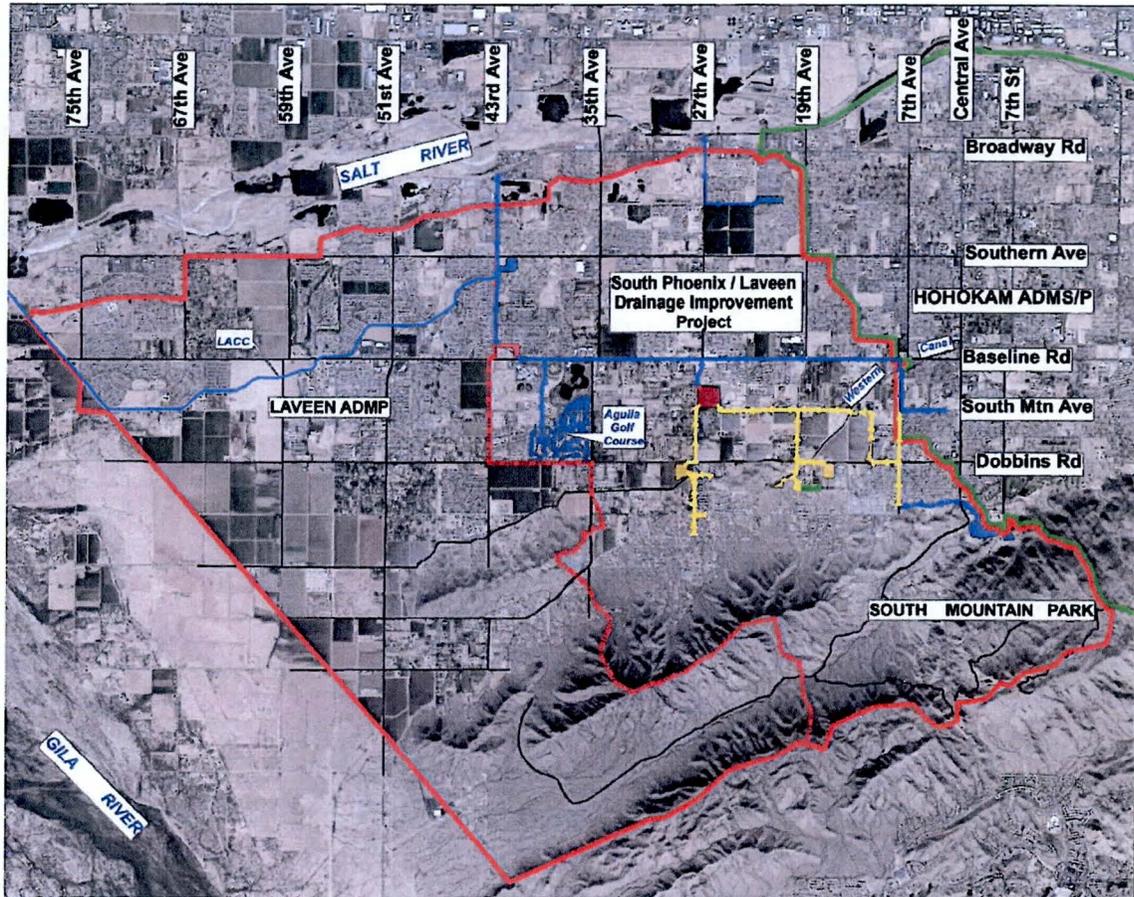


South Phoenix / Laveen Drainage Improvement Project Addendum

FCD 2011C008



Prepared For: **Flood Control District of Maricopa County**



And project partner: **City of Phoenix**



Prepared By: **Stanley Consultants**



May 2013



Expires 6-30-14



Expires 3-31-14

South Phoenix / Laveen Drainage Improvement Project Addendum FCD 2011C008

May 2013

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Appendix A – Base Regional Hydrology

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Appendix C – Initial Future Regional Infrastructure Alternatives

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Appendix I – Original South Phoenix / Laveen Drainage Improvement Project Reports, Plans and South Phoenix Two Basins Project Data Collection Report Bibliography

**Other related documents prepared as part of Contract FCD 2011C008
(under separate cover)**

- South Phoenix Two Basins Project Design Report (Including Data Collection Report), 27th Avenue and South Mountain Avenue Basin and 43rd Avenue and Baseline Road Basin, Stanley Consultants, May 2013
- South Phoenix Two Basins Project Survey Report, Stanley Consultants, May 2013
- South Phoenix Two Basins Project Geotechnical Investigation Report, 27th Avenue and South Mountain Avenue Basin, AMEC Environmental and Infrastructure, July 18, 2012
- South Phoenix Two Basins Project Geotechnical Investigation Report, 43rd Avenue and Baseline Road Basin, AMEC Environmental and Infrastructure, July 18, 2012

Note: All of the documents, reports and plans referenced herein are found in the South Phoenix Two Basins Project Data Collection Report which is part of the Design Report (first bullet item above) under separate cover. The original South Phoenix / Laveen Drainage Improvement Project and plans are also provided electronically in Appendix I of this addendum report along with the data collection report bibliography.



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Section 1 – Overview and Summary

1.1 – Purpose and Scope

This report documents an addendum of the South Phoenix / Laveen Drainage Improvement Project (SP/LDIP) prepared by consultant HDR for the Flood Control District of Maricopa County (FCDMC). Documentation for that project was finalized in January 1997 in a report titled “South Phoenix / Laveen Drainage Improvement Project, Focus Alternatives Submittal – Volume I : Main Report”. The SP/LDIP had its genesis in an earlier more comprehensive study prepared by consultant Cella Barr for FCDMC. That study was the Laveen Area Drainage Master Study (ADMS) which was concluded in September 1991.

In August of 2011, Stanley Consultants was contracted by FCDMC to produce final design and construction documents for two regional detention basins within the SP/LDIP area. One of the two basins was part of the original SP/LDIP plan and the other was added a year later through a subsequent independent analysis. The design was to be based on the prior SP/LDIP regional hydrology along with hydrologic and hydraulic documentation completed in 2001 by consultant URS for the Baseline Road regional storm drain which was part of the original SP/LDIP plan.

As part of Stanley’s design for the two regional basins, the previous documentation was to be updated to reflect:

- changes in regional drainage due to land development and other infrastructure improvements;
- changes due to the relocation of two of the original regional basin sites; and,
- the addition of the other regional basin which had not been part of the original SP/LDIP regional plan.

The project name for the design of the two basins is the “South Phoenix Two Basins Project”, AKA “SPX2B” or “Two Basins” Project. The contract number is FCD2011C008.

The original SP/LDIP plan included regional storm drains in 43rd Avenue from the Salt River to Baseline Road and in Baseline Road from 43rd Avenue to 7th Avenue, a regional detention basin at 43rd Avenue and Southern Avenue, a regional detention basin at Roeser Road and 23rd Avenue with a storm drain outfall in Roeser Road and 27th Avenue to the Salt River and regional detention storage in the Aguila Municipal Golf Course northwest of 35th Avenue and Dobbins Road. Those features have all since been constructed.

There is a large existing regional detention basin in South Mountain Park near Central Avenue that is in the Laveen ADMS contributing watershed. It pre-dates the original SP/LDIP regional plan and is a key element in the foundational hydrology.

Future regional flood control infrastructure improvements reflected in the SP/LDIP included additional regional detention basins located at the southeast corner of 27th Avenue and Baseline Road and another near 27th Avenue and Dobbins Road along with an outfall storm drain north in 27th Avenue from that basin. Also included was an extension of the regional storm drain trunk line in 7th Avenue from Baseline Road south about 1 ½ miles to a point near Olney Avenue.

The regional basin that was subsequently added within the area covered by the SP/LDIP in 1998 is at the northeast corner of 43rd Avenue and Baseline Road. This was done as the result of a concept design performed by FCDMC in-house engineering staff with the objective of down-sizing the (then future) 43rd Avenue regional storm drain. The concept design is documented in a report titled "43rd Avenue & Baseline Rd. Detention Basin Concept Report" dated September 1998.

Figure 1A on the following page illustrates the primary concepts of the original SP/LDIP from 1997. Note that the concept, at that time, did not include the regional basin at the northeast corner of 43rd Avenue and Baseline Road.

There was another regional plan that had its genesis in the Laveen ADMS and that was the Laveen Area Drainage Master Plan which was done by consultant HDR for FCDMC. It was concluded in November 2001. Its focus area was generally the portion of the original Laveen ADMS west of 43rd Avenue where the Laveen Area Conveyance Channel (LACC) has since been constructed. Figure 1B on page 9 illustrates the overall limit of the SP/LDIP and of the Laveen ADMP.

And last, there is another regional study immediately east of the SP/LDIP area which is currently being performed for FCDMC. That study is the Hohokam Area Drainage Master Plan / Study (ADMS/P) which is being done by Stanley Consultants and is scheduled for completion later in 2013. The western portion of the Hohokam ASMS/P is also reflected on Figure 1B on page 9.

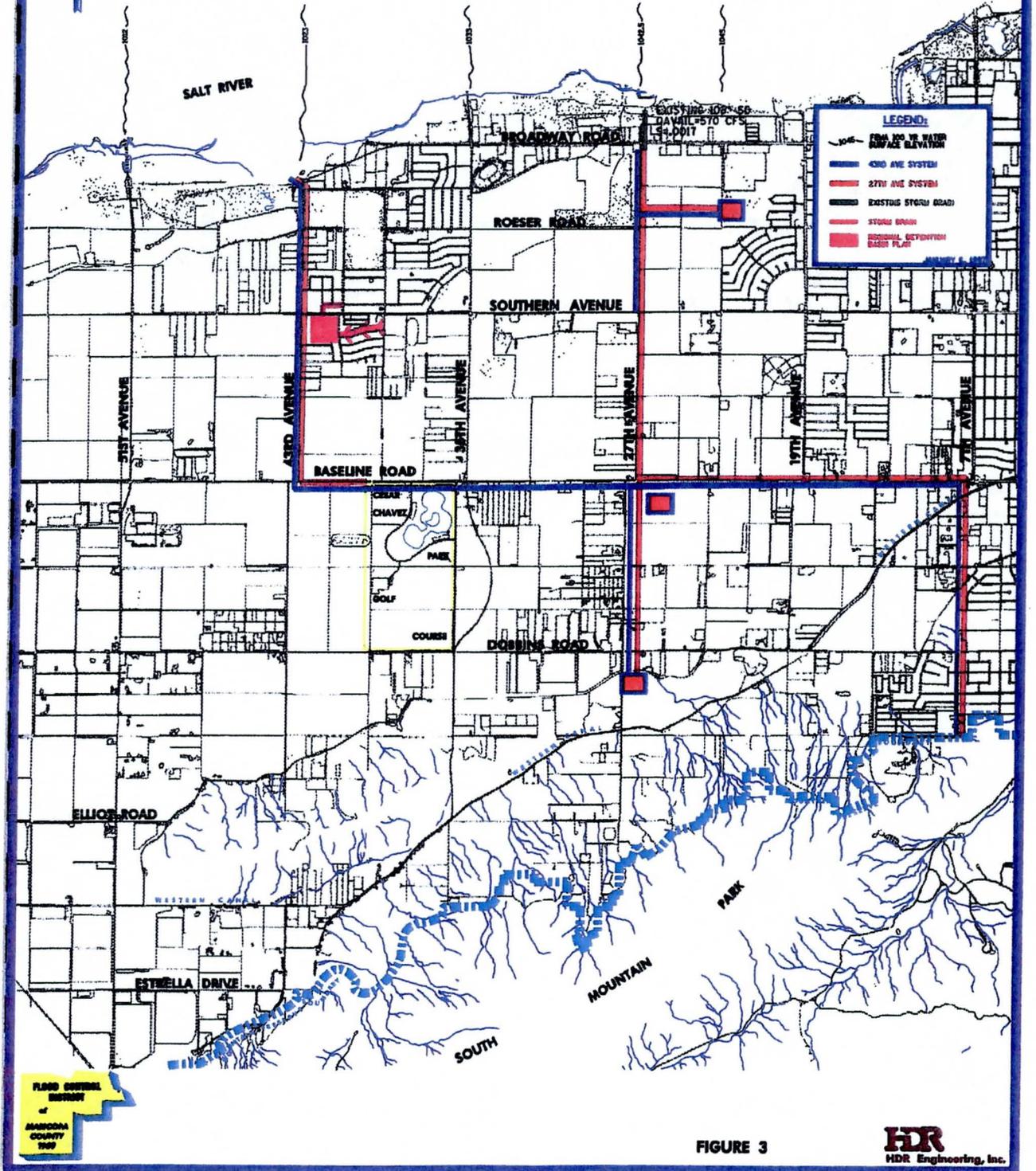
The electronic files for the original South Phoenix / Laveen Drainage Improvement Project main report, plans and other associated reports are included in Appendix I of this addendum along with the South Phoenix Two Basins Project Data Collection Report bibliography.

The 27th Avenue and Baseline Road regional basin was envisioned in the SP/LDIP plan as being located at the southeast corner of the intersection. However, sometime in the late 1990's, its location was moved about ¼ mile south to the northeast corner of 27th Avenue and South Mountain Avenue. Conceptually, the relocated basin would maintain its connection to the Baseline Road storm drain through a 60-inch diameter storm drain in 27th Avenue.

