
3580          .          .          .          123K
              .          .          .            .
              .          .          .            .
3586          .          .       123K2............
              .          .          .
              .          .          .
3591          .          .          .-------> 123K2B
3589          .          .       123K2A
              .          .          V
              .          .          V
3594          .          .       123I1
              .          .          .
              .          .          .
3597          .          .          .          123C
              .          .          .            .
              .          .          .            .
3605          .          .          .            .-------> 123C2
3603          .          .          .         123C1
              .          .          .            V
              .          .          .            V
3608          .          .          .         123I2
              .          .          .            .
              .          .          .            .
3611          .          .          .            .       123I
              .          .          .            .         .
              .          .          .            .         .
3617          .          .       123I3........................
              .          .          .
              .          .          .
3622          .          .          .-------> 123I3B
3620          .          .       123I3A
              .          .          V
              .          .          V
3625          .          .       123J1
              .          .          .
              .          .          .
3630          .          .          .            .<-------  123C2
3628          .          .          .         123C2
              .          .          .            V
              .          .          .            V
3631          .          .          .         123J2
              .          .          .            .
              .          .          .            .
3634          .          .          .            .       123J
              .          .          .            .         .
              .          .          .            .         .
3640          .          .       123J3........................
              .          .          V
```

```
                 .         .         V
3643             .         .     123B1
                 .         .         .
                 .         .         .
3646             .         .         .        123B
                 .         .         .          .
                 .         .         .          .
3652             .         .     123B2............
                 .         .         V
                 .         .         V
3655             .         .     123A3
                 .         .         .
                 .         .         .
3658             .         .         .        123H
                 .         .         .          V
                 .         .         .          V
3664             .         .         .       123N1
                 .         .         .          .
                 .         .         .          .
3667             .         .         .          .          123N
                 .         .         .          .            .
                 .         .         .          .            .
3673             .         .         .       123N2............
                 .         .         .          V
                 .         .         .          V
3676             .         .         .       123N3
                 .         .         .          .
                 .         .         .          .
3679             .         .         .          .          123G
                 .         .         .          .            .
                 .         .         .          .            .
3685             .         .         .          .            .          123F
                 .         .         .          .            .            .
                 .         .         .          .            .            .
3691             .         .         .          .       123FG............
                 .         .         .          .            V
                 .         .         .          .            V
3694             .         .         .          .          123N4
                 .         .         .          .            .
                 .         .         .          .            .
3697             .         .         .       123N5............
                 .         .         .          V
                 .         .         .          V
3700             .         .         .       123M1
                 .         .         .          .
                 .         .         .          .
3703             .         .         .          .          123E
                 .         .         .          .            V
                 .         .         .          .            V
3709             .         .         .          .          123M2
                 .         .         .          .            .
                 .         .         .          .            .
3712             .         .         .          .            .          123M
                 .         .         .          .            .            .
```

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3718                    123M4.......................
                          V
                          V
3721                    123L1
                          .
                          .
3724                      .          123L
                          .            .
                          .            .
3732                      .            .          .<------- 123K2B
3730                      .            .     123K2B
                          .            .          .
                          .            .          .
3735                      .            .          .        .<------- 123I3B
3733                      .            .          .     123I3B
                          .            .          .          .
                          .            .          .          .
3736                      .            .      123IK............
                          .            .          V
                          .            .          V
3739                      .            .      123L2
                          .            .          .
                          .            .          .
3742                    123L3.......................
                          V
                          V
3745                    123A4
                          .
                          .
3748                 123A5.......................
                        V
                        V
3753                 123BC
                        V
                        V
3759                 121B1
                        .
                        .
3762                    .        121B
                        .          .
                        .          .
3768                 121B2............
                        V
                        V
3771                 121C1
                        .
                        .
3774                    .        121C
                        .          .
                        .          .
3780                 121C2............
                        .
                        .
```

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3783    121C3............
           V
           V
3786    122C1
           .
           .
3789       .        122A
           .          V
           .          V
3795       .       122C2
           .          .
           .          .
3798       .          .        122C
           .          .          .
           .          .          .
3804    122C3.......................
           .
           .
3807       .        122B
           .          V
           .          V
3813       .       122C4
           .          .
           .          .
3816    122C5............
           V
           V
3819    122E1
           .
           .
3822       .        122D
           .          V
           .          V
3828       .       122E2
           .          .
           .          .
3831       .          .        122E
           .          .          .
           .          .          .
3837    122E3.......................
           V
           V
3840     C132
           .