The revised basin site creates an unsteady flow condition between the basin and the Baseline Road storm drain. Flows in the 60-inch storm drain potentially change direction between the basin and the Baseline Road storm drain as the difference in head between the basin and the Baseline Road storm drain changes over the duration of the runoff event.

The basin floor is about 2 feet higher in elevation than the Baseline Road storm drain invert at 27th Avenue. During the initial stage of the runoff hydrograph, flow from the Baseline Road storm drain surges up the pipe south along 27th Avenue to the basin. As runoff recedes, flow reverses and goes north in the storm drain from the basin to Baseline Road.

RECOMMENDED DETAILED CONCEPT ALTERNATIVES



FROM: HDR SOUTH PHOENIX LAVEEN DRAINAGE IMPROVEMENT PROJECT
FOCUS ALTS SUBMITTAL, VOL I: MAIN REPORT JAN 1997
FIGURE 1A

The dynamic surge function between the relocated 27th Avenue regional basin and the Baseline Road storm drain was investigated by consultant URS for MCDOT as part of the design of Baseline Road improvements in the late 1990's. The documentation for that analysis is contained in a report prepared by URS titled "Storm Drain Design Report, Baseline Road (51st Avenue to 7th Avenue) Work Order #68914, 90% Submittal", dated May 1, 2000. None of the electronic files from that analysis were available for this addendum.

The direct surface runoff contributing to the 27th Avenue regional basin from the south and southeast is another key element in its design and function that had not been specifically established in the previous SP/LDIP regional plan or in the Baseline Road storm drain design report. Subsequent to the conclusion of the original SP/LDIP regional plan, there had been a number of physical changes in the contributing watershed that impact hydrology.

These changes involve various land development and other improvement projects that have taken place in the past 10 or so years. Land development improvements that have occurred subsequent to the original regional plan complicated the previous assumptions regarding direct surface runoff to the 27th Avenue regional basin.

The future regional detention basin in the 27th Avenue and Dobbins Road area has also changed locations since it was originally conceived. Originally, it was south of the Western Canal lateral about 700 feet south of Dobbins Road and east of 27th Avenue. The new location was at the southwest corner of 27th Avenue and Dobbins Road.

The discharge of flow from this basin was originally envisioned as being conveyed north via storm drain to the (then future) regional storm drain in Baseline Road. The new outfall for the basin is currently envisioned as contributing directly to the new 27th Avenue and South Mountain Avenue regional basin.

One of the foundational tenets of the original regional master plan was that Baseline Road and its storm drain were to form a regional 100-year hydrologic boundary. That is, for the future developed land use condition with future regional drainage projects constructed, Baseline Road (and its storm drain) would intercept and convey all of the 100-year flow coming to it from the south.

The dynamic level of interaction between the 27th Avenue regional basin design and the regional hydrology became apparent early in the hydrologic analysis for Two Basins design. It also appeared, based on initial storm drain analysis, that the existing Baseline Road storm drain may not meet its original hydrologic boundary goal.

The Two Basins initial analysis also indicated the need for a potentially extensive secondary system of regional collection and conveyance facilities in the area upstream from the 27th Avenue regional basin to complete the regional hydrologic function as it was originally conceived.

The two basins being designed under Contract FCD 2011C008 are the basin at 43rd Avenue and Baseline Road and the basin at 27th Avenue and South Mountain Avenue. The original Two Basins Project scope included a task to update the regional hydrology so that it could be incorporated in the design phase for the two basins. This addendum evolved from that original scope. The primary focus of this addendum is the upper watershed of the SP/LDIP area which is primarily the area south of Baseline Road tributary to the two basins being designed.

This addendum report includes:

- an update of regional hydrology due to changes in the watershed contributing to the two regional basins being designed;
- creation of an unsteady hydraulic model for the existing storm drain in Baseline Road and in 43rd Avenue including dynamic surge analysis between the 27th Avenue regional basin and the Baseline Road storm drain and analysis of the apparent lack of capacity of the Baseline Road storm drain;
- an updated assessment of the future regional basin near 27th Avenue and Dobbins Road;
- analyses of alternatives for future regional drainage infrastructure including storm drains, channels and detention basins necessary to adequately collect, detain and attenuate flows and convey stormwater to the Salt River outfall;
- preliminary cost estimates for alternatives and recommended improvements, and;
- hydraulic analysis of the recommended future regional storm drain system.

The City of Phoenix has incorporated jurisdiction covering most of the area included in the SP/LDIP watershed which is potentially subject to runoff from the South Mountain foothills. The City of Phoenix is a project partner with FCDMC on the Two Basins Project. The City of Phoenix will be instrumental in the further planning, design and construction of regional drainage infrastructure in the area.

One of the objectives of this addendum is to document the necessary future infrastructure for use by the City of Phoenix in the planning and design of CIP projects and for use in review of private development projects.

This report is intended to addend the original South Phoenix / Laveen Drainage Improvement Project and to revise the original watershed master plan and re-define the required drainage infrastructure improvements needed to accomplish the original SP/LDIP objectives.

1.2 – Conclusions

The original regional HEC-1 hydrology model was reconstructed and updated to account for changed conditions that have occurred subsequent to the last significant regional drainage improvement activity which was concluded a little over 10 years ago. That activity included the design and construction of the Baseline Road improvements, including the regional storm drain in Baseline Road. The last look at regional hydrology in the area concluded with the Laveen ADMP in 2001 which was mainly focused on the area west of 43rd Avenue.

This addendum also updates the regional HEC-1 hydrology to reflect the final recommended additional detention basins and storm drains concluded from the alternatives analysis and updated with the final designs of the two new regional basins at 43rd Avenue and Baseline Road and 27th Avenue and South Mountain Avenue.

Hydrology related to the existing regional detention basin in South Mountain Regional Park has been resolved. This was significant in that the outflow from that basin represents a large sustained volume of flow that impacts almost all of the downstream facilities under consideration. The results of the hydrologic analysis indicate that no modifications to the basin volume or low level outlet pipe are necessary to meet downstream regional objectives.

Hydraulic models of the existing regional storm drains were created, including an unsteady flow model using SWMM which concluded that the existing system still meets the design intent of the original regional plan. The analysis indicates that the inlets along the back side of the catch basins on the south side of Baseline Road are necessary for complete interception of flow and therefore should remain in place to reduce the potential for flooding downstream (north) of Baseline Road.

The hydrologic and hydraulic feasibility of the future 27th Avenue and Dobbins Road basin and storm drains has been analyzed and the Alternative 1 form of that system with the basin at the southwest corner of 27th Avenue and Dobbins Road is recommended. Another alternative for that basin was considered on property on the south side of Dobbins Road just east of 27th Avenue. The cost for that alternative was similar but it would involve acquisition of occupied residential properties.

The future storm drains that are needed in that area will need to cross the existing City of Phoenix 60" regional water transmission main in 27th Avenue. This will require close coordination with the City's Water Services Department (WSD). Because of the magnitude of discharge and size of the pipe involved in the 27th Avenue crossing near the Western Canal lateral, this crossing is envisioned as a 3 barrel 48" diameter crossing with a reinforced concrete vault on either side of 27th Avenue.

Based on preliminary feedback from WSD staff, the storm drain would have to go under the water transmission main. This has been the assumption all along in developing the storm drain and basin layout. Because of the type of pipe used to construct the water main, its age and its strategic nature, the storm drain crossing must be done via jack and bore with a minimum of 4 feet of undisturbed soil between the storm drain and water main pipe. The City will also require acoustic monitoring or other monitoring as determined during construction.

Alternatives for additional future regional detention basins and storm drains needed to complete the system and validate the original South Phoenix / Laveen Drainage Improvement Project objectives were developed and analyzed. This was done based on the updated regional

hydrology and hydraulics and in conjunction with the analysis of the future 27th Avenue and Dobbins Road regional basin alternatives.

The alternatives analysis involved a somewhat complex, interconnected system with initially as many variables as solutions. Some of the key elements of the initial analysis involved basins, storm drains and outfalls situated on property owned by the City of Phoenix north of Dobbins Road adjacent to the east side of the Western Canal. That property is planned for a future water treatment plant site but has inherent challenges of its own with significant offsite drainage to deal with and a delineated Zone 'A' floodplain along the Western Canal. The City's Water Services Department was instrumental in helping develop a plan for the additional regional drainage infrastructure that would help address both the regional needs and solve the drainage challenges associated with development of the future water treatment plant.

Alternative 6 is the recommended alternative that was developed and concluded from that phase of the addendum analysis. Alternative 6 incorporates the following primary features:

- A future regional storm drain extension in 7th Avenue from just south of Baseline Road to approximately Olney Avenue which intercepts outflow from the existing South Mountain Park regional detention basin and local flow from east of 7th Avenue. This storm drain includes a flow split structure at the intersection of 7th Avenue and Dobbins Road. The outfalls are north to the existing Baseline Road storm drain and west in Dobbins Road via future storm drain that outfalls to a small future regional detention basin in the City of Phoenix future water treatment plant site.
- Two small regional detention basins within the future City of Phoenix water treatment plant site with associated storm drain and an open channel. The future Dobbins Road storm drain outfalls to this system. A future storm drain west in South Mountain Avenue provides the outfall for this system.
- A future regional detention basin on the south side of Dobbins Road just west of the Humane Society facility. This is an updated version of what had been part of Initial Alternative 3 at that location. A future storm drain west in Dobbins Road provides the outfall for this basin.
- A small regional detention basin and storm drain collector system on the south side of the Western Canal near 19th Avenue. This is an updated version of what had been part of Initial Alternative 3 at that location. A future regional storm drain north in 19th Avenue provides the outfall for this system.
- A regional outfall storm drain in 19th Avenue from Dobbins Road north to South Mountain Avenue, then west to the new 27th Avenue and South Mountain Avenue regional basin provides the outfall for the contributing upstream future regional basin and storm drain systems mentioned above.

Once Alternative 6 was concluded, hydraulic analysis of the required storm drains was performed using SWMM. The profiles from the SWMM model represent actual concept level design profiles based on 1988 vertical datum. Concept level profile sketches were also created for each of the primary storm drain outfalls illustrating existing water, sewer and irrigation facilities from quarter section maps, as-builts and survey. Alignments, typically offsets from section lines, mid-section line or street centerline, are illustrated on .jpg image files in Appendix H at the back of this report.

The recommended alternative overall future regional drainage features are illustrated on Figure 1B on the following page including the future 27th Avenue and Dobbins Road regional basin. The associated regional drainage system peak flows and peak times are illustrated on Figure 1C which follows that.

Concept level cost estimates for recommended Alternative 6 and for the 27th Avenue and Dobbins Road basin and storm drains follow on the pages after Figures 1B and 1C. Cost estimate Table 1A is a summary of the entire cost of recommended Alternative 6 followed by Tables 1B through 1G which are a breakdown of each of its basic component parts. Cost estimate Table 1H covers the future 27th Avenue and Dobbins Road regional basin and storm drain system. Cost estimate tables are provided in electronic spreadsheet file format in Appendices F and G at the back of this addendum report.

Documentation for the design of the regional basins at 27th Avenue and South Mountain Avenue and 43rd Avenue and Baseline Road are in the project design report under separate cover.

South Phoenix / Laveen
Drainage Improvement
Project Addendum

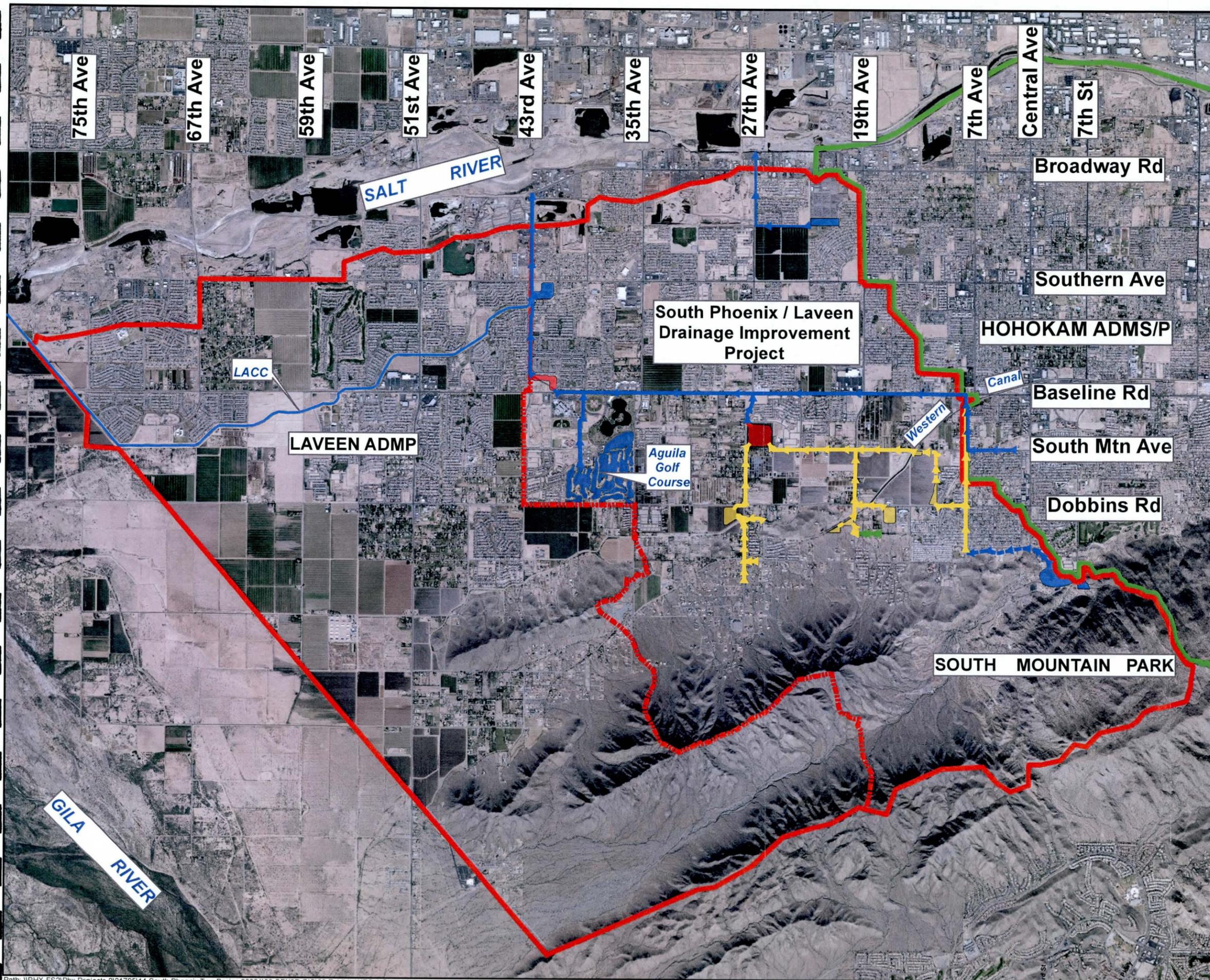


Recommended Alternative
Overall Regional Drainage
System Features

Figure 1B

Legend

- Existing Detention Facility
- New Basin
- Future Basin
- ← Existing Storm Drain
- ← Future Storm Drain
- ← Future Storm Drain (Optional)
- ← Future Channel
- ← Existing Wash
- Laveen ADMS Boundary
- Hohokam ADMS/P
- - - Boundary Between SP/LDIP and Laveen ADMP Watersheds



N.T.S.

Date: 4/11/2013

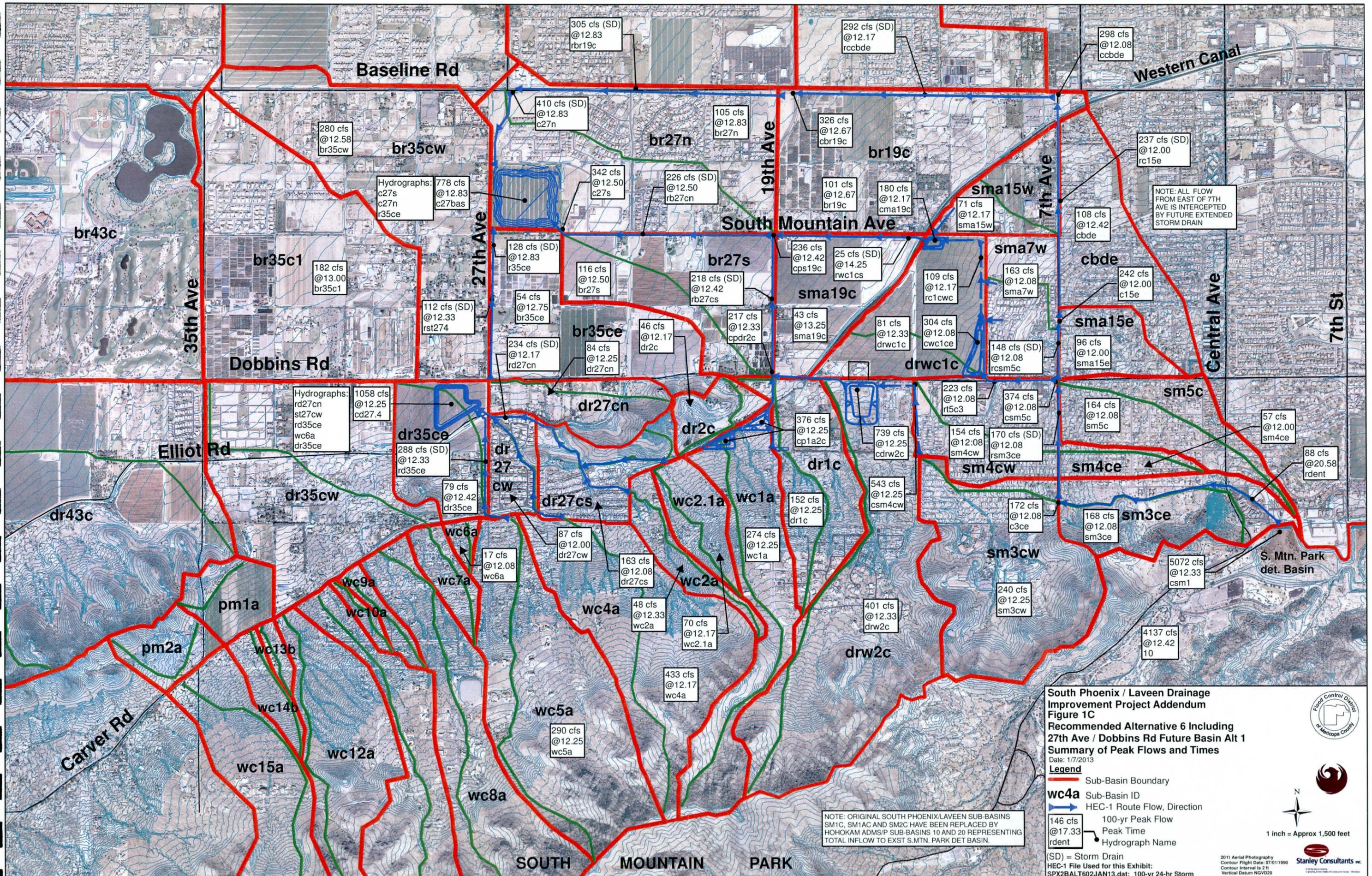


Table 1A (Note: Table 1A corresponds to Table 8.1 in Section 8.1)

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE SUMMARY - RECOMMENDED ALTERNATIVE 6 (TOTAL COST)**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	6	\$25,000	\$150,000
2	DRAINAGE EXCAVATION (BASIN)	CY	257,096	\$5	\$1,285,479
3	DRAINAGE EXCAVATION (CHANNEL)	CY	2,135	\$6	\$12,810
4	HUMANE SOCIETY CHANNEL OUTFALL STR	EA	1	\$50,000	\$50,000
5	24" SD	LF	850	\$40	\$34,000
6	30" SD	LF	2,850	\$60	\$171,000
7	36" SD	LF	2,850	\$70	\$199,500
8	48" SD	LF	1,300	\$110	\$143,000
9	54" SD	LF	1,800	\$160	\$288,000
10	60" SD	LF	4,950	\$190	\$940,500
11	66" SD	LF	7,400	\$220	\$1,628,000
12	FLOW SPLIT STRUCTURE (7TH AVE & DOBINS RD)	EA	1	\$50,000	\$50,000
13	CONCRETE INLET SPILLWAY	EA	5	\$12,000	\$60,000
15	CONCRETE INLET STRUCTURE	EA	2	\$25,000	\$50,000
16	MANHOLE	EA	56	\$3,200	\$179,200
17	HEADWALL	EA	9	\$50,000	\$450,000
18	CONCRETE CHANNEL LINING (6")	SY	1010	\$37	\$37,370
19	LANDSCAPING	AC	26.7	\$15,000	\$399,750

Subtotal Construction		\$6,128,609
Construction Contingency	25%	\$1,532,152
Design	7%	\$536,253
Construction Admin	6%	\$459,646
Total Construction Costs		\$8,656,660

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-52-001	South side Dobbins Rd just west of Humane Soc	11.8	Part (vac)	\$3.00	\$1,542,024
300-16-013F	South side Western Canal just west of 19th Ave	4.3	Whole (vac)	\$3.00	\$561,924
300-52-002W	Northeast corner of 19th Ave and Piedmont Rd (200'x50')	0.23	Part (vac)	\$3.00	\$30,056
300-16-013U	South side Western Canal west of 19th Ave	3.6	Whole (vac)	\$3.00	\$470,448
		19.9			\$2,604,452

Total Construction Costs	\$8,656,660
Total ROW Acquisition Costs	\$2,604,452
Total Estimated Cost	\$11,261,112

Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals. Larger regional size catch basin inlets / laterals are included at locations such as 7th Ave near Olney and at 19th Ave near Piedmont (see line item 15).
2. Estimate does not include 27th Ave & South Mtn Ave regional basin or future 27th Ave and Dobbins Rd basin.
3. Estimate does not include R/W acquisition costs on property owned by City of Phoenix.
4. Landscaping acreage and costs in table above relating to drainage infrastructure improvements on COP water treatment plant site reflect only the actual drainage improvements and not to overall site.
5. Estimate does not include future storm drain depicted as "optional" on Recommended Alternative 6 Storm Drain Concept Layout figure.

Table 1B

SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM					
COST ESTIMATE - FUTURE SOUTH MOUNTAIN AVENUE DRAINAGE INFRASTRUCTURE					
27TH & SOUTH MTN AVE BASIN TO WESTERN CANAL					
Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	30" SD	LF	2,850	\$60	\$171,000
3	66" SD	LF	4,000	\$220	\$880,000
4	MANHOLE	EA	19	\$3,200	\$60,800
Subtotal Construction					\$1,136,800
Construction Contingency				25%	\$284,200
Design				7%	\$99,470
Construction Admin				6%	\$85,260
Total Construction Costs					\$1,605,730
Total Estimated Cost					\$1,605,730
Notes:					
1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals.					
2. Estimate does not include 27th Avenue & South Mountain Avenue regional basin.					
3. Estimate assumes all street R/W needed for storm drain has been acquired. Therefore, no costs for R/W.					

Table 1C

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE CITY OF PHOENIX WATER TREATMENT PLANT SITE**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	39,177	\$5	\$195,885
3	DRAINAGE EXCAVATION (CHANNEL)	CY	2,135	\$6	\$12,810
4	24" SD	LF	850	\$40	\$34,000
5	CONCRETE INLET SPILLWAY	EA	2	\$12,000	\$24,000
6	MANHOLE	EA	3	\$3,200	\$9,600
7	HEADWALL	EA	4	\$50,000	\$200,000
8	CONCRETE CHANNEL LINING (6")	SY	1010	\$37	\$37,370
9	LANDSCAPING	AC	6.8	\$15,000	\$101,250

Subtotal Construction		\$639,915
Construction Contingency	25%	\$159,979
Design	7%	\$55,993
Construction Admin	6%	\$47,994
Total Construction Costs		\$903,880

Total Estimated Cost		\$903,880
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Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals.
2. Landscaping acreage and costs in table above relating to drainage infrastructure improvements on COP water treatment plant site reflect only the actual drainage improvements and not to overall site.
3. Cost of Dobbins Rd storm drain from 7th Ave to WTP is included in 7th Ave cost estimate.

Table 1D

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE 7TH AVENUE DRAINAGE INFRASTRUCTURE
WESTERN CANAL TO OLNEY AVE INCLUDING DOBBINS RD FROM 7TH AVE TO WTP**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	48" SD	LF	1,300	\$110	\$143,000
3	54" SD	LF	1,500	\$160	\$240,000
4	60" SD	LF	2,300	\$190	\$437,000
5	66" SD	LF	3,400	\$220	\$748,000
6	FLOW SPLIT STRUCTURE (7TH AVE & DOBINS RD)	EA	1	\$50,000	\$50,000
7	MANHOLE	EA	20	\$3,200	\$64,000
8	CONCRETE INLET STRUCTURE	EA	1	\$25,000	\$25,000

Subtotal Construction		\$1,732,000
Construction Contingency	25%	\$433,000
Design	7%	\$151,550
Construction Admin	6%	\$129,900
Total Construction Costs		\$2,446,450
Total Estimated Cost		\$2,446,450

Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals. A large regional size catch basin inlet / lateral has been included at 7th Ave near Olney.
2. Estimate includes section of 54-inch storm drain in Dobbins Road extending from 7th Avenue to future COP WTP site basin.

Table 1E

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
 COST ESTIMATE - FUTURE 19TH AVENUE DRAINAGE INFRASTRUCTURE
 SOUTH MTN AVE TO WESTERN CANAL
 INCLUDING DOBBINS RD FROM 19TH AVE TO HUMANE SOCIETY BASIN**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	36" SD	LF	2,200	\$70	\$154,000
3	60" SD	LF	2,650	\$190	\$503,500
4	MANHOLE	EA	12	\$3,200	\$38,400
Subtotal Construction					\$720,900
Construction Contingency				25%	\$180,225
Design				7%	\$63,079
Construction Admin				6%	\$54,068
Total Construction Costs					\$1,018,271
Total Estimated Cost					\$1,018,271

Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals.
2. Estimate includes 36-inch storm drain in Dobbins Road extending from 19th Ave east to future Humane Society basin and extending south in 19th Ave from Dobbins Rd to just past Western Canal.