```

Partial copy
From RC1-240

HYDROGRAPH AT	123D	303.	12.35	61.	19.	14.	0.34
ROUTED TO	123K1	298.	12.40	61.	19.	14.	0.34
HYDROGRAPH AT	123K	39.	12.10	5.	2.	1.	0.03
2 COMBINED AT	123K2	313.	12.40	66.	21.	15.	0.37
DIVERSION TO	123K2B	156.	12.40	33.	10.	8.	0.37
HYDROGRAPH AT	123K2A	156.	12.40	33.	10.	8.	0.37
ROUTED TO	123I1	155.	12.40	33.	10.	8.	0.37
HYDROGRAPH AT	123C	107.	12.30	20.	6.	5.	0.12
DIVERSION TO	123C2	53.	12.30	10.	3.	2.	0.12
HYDROGRAPH AT	123C1	53.	12.30	10.	3.	2.	0.12
ROUTED TO	123I2	51.	12.40	10.	3.	2.	0.12
HYDROGRAPH AT	123I	40.	12.10	6.	2.	1.	0.03
3 COMBINED AT	123I3	224.	12.40	48.	15.	11.	0.53
DIVERSION TO	123I3B	112.	12.40	24.	8.	6.	0.53
HYDROGRAPH AT	123I3A	112.	12.40	24.	8.	6.	0.53
ROUTED TO	123J1	112.	12.40	24.	8.	6.	0.53
HYDROGRAPH AT	123C2	53.	12.30	10.	3.	2.	0.12
ROUTED TO	123J2	52.	12.35	10.	3.	2.	0.12

HYDROGRAPH AT	123J	20.	12.10	3.	1.	1.	0.02
3 COMBINED AT	123J3	173.	12.40	37.	12.	9.	0.54
ROUTED TO	123B1	173.	12.40	37.	12.	9.	0.54
HYDROGRAPH AT	123B	85.	12.30	16.	5.	4.	0.09
2 COMBINED AT	123B2	252.	12.35	53.	16.	12.	0.64
ROUTED TO	123A3	247.	12.45	53.	16.	12.	0.64
HYDROGRAPH AT	123H	262.	12.00	25.	8.	6.	0.12
ROUTED TO	123N1	232.	12.10	25.	8.	6.	0.12
HYDROGRAPH AT	123N	234.	12.10	32.	10.	7.	0.19
2 COMBINED AT	123N2	465.	12.10	57.	18.	13.	0.31
ROUTED TO	123N3	396.	12.30	57.	18.	13.	0.31
HYDROGRAPH AT	123G	169.	12.00	17.	5.	4.	0.08
HYDROGRAPH AT	123F	276.	12.35	60.	19.	14.	0.29
2 COMBINED AT	123FG	315.	12.05	76.	24.	18.	0.37
ROUTED TO	123N4	303.	12.45	76.	24.	18.	0.37
2 COMBINED AT	123N5	693.	12.30	133.	41.	31.	0.68
ROUTED TO	123M1	667.	12.40	133.	41.	31.	0.68
HYDROGRAPH AT	123E	38.	12.40	8.	3.	2.	0.05

ROUTED TO	123M2	37.	12.55	8.	3.	2.	0.05
HYDROGRAPH AT	123M	112.	12.15	16.	5.	4.	0.09
3 COMBINED AT	123M4	755.	12.40	157.	49.	37.	0.82
ROUTED TO	123L1	723.	12.60	157.	49.	37.	0.82
HYDROGRAPH AT	123L	246.	12.10	33.	10.	8.	0.20
HYDROGRAPH AT	123K2B	156.	12.40	33.	10.	8.	0.37
HYDROGRAPH AT	123I3B	112.	12.40	24.	8.	6.	0.53
2 COMBINED AT	123IK	269.	12.40	57.	18.	13.	0.25
ROUTED TO	123L2	264.	12.50	57.	18.	13.	0.25
3 COMBINED AT	123L3	1043.	12.55	246.	77.	58.	1.27
ROUTED TO	123A4	985.	12.95	246.	77.	58.	1.27
3 COMBINED AT	123A5	3027.	13.05	2554.	1149.	863.	9.04
ROUTED TO	123BC	2755.	15.55	2461.	1141.	857.	9.04
ROUTED TO	121B1	2753.	15.65	2458.	1141.	857.	9.04
HYDROGRAPH AT	121B	169.	12.10	24.	7.	6.	0.14
2 COMBINED AT	121B2	2761.	15.65	2466.	1148.	862.	9.18
ROUTED TO	121C1	2761.	15.70	2465.	1147.	862.	9.18
HYDROGRAPH AT	121C	107.	12.05	13.	4.	3.	0.08

2 COMBINED AT	121C2	2765.	15.70	2470.	1151.	865.	9.25
2 COMBINED AT	121C3	5122.	15.30	4959.	3633.	2729.	303.64
ROUTED TO	122C1	5120.	15.55	4958.	3601.	2705.	303.64
HYDROGRAPH AT	122A	232.	12.10	31.	10.	7.	0.18
ROUTED TO	122C2	216.	12.20	31.	10.	7.	0.18
HYDROGRAPH AT	122C	334.	12.05	38.	12.	9.	0.22
3 COMBINED AT	122C3	5140.	15.50	4975.	3619.	2719.	304.04
HYDROGRAPH AT	122B	268.	12.10	37.	11.	9.	0.22
ROUTED TO	122C4	249.	12.20	37.	11.	9.	0.22
2 COMBINED AT	122C5	5152.	15.50	4984.	3629.	2726.	304.26
ROUTED TO	122E1	5150.	15.70	4983.	3598.	2703.	304.26
HYDROGRAPH AT	122D	111.	12.05	13.	4.	3.	0.08
ROUTED TO	122E2	93.	12.30	13.	4.	3.	0.08
HYDROGRAPH AT	122E	389.	12.25	66.	20.	15.	0.39
3 COMBINED AT	122E3	5173.	15.70	5002.	3619.	2719.	304.73
ROUTED TO	C132	5148.	16.50	4981.	3547.	2664.	304.73