Table 1F

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE BASIN ADJACENT TO HUMANE SOCIETY**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	141,414	\$5	\$707,071
3	HUMANE SOCIETY CHANNEL OUTFALL STR	EA	1	\$50,000	\$50,000
4	CONCRETE INLET SPILLWAY	EA	1	\$12,000	\$12,000
5	HEADWALL	EA	1	\$50,000	\$50,000
6	LANDSCAPING	AC	11.8	\$15,000	\$177,000

Subtotal Construction		\$1,021,071
Construction Contingency	25%	\$255,268
Design	7%	\$89,344
Construction Admin	6%	\$76,580
Total Construction Costs		\$1,442,263

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-52-001	South side Dobbins Rd just west of Humane Soc	11.8	Part (vac)	\$3.00	\$1,542,024
		11.8			\$1,542,024

Total Construction Costs	\$1,442,263
Total ROW Acquisition Costs	\$1,542,024
Total Estimated Cost	\$2,984,287

Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals.
2. 36" outfall storm drain in Dobbins Rd to 19th Ave is included in 19th Ave cost estimate.

Table 1G

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE BASIN @ SW CORNER OF 19TH AVE AND WESTERN CANAL**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	76,505	\$5	\$382,523
3	36" SD	LF	650	\$70	\$45,500
4	54" SD	LF	300	\$160	\$48,000
5	CONCRETE INLET SPILLWAY	EA	2	\$12,000	\$24,000
6	CONCRETE INLET STRUCTURE	EA	1	\$25,000	\$25,000
7	MANHOLE	EA	2	\$3,200	\$6,400
8	HEADWALL	EA	4	\$50,000	\$200,000
9	LANDSCAPING	AC	8.1	\$15,000	\$121,500

Subtotal Construction		\$877,923
Construction Contingency	25%	\$219,481
Design	7%	\$76,818
Construction Admin	6%	\$65,844
Total Construction Costs		\$1,240,066

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-16-013F	South side Western Canal just west of 19th Ave	4.3	Whole (vac)	\$3.00	\$561,924
300-52-002W	Northeast corner of 19th Ave and Piedmont Rd (200'x50')	0.23	Part (vac)	\$3.00	\$30,056
300-16-013U	South side Western Canal west of 19th Ave	3.6	Whole (vac)	\$3.00	\$470,448
		8.1			\$1,062,428

Total Construction Costs	\$1,240,066
Total ROW Acquisition Costs	\$1,062,428
Total Estimated Cost	\$2,302,494

Notes:

1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals. A large regional size catch basin inlet / lateral has been included at 19th Ave near Piedmont.
2. Estimate does not include future storm drain depicted as optional on Recommended Alternative 6 storm drain concept layout figure.

Table 1H (Note: Table 1H corresponds to Table 7.1 in Section 7.1)

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE 27TH AVE / DOBBINS ROAD BASIN ALTERNATIVE 1**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	CHANNEL GRADING	CY	2,777	\$5	\$13,885
3	DRAINAGE EXCAVATION (BASIN)	CY	164,798	\$5	\$823,988
4	PLAIN DUMPED RIPRAP, D50=6"	CY	500	\$60	\$30,000
5	STABELIZED GRANITE MAINT ACCESS RD	SY	2,881	\$15	\$43,215
6	5.5" AC PVMT @ 27TH AVE SD CROSSING	SY	450	30	\$13,500
7	4" AB BASE @ 27TH AVE SD CROSSING	SY	450	8	\$3,600
8	6" STBLZD SUB-G @ 27TH AVE SD CROSSING	SY	450	\$20	\$9,000
9	SPECIAL STR @ 27th AVE CROSSING (3x48 in)	EA	1	\$120,000	\$120,000
10	SPECIAL STR @ 27th AVE CROSSING (36 in)	EA	1	\$30,000	\$30,000
11	36" SD	LF	570	\$70	\$39,900
12	42" SD	LF	680	\$80	\$54,400
13	48" SD	LF	2,430	\$120	\$291,600
14	54" SD	LF	1,630	\$160	\$260,800
15	60" SD	LF	2,290	\$190	\$435,100
16	66" SD	LF	900	\$220	\$198,000
17	84" SD	LF	80	\$380	\$30,400
18	96" SD	LF	470	\$500	\$235,000
19	MANHOLE	EA	24	\$3,200	\$76,800
20	CONCRETE CATCH BASIN	EA	88	\$5,000	\$440,000
21	HEADWALL	EA	4	\$75,000	\$300,000
22	LANDSCAPING	AC	12.1	\$15,000	\$181,500

Subtotal Construction		\$3,655,688
Construction Contingenc	25%	\$913,922
Design	7%	\$319,873
Construction Admin	6%	\$274,177
Total Construction Costs		\$5,163,659

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
304-91-105E	Southwest corner Dobbins / 27th Ave	19.4	Part (vac)	\$2.00	\$1,690,128
		19.4			\$1,690,128

Total Construction Costs	\$5,163,659
Total ROW Acquisition Costs	\$1,690,128
Total Estimated Cost	\$6,853,787

Notes:

1. Estimate includes the cost of the collector storm drain system, the future regional basin and the outfall to the 27th / S Mtn Ave regional basin. Catch basins are assumed to be part of street improvements. Pavement replacement assumes conventional trenching.
2. Estimate does not include R/W cost from SRP or any R/W other than basin parcel.

Section 2 – Base Regional Hydrology

2.1 – Base Regional Hydrology Overview

The original Laveen ADMS HEC-1 model prepared by HDR in 1996 and further updated by URS in 2000 was reviewed and revised by Stanley Consultants as part of the South Phoenix / Laveen Drainage Improvement Project (SP/LDIP) Addendum. Hydrologic revisions were necessary to reflect changes that have occurred since the SP/LDIPA was completed in 1997.

The HEC-1 model assumes future completely developed land use conditions in the watershed and generally includes the detention basins and storm drains that were part of the regional plan at that time. Future land use was projected from the (then current) zoning and general plan for the area. Onsite stormwater retention within developing sub-basins was reflected in the original model based on future land use projections. It is unknown if there were any existing condition (existing land use, without project) watershed models that were developed as part of the original hydrology. Only future completely developed land use condition with project HEC-1 models have been the focus of this addendum.

The original hydrology utilizes a 100-year, 24-hour storm as its basis. It is unknown if any other storm durations or frequencies were performed in the original study. Only the 100-year, 24-hour HEC-1 model has been the focus of this addendum.

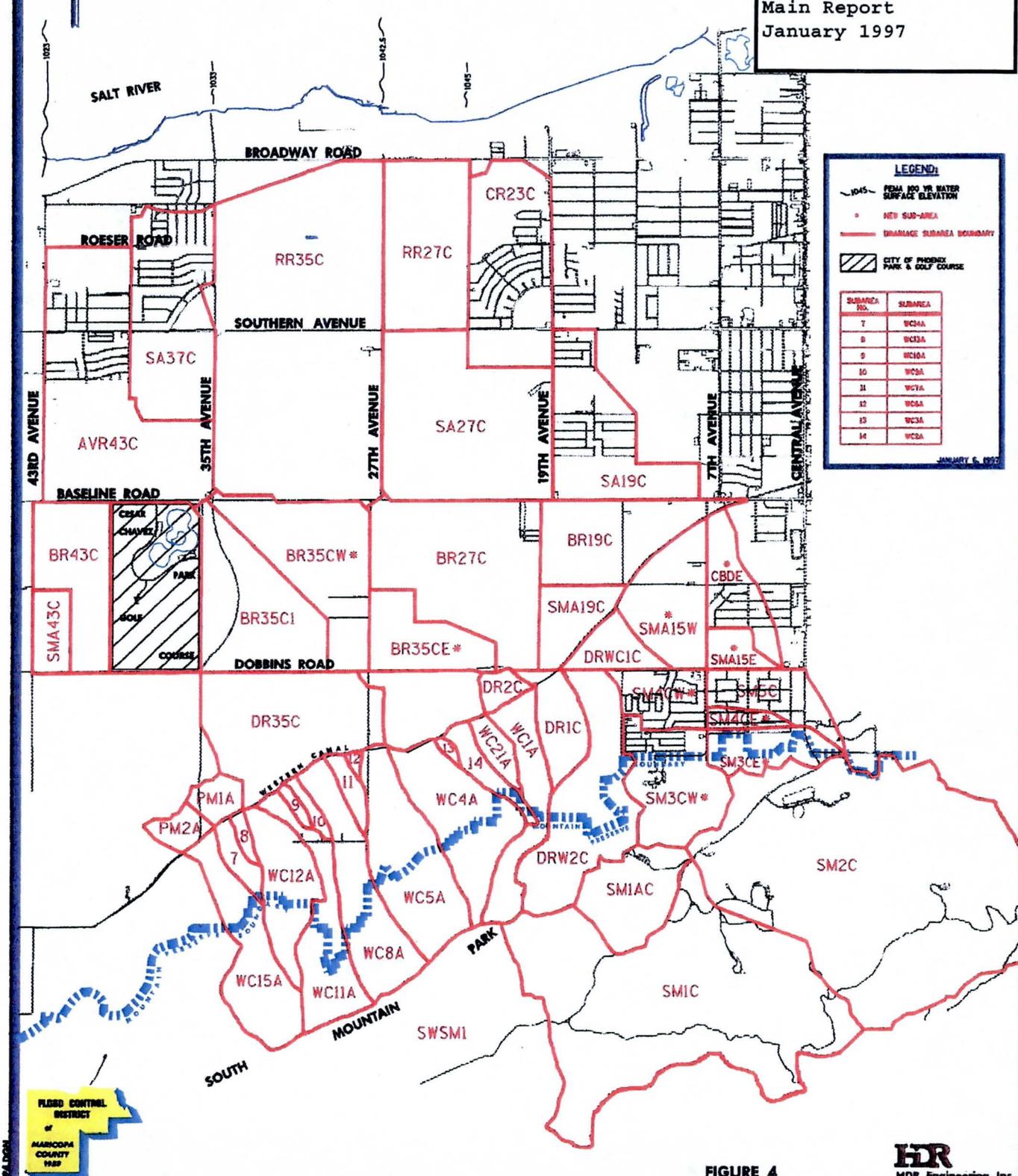
All of the original regional hydrology is based on NOAA 2 rainfall data. Early in scoping, the project team considered revising the hydrology based on NOAA 14 rainfall which was about 10% lower than NOAA 2 but since so much had been invested in the original analysis using NOAA 2 and since a substantial portion of the regional system had already been constructed on that basis, it was decided to stay with NOAA 2. Converting to NOAA 14 would also be a major undertaking as it would involve revision to sub-basin times of concentrations and storage coefficients and revisions to routing steps and other components of the HEC-1 model.

Stanley was provided two HEC-1 models at the beginning of the project. The most current and hydrologically up-to-date model was the one URS used to analyze regional drainage for the Baseline Road improvement plans and was documented in their Storm Drain Design report dated May 1, 2000 in support of that project. Portions of that report including the main report document are found in Appendix A on the CD inside the back cover of this report. The URS HEC-1 model was only available in hard copy printout.

The other model provided to Stanley was an FCD version of an HDR model from the late 1990's which was provided in editable electronic format. Both models covered the overall South Phoenix / Laveen area represented in Figure 2A on the next page as developed by HDR. Some elements of the HEC-1 model go back to the models originated by consultant Cella Barr for the Laveen ADMS which concluded in 1991.

HEC-1 SUBAREA BOUNDARY MAP

From: HDR
 South Phoenix/Laveen
 Drainage Improvement
 Project Fucus Alts
 Submittal, Vol I:
 Main Report
 January 1997



LEGEND:

- 1045' FROM 100 YR WATER SURFACE ELEVATION
- NEW SUB-AREA
- DRAINAGE SUBAREA BOUNDARY
- CITY OF PHOENIX PARK & GOLF COURSE

SUBAREA NO.	SUBAREA
7	WC3A
8	WC3A
9	WC1A
10	WC3A
11	WC1A
12	WC3A
13	WC3A
14	WC3A

JANUARY 5, 1997

FLOOD CONTROL DISTRICT
 of
 MARICOPA COUNTY
 1989

FIGURE 4

HDR
 HDR Engineering, Inc.

Figure 2A

Revisions and updates to the model performed for this addendum include sub-basin data such as boundary, flow path, Green and Ampt parameters and retention volume along with revisions to routing reaches, hydrograph combinations, flow splits and level pool routing steps and volume-divert steps (reflecting future onsite stormwater retention). The original HEC-1 model was also revised at level pool hydrograph steps corresponding to the regional basins at 43rd Avenue and Baseline Road, 27th Avenue and South Mountain Avenue and at 27th Avenue and Dobbins Road. The level pool routing step corresponding to the existing regional detention basin in South Mountain Regional Park was also updated.

The two HEC-1 models provided to Stanley had essentially the same sub-basin hydrograph steps but differed in other ways, including a difference in model branching structure. Stanley edited the electronic input file that was provided to essentially re-create the HEC-1 model in the URS Baseline Road storm drain design report. However, Stanley's re-created model still followed the same branching structure as the FCDMC electronic version that had been provided. When completed, Stanley's re-created model was run and the output checked against the output in the URS report to verify it produced the same results.

The branching structure of the initial model Stanley re-created was later changed (by Stanley) to match the same sequence and structure found in the URS model from 2000. All revisions made by Stanley subsequent to that related to items described on the first page of this section have been documented in the model input file by notes starting with "Stanley:".

For the most part, revisions made by Stanley to HEC-1 sub-basin boundaries reflect physical changes that have occurred in the watershed due to land development and other improvements in the past 10 – 15 years. Revisions to Green and Ampt parameters and onsite retention reflect both physical changes that have already occurred but have also been revised to better reflect what is anticipated to occur due to future land development.

Revisions to routing reaches have also been made reflecting both physical improvements that have already taken place and revisions that the project team felt better reflect either existing conditions or conditions more consistent with anticipated future drainage infrastructure. Some revisions to hydrograph combinations and other minor revisions to the model structure were necessitated in the process.

A level pool hydrograph step representing the 43rd Avenue and Baseline Road regional basin was added to the new Stanley base HEC-1 model. Preliminary hydrology and hydraulics related to that basin had been developed independently by FCDMC engineering staff. However, there had not been a level pool routing step reflecting the 43rd Avenue basin in either the previous HDR or URS HEC-1 models.

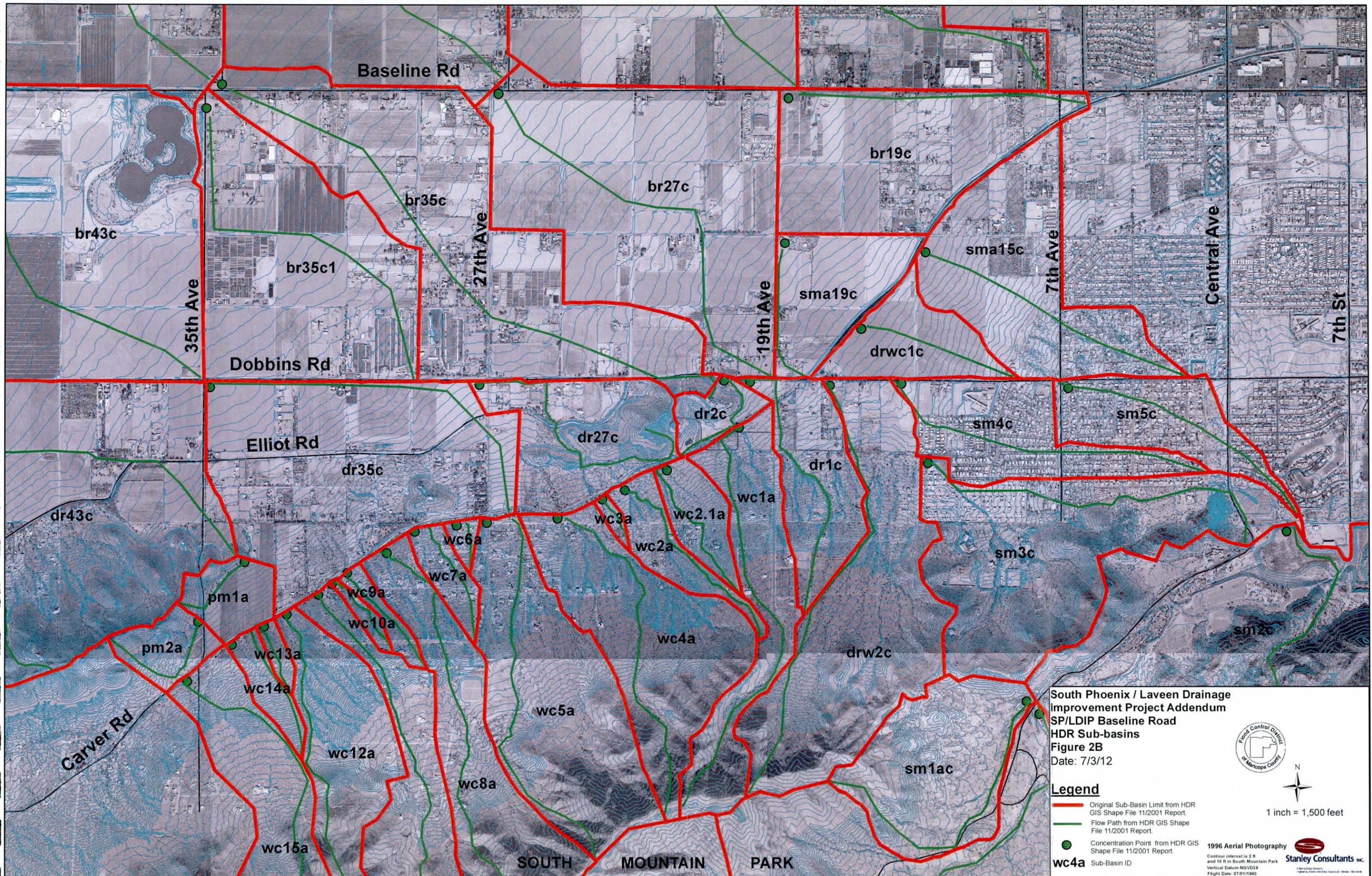
The 27th Avenue and South Mountain Avenue regional basin was also revised in the new Stanley base HEC-1. New elevation-storage-discharge data was developed for that basin based on Stanley's new layouts which were developed in support of the initial South Phoenix Two Basins Project design phase. The flow split step in the URS model representing the junction / diversion structure in the Baseline Road storm drain at 27th Avenue was eliminated and the HEC-1 model structure was reconfigured.

The 27th Avenue basin then behaved the same way in the new base HEC-1 model as what is represented in Table 7 of URS' Baseline Road storm drain design report from 2000. That is, it receives a total combined inflow from the Baseline Road storm drain, local direct surface flow from the south and southeast and flow from the future 27th Avenue storm drain (from the south).

The basin outlet corresponds to the 54" diameter orifice plate in the Baseline Road storm drain junction / diversion structure at 27th Avenue.

As part of the re-creation and update process leading to the project "base" HEC-1 model, Stanley prepared graphic figures to document the effort. These figures were created from GIS data provided by FCDMC and primarily focused on the sub-basins that are tributary to Baseline Road in the upper watershed. Figure 2B on the next page incorporates the older South Phoenix / Laveen Drainage Improvement Project sub-basin limits from the late 1990's with aerial photography from 1996 as the basis for revisions related to changes in drainage pattern due to land development.

Sub-basins contributing to the future 27th Avenue and Dobbins Road basin that were revised include WC2A, WC3A, WC4A, DR27C and DR35C. Sub-basins WC4A and WC2A were revised and WC3A was eliminated. Stanley revised sub-basin DR27C by splitting it into three sub-basins, DR27CS, DR27CW and DR27CN, to better reflect land development improvements and the Western Canal Lateral. Sub-basin DR35C was split into DR35CE and DR35CW to better reflect that portion of the sub-basin that would contribute to the future regional basin. The above revisions were also necessitated due to the location of the future regional basin having been moved to the southwest corner of 27th Avenue and Dobbins Road. This subject is covered in more detail in Section 7 of this report.



South Phoenix / Laveen Drainage Improvement Project Addendum
 SP/LDIP Baseline Road
 HDR Sub-basins
 Figure 2B
 Date: 7/3/12

- Legend**
- Original Sub-Basin Limit from HDR GIS Shape File 11/2001 Report.
 - Flow Path from HDR GIS Shape File 11/2001 Report.
 - Concentration Point from HDR GIS Shape File 11/2001 Report.
 - wc4a** Sub-Basin ID



1 inch = 1,500 feet

1996 Aerial Photography
 Contour interval is 2 ft and 10 ft in South Mountain Park
 Vertical Datum NGVD29
 Flight Date: 07/01/1990



Generally, sub-basins between Baseline Road and Dobbins Road from 19th Avenue to 35th Avenue were updated to account for existing and anticipated land use. The primary sub-basins involved include BR27N, BR35CW, and BR35C1. These updates included modifying the percent impervious area and initial abstraction values and the 100-year, 2-hour retention volumes. The sub-basin boundary between BR27S and BR27N was revised to better reflect existing condition.

Sub-basins BR27S, SMA15W, DRWC1C, and SMA19C which contribute runoff to the proposed 27th Avenue and South Mountain Avenue regional basin were updated. Sub-basin boundaries were revised for BR27S, DRWC1C and SMA15W. New sub-basin SMA7W was introduced in the area previously covered by sub-basin SMA15W. Sub-basin DRWC1C now corresponds to the area covered by the future City of Phoenix water treatment plant and existing fire station. The water treatment plant is covered in more detail in Section 4.4 of this report. Updates to sub-basin SMA19C included updates to land use based on development that has occurred and 100-year, 2-hour retention values.

Flow that was previously routed from approximately 15th Avenue west along South Mountain Avenue was revised and is now routed to the southwest along the Western canal through sub-basin DRWC1C to computation point CWC1CS, which is located at Dobbins Road just east of the Western Canal. This better reflects existing conditions and the Western Canal flood zone as discussed in Section 4.3 of this report. The flow split at 7th Avenue and Dobbins Road was also revised based on field survey and hydraulic analysis to better reflect existing surface flow hydraulics at the intersection and the residential subdivision improvements that have been constructed north and west of the intersection subsequent to the original HDR / URS models.

Two-foot contour topographic mapping dated July 1, 1990 (1929 vertical datum), soil and future land use information provided by FCDMC served as the basis for development of Green and Ampt loss and Clark unit hydrograph parameters in accordance with current procedures outlined in the FCDMC Hydrology Manual. Subdivision development drainage improvement plans and drainage reports, where available, were also used to estimate existing retention volumes. In sub-basin BR27N where the 27th Avenue and South Mountain Avenue regional basin is located, the basin itself is reflected in the total area of sub-basin BR27N but it is accounted for as providing retention for all of the 100-year, 24-hour rain that would fall directly on it.

Upon review of past hydrology models and documentation, Stanley developed an initial list of potential hydrologic anomalies that had been found in previous HEC-1 models. Some of these items related to the regional hydrology. It was anticipated that resolution could affect the base HEC-1 model and its peak discharges and peak times. It was also a concern that some of these anomalies might affect the performance of regional alternative drainage and flood control improvements that were conceptualized in prior studies. And finally, some of the anomalies were very minor and would not affect hydrology but were simple documentation issues like missing or misplaced notes on exhibits or other such elements.

The initial anomalies were reviewed and appropriate revisions were made to Stanley's base HEC-1 model. These revisions involved the following: HEC-1 routing reach RRB27C; the diversion flow note on one of the URS HEC-1 exhibits; the diversion and routing steps related to Baseline Road from 7th Avenue to 19th Avenue; the 27th Avenue and South Mountain Avenue basin storage routing mentioned previously and its location relative to Inflow; various minor sub-basin area discrepancies and adjustments to routing time steps. A more complete list and description of the initial hydrologic anomalies is included in Appendix A of this report. As mentioned, notes describing revisions are found in the various Stanley HEC-1 models.

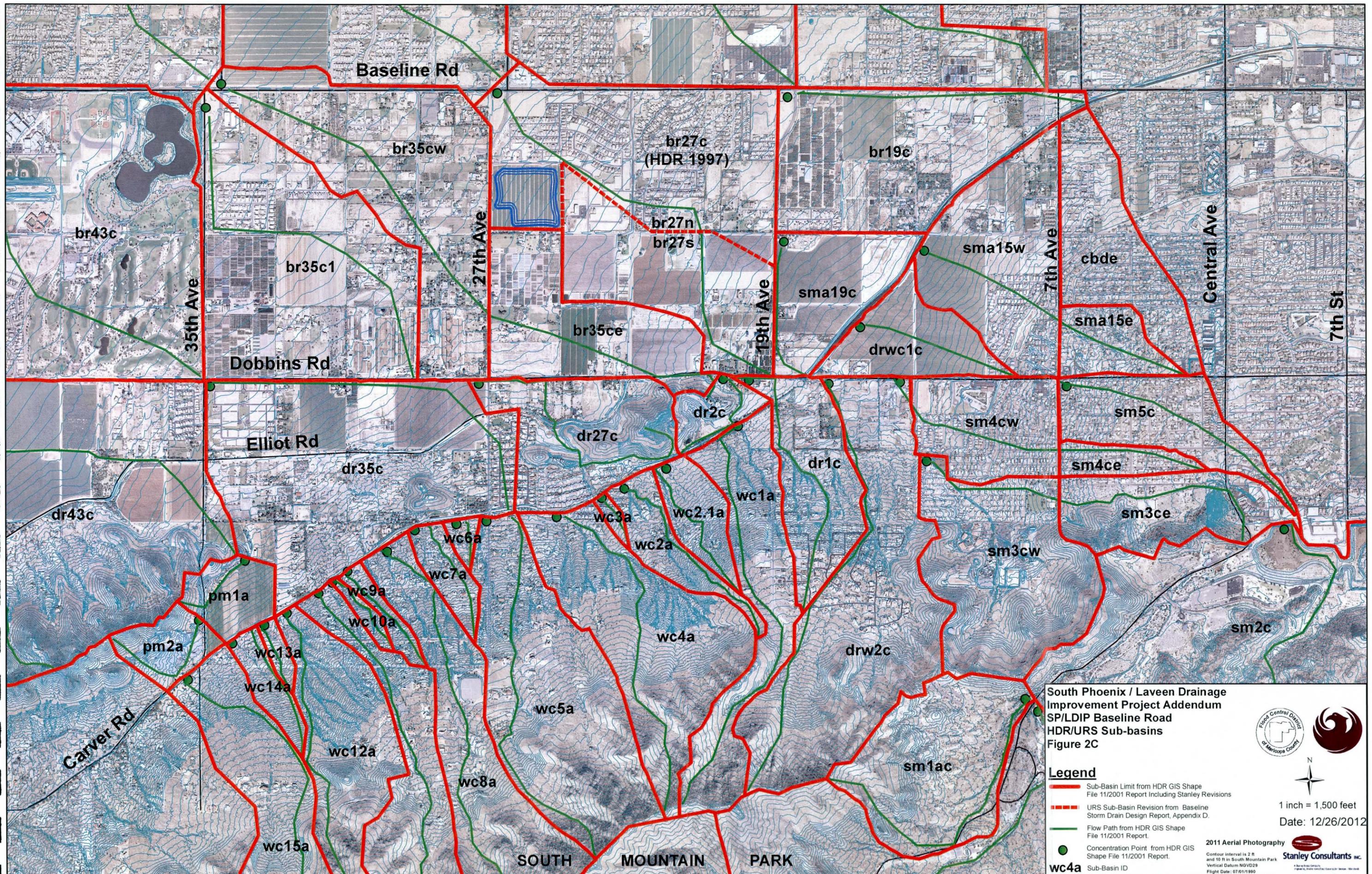
2.2 – Revisions to Base Regional Hydrology - General Approach and Methods

Revisions were made to the HEC-1 model in response to review comments received covering the initial hydrology and hydraulics report submittals for the South Phoenix / Laveen Drainage Improvement Project Addendum and also related to the update in model steps in the area around 27th Avenue and Dobbins, the area along Baseline Road between 19th Avenue and 35th Avenue and the area in the vicinity of 7th Avenue and Dobbins Road. The following general methodology was applied related to the regional hydrology base model revisions.

- Physical parameters such as revised sub-basin areas, length of the longest hydraulic flow path and watercourse slope were estimated using GIS software and 2 ft to 10 ft contours provided by the FCDMC GIS department.
- Estimated watercourse slope was adjusted using Figure 5.4 in '*Drainage Design Manual for Maricopa County, Hydrology 2009*'.
- Resistance coefficient (K_b) was selected for revised sub-basins, where applicable, using Table 5.3 in '*Design Manual for Maricopa County, Hydrology 2009*'.
- Rainfall losses were estimated using the Green and Ampt infiltration equation. The analysis with this method uses soil data with XKSAT values in the Soils.shp file provided by FCDMC (Soil book 651 for Maricopa County, Arizona, Central Part).
- FCD procedure for aerially averaging Green and Ampt parameter values with equation 4.4 in '*Design Manual for Maricopa County, Hydrology 2009*' was used to estimate XKSAT (see Table 4).
- Wetting front capillary suction (PSIF) and volumetric soil moisture deficit (DTHETA) at the start of rainfall were selected from Figure 4.3 using XKSAT values prior to adjusting for vegetation cover (see Table 4 in Appendix A). The DTHETA (Dry) graph was used.
- Representative land use in Maricopa County is based on Landuse.shp provided by FCD and 2011 aerial photography (see Table 5 in Appendix A). Table 4.2 in '*Design Manual for Maricopa County, Hydrology 2009*' was used to estimate IA, RTIMP, and percent vegetation cover. Judgment was employed on a case by case basis to reflect current percent vegetation and RTIMP.
- FCD procedure for adjusting XKSAT for vegetation cover was used to estimate vegetation correction factor (see Table 4 in Appendix A).
- Time of concentration (T_c) and storage coefficient (R) were estimated based on '*Drainage Design Manual for Maricopa County, Hydrology 2009*' equations 5.5 and 5.8 respectively. T_c was computed as a function of the average rainfall excess intensity found upon initial HEC-1 run with T_c and R set to zero.
- Retention volume was computed based on methodology found in excel file phxflu.xls provided by FCDMC. Retention volume is estimated using the following equation:
$$V \equiv AiC$$
- Routing steps (NSTPS) were estimated using equation 7.1 in '*Design Manual for Maricopa County, Hydrology 2009*'.

Tables, figures, HEC-1 output and other supporting data for this section are found in Appendix A of this report. In addition to what is described above, Stanley increased the number of computational time steps in HEC-1 models from 300 to 600 to better reflect the extended nature of receding hydrograph limbs associated with regional detention basins. Stanley left the original computation time step of 5 minutes as it was in the original South Phoenix / Laveen model.

Figure 2C on the following page illustrates the Baseline Road sub-basins circa 2000 with a 2011 aerial photo as backdrop.



South Phoenix / Laveen Drainage Improvement Project Addendum
SP/LDIP Baseline Road
HDR/URS Sub-basins
Figure 2C

Legend

- Sub-Basin Limit from HDR GIS Shape File 11/2001 Report Including Stanley Revisions
- - - URS Sub-Basin Revision from Baseline Storm Drain Design Report, Appendix D.
- Flow Path from HDR GIS Shape File 11/2001 Report.
- Concentration Point from HDR GIS Shape File 11/2001 Report.
- wc4a** Sub-Basin ID

2011 Aerial Photography
 Contour interval is 2 ft and 10 ft in South Mountain Park
 Vertical Datum NGVD29
 Flight Date: 07/01/1990

Stanley Consultants Inc.

1 inch = 1,500 feet
 Date: 12/26/2012

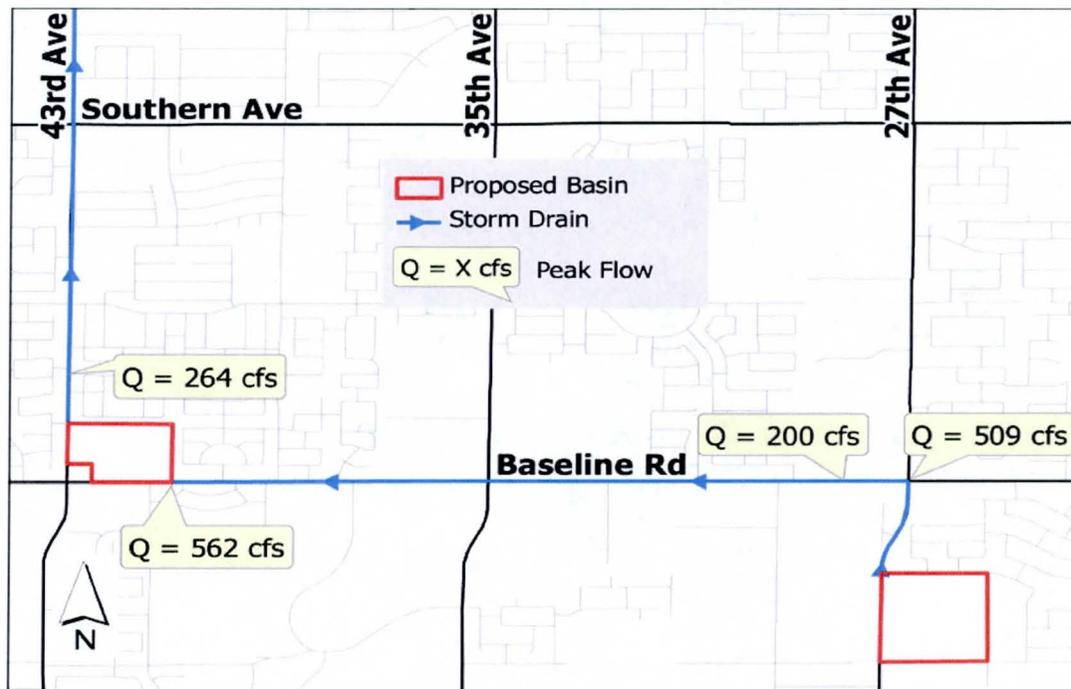


Figure 2D – Baseline Road Design Discharges Circa 2000

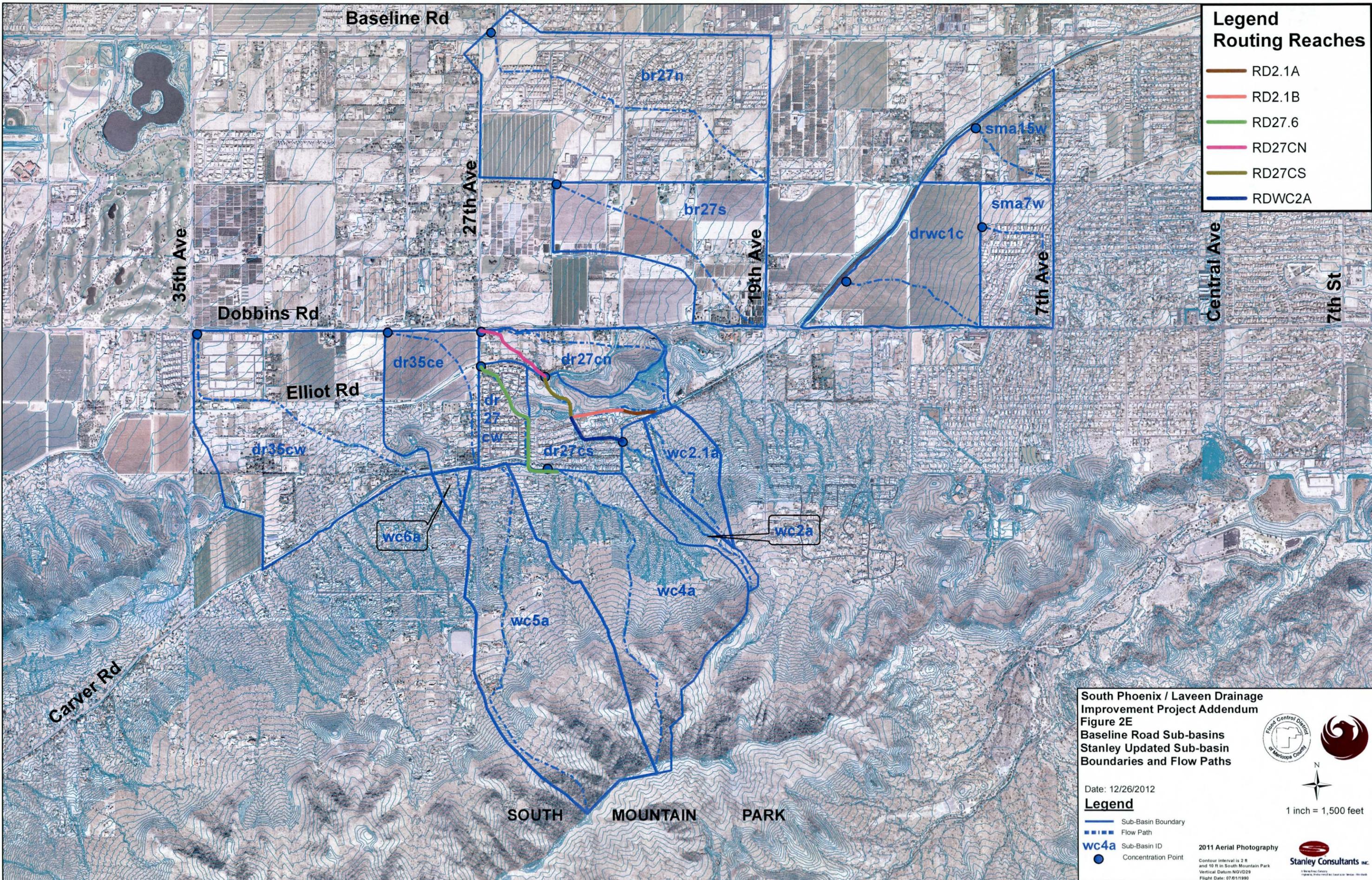
Figure 2D above illustrates design discharges for the Baseline Road storm drain, 43rd Avenue storm drain and the regional detention basins at 43rd Avenue and Baseline Road and at 27th Avenue and South Mountain Avenue based on cumulative documentation through the year 2000.

Figures 2E, 2F and 2G on the following pages illustrate the various revisions to sub-basin boundaries and flow paths made by Stanley, the soils data that was used to update Green and Ampt parameters and the resulting discharges and peak times from Stanley's updated base HEC-1 model. All of the supporting H & H data relative to the base HEC-1 model is found in Appendix A of this report.

Additional revisions to the HEC-1 model were made as the Two Basins Project moved closer to design and alternatives were evaluated involving future storm drain and detention basin improvements in the contributing watershed above the 27th Avenue and South Mountain Avenue regional basin.

Base revisions, for example, were made to the alternative models in the vicinity of 15th Avenue and Dobbins Road to better reflect the recently constructed local drainage improvements that were needed to protect the Arizona Humane Society facility from flooding. That facility is located at the southwest corner of 15th Avenue and Dobbins Road. These revisions involved a flow split that was introduced for sub-basin DRW2C and reach routing and combination steps along 15th Avenue south of Dobbins Road.

Also, near the end of the alternatives evaluation phase, sub-basin DR2C at the southwest corner of 19th Avenue and Dobbins Road was re-routed. Prior, it had always contributed to the concentration point at the intersection of 19th Avenue and Dobbins Road. But physically, it drains to Dobbins Road west of 19th Avenue, then through sub-basin BR35CE. Various other revisions were made to the HEC-1 model throughout the alternatives analysis phase to reflect the various future regional storm drain and detention basin improvements being considered. Evaluation of initial alternatives is discussed in more detail in Section 4 of this report.



Legend
Routing Reaches

- RD2.1A
- RD2.1B
- RD27.6
- RD27CN
- RD27CS
- RDWC2A

South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 2E
Baseline Road Sub-basins
Stanley Updated Sub-basin Boundaries and Flow Paths

Date: 12/26/2012

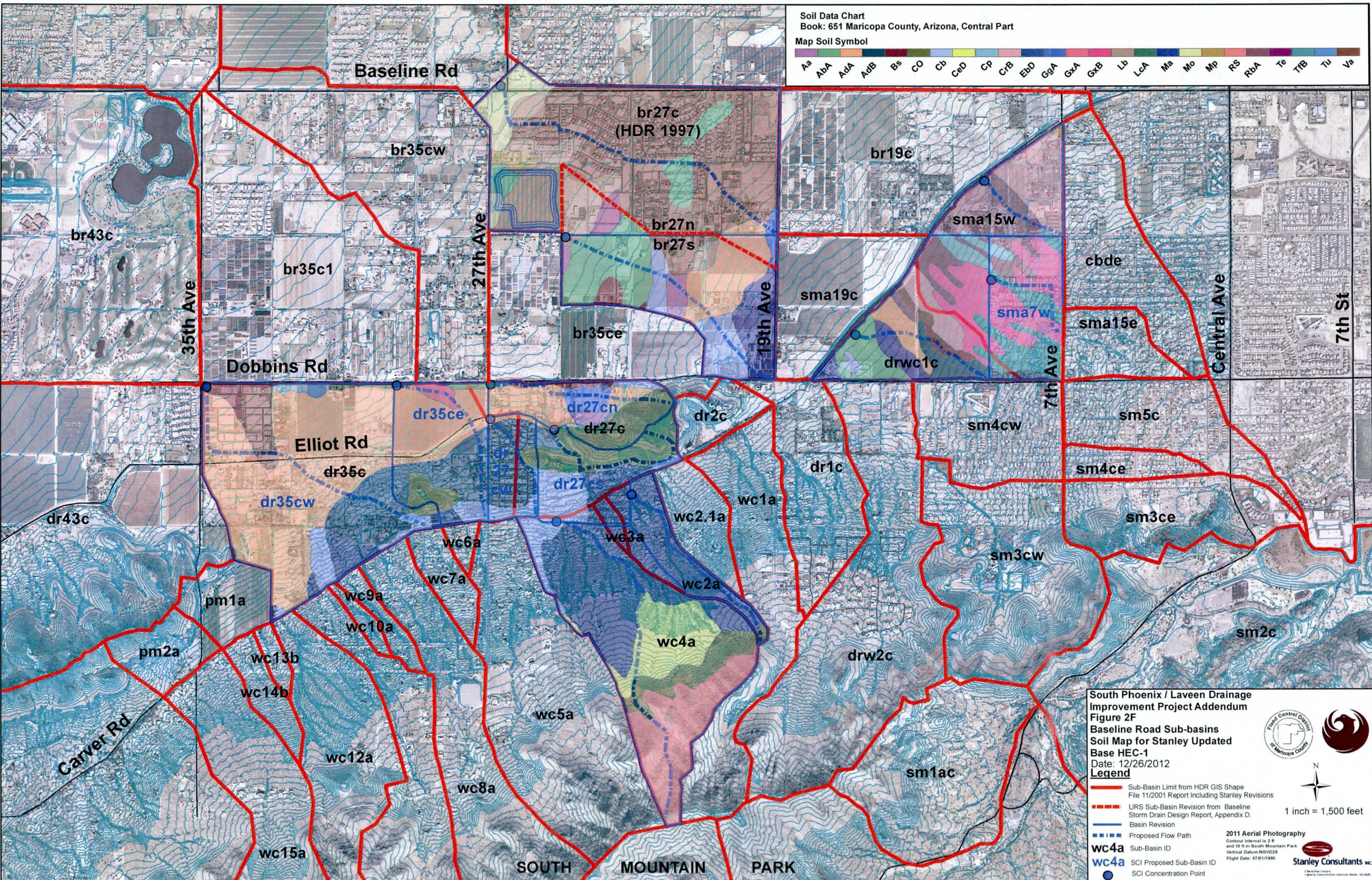
Legend

- Sub-Basin Boundary
- Flow Path
- Sub-Basin ID
- Concentration Point

1 inch = 1,500 feet

2011 Aerial Photography
 Contour Interval is 2 ft and 10 ft in South Mountain Park
 Vertical Datum NGVD29
 Flight Date: 07/01/1990

Stanley Consultants inc.



Soil Data Chart
 Book: 651 Maricopa County, Arizona, Central Part

Map Soil Symbol



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 2F
Baseline Road Sub-basins
Soil Map for Stanley Updated
Base HEC-1
 Date: 12/26/2012

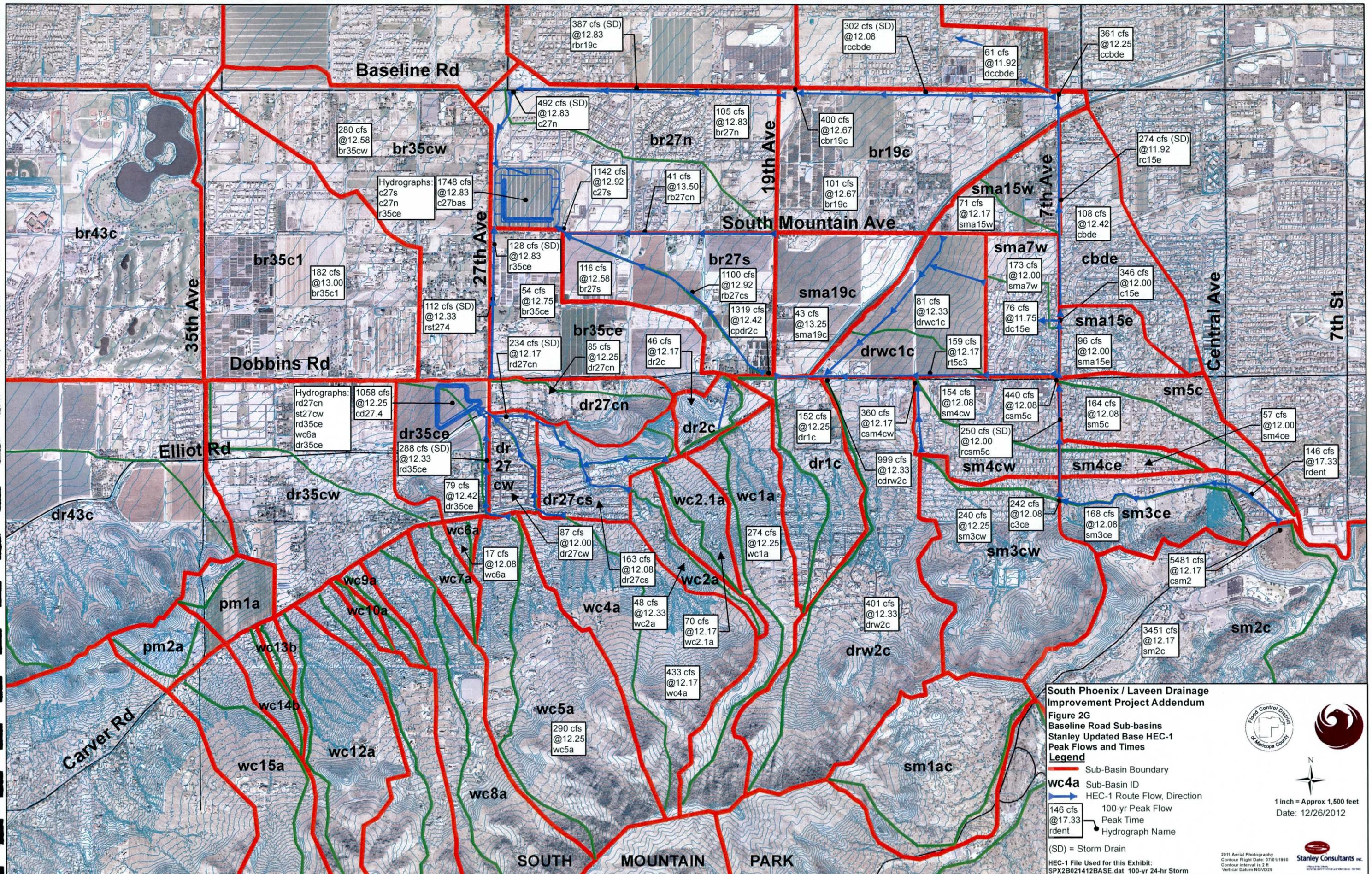
Legend

- Sub-Basin Limit from HDR GIS Shape File 11/2001 Report including Stanley Revisions
- - - URS Sub-Basin Revision from Baseline Storm Drain Design Report, Appendix D.
- Basin Revision
- - - Proposed Flow Path
- Sub-Basin ID
- SCI Proposed Sub-Basin ID
- SCI Concentration Point

2011 Aerial Photography
 Contour interval is 2 ft and 10 ft in South Mountain Park
 Vertical Datum NGVD29
 Flight Date: 07/01/1990

1 inch = 1,500 feet

Stanley Consultants Inc.



2.3 – Aguila Golf Course Regional Detention Basin

The Aguila Golf Course is an existing City of Phoenix municipal golf course located northwest of the intersection of 35th Avenue and Dobbins Road. It occupies roughly the southeast quarter of Section 3, Township 1 South, Range 2 East. To the north is the existing City of Phoenix Cesar Chavez Park and to the east are residential subdivisions. The golf course was designed in 1998 from then recent concepts developed from the South Phoenix / Laveen Drainage Improvement Project.

As a municipal Golf course, there was an opportunity to incorporate regional stormwater storage in its grading design. The basic concept was to collect regional flows from the southeast and direct them into the golf course where the flow would be attenuated and discharged at a much reduced flow rate to the north. This would control a significant portion of the regional drainage and reduce the flows contributing to the (then future) Baseline Road storm drain.

Construction drawings and a stormwater pollution prevention plan for the golf course are included in the data collection report for the South Phoenix Two Basins Project under separate cover. The golf course was designed as a system of smaller individual detention basins that would operate in series. Flow would enter from the south along Dobbins Road west of 35th Avenue, pass through the basins from one to another and outfall to a 36" diameter storm drain near the 39th Avenue alignment southwest of the golf course club house. Individual golf course detention basins are inter-connected by low-level drain pipes and high level overflow spillways.

The peak inflow to the golf course in the regional HEC-1 model is 1,374 cfs corresponding to hydrograph step 'CD35.2'. The basin routing step is hydrograph 'STG' with KM note "dummy basin to simulate future golf course". It is a simple diversion step as opposed to a level pool routing step and has a limiting flow of 50 cfs to the north. The outfall from the golf course to Baseline Road in HEC-1 is hydrograph step RSTG39 representing 7,920 feet of 5 foot diameter storm drain pipe.

Some form of collection system is implied by the HEC-1 model for flow from the contributing sub-basins south of Dobbins Road, east of 35th Avenue. Some form of future storm drain in Dobbins Road or open channel conveyance along the south side of Dobbins Road from 27th Avenue to 35th Avenue would be anticipated based on the regional sub-basin boundaries.

There is an existing open channel along the south and west perimeter of the residential subdivision at the southeast corner of 35th Avenue and Dobbins Road. This channel is substantial in size and would appear to serve as a portion of a regional collection / conveyance system. The channel has a dead end outfall at the intersection of 35th Avenue and Dobbins Road. There does not appear to be any direct conveyance from the channel to the Aguila Golf Course. There are existing irrigation laterals just north of Dobbins Road west of 35th Avenue which would affect how existing flow might pass from Dobbins Road into the golf course.

A field reconnaissance of the golf course indicates it appears to have the basic multi-basin storage represented on the grading plan. The golf course plan does not appear to include a formal inlet from the Dobbins Road corridor but the 36" diameter storm drain outfall to Baseline Road is part of the civil drawings. A formal inlet for regional drainage from the south may have been envisioned as a future separate project. The Baseline Road storm drain plans prepared by consultant URS includes a 36" diameter storm drain lateral connection at 39th Avenue to the terminal manhole of the storm drain from the golf course.

The inlet end of the 36" storm drain at the golf course has been plugged. It is assumed that this was done when the golf course and outfall storm drain were initially constructed because the storm drain in Baseline Road, which ultimately provides the outfall for the golf course, did not exist at the time and would not be constructed for perhaps two or three more years. The plug appears to be a MAG Standard Detail 427 or similar type.

There is presently no apparent means of collecting and conveying offsite flow from the south into golf course. For most frequent or moderate storm events, the golf course is probably only subject to onsite runoff. Since the outlet pipe is plugged, it appears that onsite golf course runoff is currently disposed of only through evaporation and percolation. This situation has been present for over ten years and does not appear to have created any issues. However, now that the Baseline Road storm drain has been constructed, the storm drain plug at the inlet could probably be removed. If this were done, some form of access barrier / debris grate would be appropriate at the inlet.

The project team reviewed the HEC-1 diversion step that represents the Aguila Golf Course and also the amount of storage that is in the golf course relative to the potential inflow hydrograph volume. The golf course volume is greater than the potential inflow volume. Although the diversion step in HEC-1 may not properly account for the continuity of volume routed through the golf course, the outflow peak discharge and peak time in the model was thought to be a reasonable approximation for the purpose of downstream regional infrastructure design.

A StormCAD model was prepared by Stanley Consultants for the 36" outlet storm drain from the Aguila Golf Course in the latter stages of design for the 43rd Avenue and Baseline Road regional basin. This was to confirm the flow limit of 50 cfs that was in the original HEC-1 regional model. The result of the StormCAD model indicates that 50 cfs is a reasonable approximation.

The StormCAD model electronic file is included in Appendix A of this addendum along with the storm drain plan and profile sheets from the original 1998 golf course improvement plans. The complete golf course improvement plans are included in the Two Basins data collection report under separate cover.

Section 3 – Base Regional Hydraulics

3.1 – Base Hydraulics Overview

The primary base hydraulic analysis for this project involves the existing regional storm drains in Baseline Road and in 43rd Avenue as they relate to the designs of the new regional detention basins at 27th Avenue and South Mountain Avenue and at 43rd Avenue and Baseline Road. Preliminary storm drain hydraulic analysis was also performed for proposed future storm drains that would collect and convey flow to the 27th Avenue and South Mountain Avenue regional basin and to other future regional detention basins that were investigated to complete the regional function and meet the original South Phoenix / Laveen Drainage Improvement Project design objectives. These future regional detention basin and storm drain facilities and their alternatives analyses are discussed in more detail in later sections of this report.

The hydraulic analyses that were done in the period from around 1998 to 2000 in support of the original improvement designs are documented to varying degrees in reports found in the data collection phase of the South Phoenix Two Basins Project. There were no electronic files found during the data collection phase corresponding to any of the previous hydraulic analyses.

The previous hydraulics for the 43rd Avenue storm drain was done using StormCAD by Flood Control District of Maricopa County in-house engineering staff. The previous hydraulic analysis for the Baseline Road storm drain was done by consultant URS for MCDOT and the City of Phoenix as part of the improvement plans for Baseline Road.

The results of URS' overall analysis are presented in Table 4 - "Storm Drain Hydraulic Data" from their Storm Drain Design Report dated May 1, 2000. Since no electronic files were found, it is not known what methods, models and approaches had been used in support of the data presented in that table. An unsteady flow model was developed by URS to analyze the hydrologic and hydraulic relation between the Baseline Road storm drain and the (then future) regional basin at 27th Avenue and South Mountain Avenue. This unsteady analysis will be discussed in more detail in Sub-section 3.2. The URS unsteady model was done using EPA SWMM Version 4.31.

The original authorized scope of work under contract FCD2011C008 included re-creating the hydraulic analysis for the existing storm drain trunk lines in 43rd Avenue from its outfall at the Salt River south to the new regional detention basin at 43rd Avenue and Baseline Road and for the existing Baseline Road storm drain from its outfall at the 43rd Avenue and Baseline Road regional basin east to 7th Avenue. The scope also included hydraulic analysis of the future storm drain in 27th Avenue from the new regional basin at 27th Avenue and South Mountain Avenue south to the future regional basin at 27th Avenue and Dobbins Road. The original scope for the Two Basins Project also included hydraulic analysis of the future storm drain extension in 7th Avenue south to a point about ½ mile south of Dobbins Road (near Olney Avenue).

The basic elevations, profile and geometry for the SWMM model were developed based on as-builts. Baseline Road improvement plans prepared by consultant URS had developed based on Metric units instead of English units and also utilized 1929 vertical datum. 43rd Avenue improvements were also based on 1929 vertical datum. Once the base hydraulic models were

developed, they were converted to 1988 vertical datum using a 'VERTCON' conversion of +2.10 feet (NGVD 1929 + 2.10' = NAVD 1988) so they would be directly compatible with the design phase of the South Phoenix Two Basins Project.

The storm drain inlet designs for Baseline Road were originally documented by URS in terms of flow spread and dry lane criteria based typically on the hydrology associated with the roadway as contributing area without regard to the offsite regional flows. The design flows for the storm drain trunk lines themselves are generally based on the regional hydrology but it is not exactly clear what maximum hydraulic grade line profile target was being used along with the regional flow rate. For storm drain trunk lines having a limited design discharge, i.e., not recognizing offsite flows, the target hydraulic grade line would typically be no higher than 6 inches below the catch basin inlet to ensure no hydraulic conflict between inlet intercept and storm drain conveyance.

For a similar reason, the SWMM model for the Baseline Road storm drain design targeted a hydraulic grade line no higher than the catch basin for the offsite collector ditch on the south side of Baseline Road near 27th Avenue. However, beyond this, a clear relationship in the original designs could not be established between the capacity of catch basin inlets (and their respective laterals) to receive regional flows and the corresponding storm drain trunk line design flow and target hydraulic grade line. These issues required analysis and documentation for the SP/LDIP Addendum and for the establishment of project specific design criteria. This analysis and documentation is discussed in more detail in later sub-sections.

3.2 – Need for Unsteady Flow Analysis

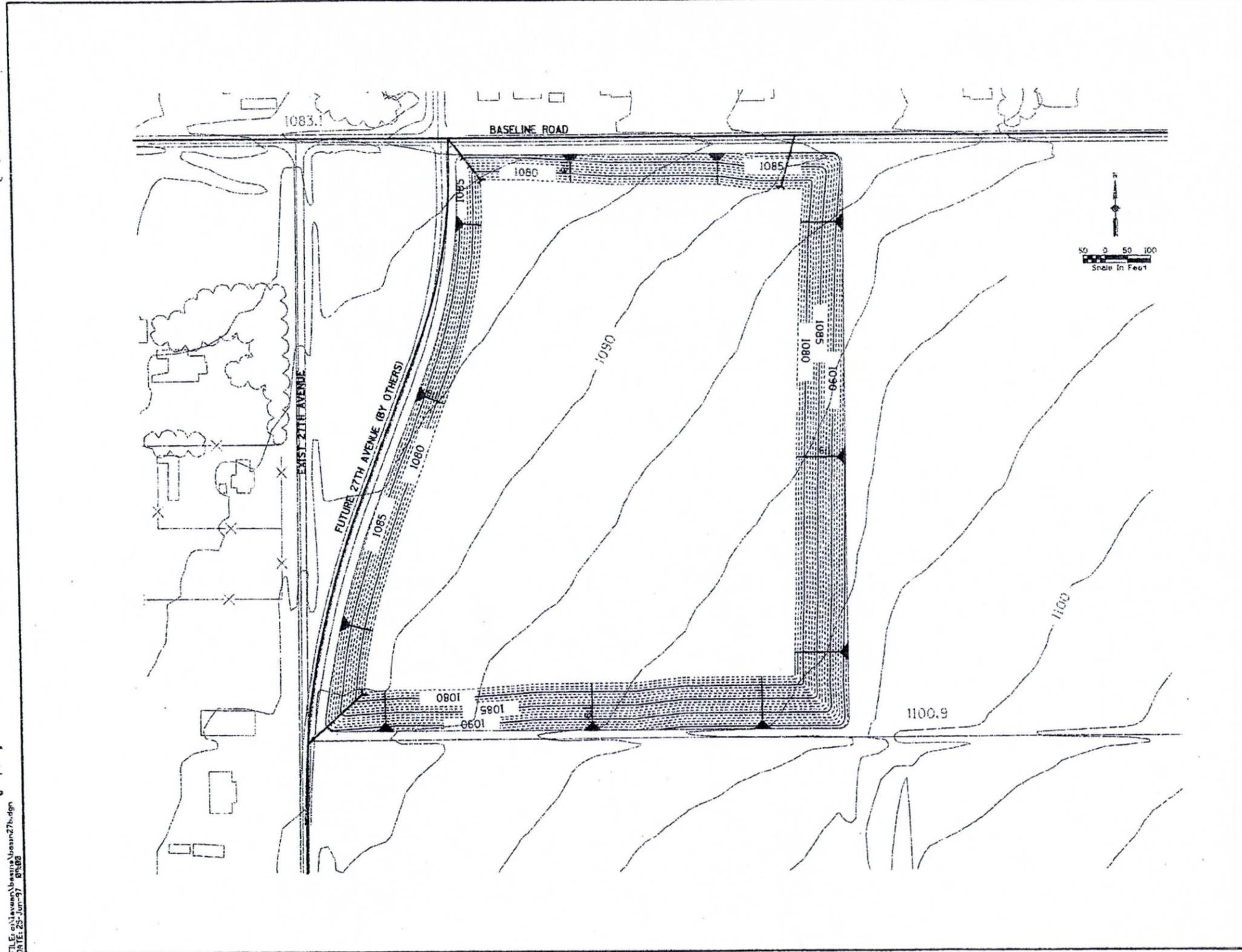
There is an unsteady flow condition or “surge function” involving the Baseline Road and 27th Avenue storm drains and the new regional detention basin at 27th Avenue and South Mountain Avenue. This dynamic hydrologic / hydraulic relationship results primarily from the location of the new regional 27th Avenue basin relative to the storm drain in Baseline Road. In the original South Phoenix / Laveen Drainage Improvement Project, the new 27th Avenue regional basin was located immediately southeast of the intersection of Baseline Road and 27th Avenue. It was needed to receive and attenuate a portion of the flow in the Baseline Road storm drain to achieve an optimized flow reduction in the Baseline Road storm drain west of (downstream from) 27th Avenue.

In that concept, the new 27th Avenue regional basin was “off line” to the Baseline Road storm drain. It would receive a portion of the flow in the Baseline Road storm drain via a short turnout storm drain at the basin’s northeast corner. The new regional basin would also receive direct surface flows from the area to the southeast. This aspect made the basin “on-line” to local flows. The portion of Baseline Road storm drain flow combined with the direct local inflow would be temporarily stored and attenuated and the reduced flow rate would then discharge through an outlet pipe to the Baseline Road storm drain just west of 27th Avenue. About one quarter of the total peak flow going into the new 27th Avenue regional basin would be from the Baseline Road storm drain while the other approximately three quarters would contribute directly from local surface flows approaching from the southeast.

The South Phoenix / Laveen Drainage Improvement Project included concept level plans. The concept storm drain plan and profile for the Baseline Road storm drain incorporated a significant drop in the storm drain profile at 27th Avenue. This drop enabled the outflow from the regional basin at 27th Avenue and Baseline Road, which had its outfall to the Baseline Road storm drain downstream from the drop at the intersection with 27th Avenue, to be more or less independent from inflow into the basin from the Baseline Road storm drain east of the intersection and combined local drainage from the southeast. The originally proposed system was thus capable of being reasonably modeled through conventional HEC-1 hydrologic approach.

As mentioned previously, sometime in the late 1990’s, the location of the new 27th Avenue regional basin was moved to the south about ¼ mile to a 38 acre parcel on the east side of 27th Avenue between Gary Way to the north and South Mountain Avenue to the south. That put the basin slightly up-gradient from the Baseline Road storm drain because the ground elevations there are higher than at the original site. A storm drain was needed in 27th Avenue to convey flow from the Baseline Road storm drain south to the new 27th Avenue regional basin which was also still intended to receive the majority of its inflow from direct local runoff from the southeast. The storm drain in 27th Avenue would also serve as the outflow pipe from the new regional basin that would discharge post-peak flow back to the Baseline Road storm drain. The 27th Avenue storm drain profile rises about 2 feet in elevation from Baseline Road to Gary Way.

Figures 3.1A and 3.1B on the following pages show the original concept location and layout for the 27th Avenue regional basin from the South Phoenix / Laveen Drainage Improvement Project from 1997 and the basin location and layout per the Baseline Road improvement plans from 2000. The basin site ¼ mile south of Baseline Road is the current location per the South Phoenix Two Basins Project.



FILE: c:\lavene\basins\basin27b.dgn
DATE: 25-Jun-97 09:00

REMOVE

CONSTRUCT

DETENTION BASIN DATA
 AREA AT MAX WSEL = 24.2 ACRES
 STORAGE VOLUME = 135.1 ACRE-FEET
 OUTFLOW = 45 CUFT/SEC
 MINIMUM ELEVATION = 1077.00
 MAXIMUM ELEVATION = 1097.00
 MAXIMUM WSEL = 1083.00

NO.	REVISION	BY	DATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION			
SOUTH PHOENIX/LAVEEN DRAINAGE IMPROVEMENT PROJECT PROJECT NO. 94-14			
		BY	DATE
	DESIGNED	S. MILLER	6/97
	DRAWN	K. JACOBSON	6/97
	CHECKED	M. HEATON	6/97
			
BASIN SITE PLAN			SHEET OF
27TH AVE AND BASELINE RD			55 58

TRACS NO. TE -

Figure 3.1A

BASELINE ROAD
51st AVENUE TO 7th AVENUE
PHASE I
MARICOPA COUNTY

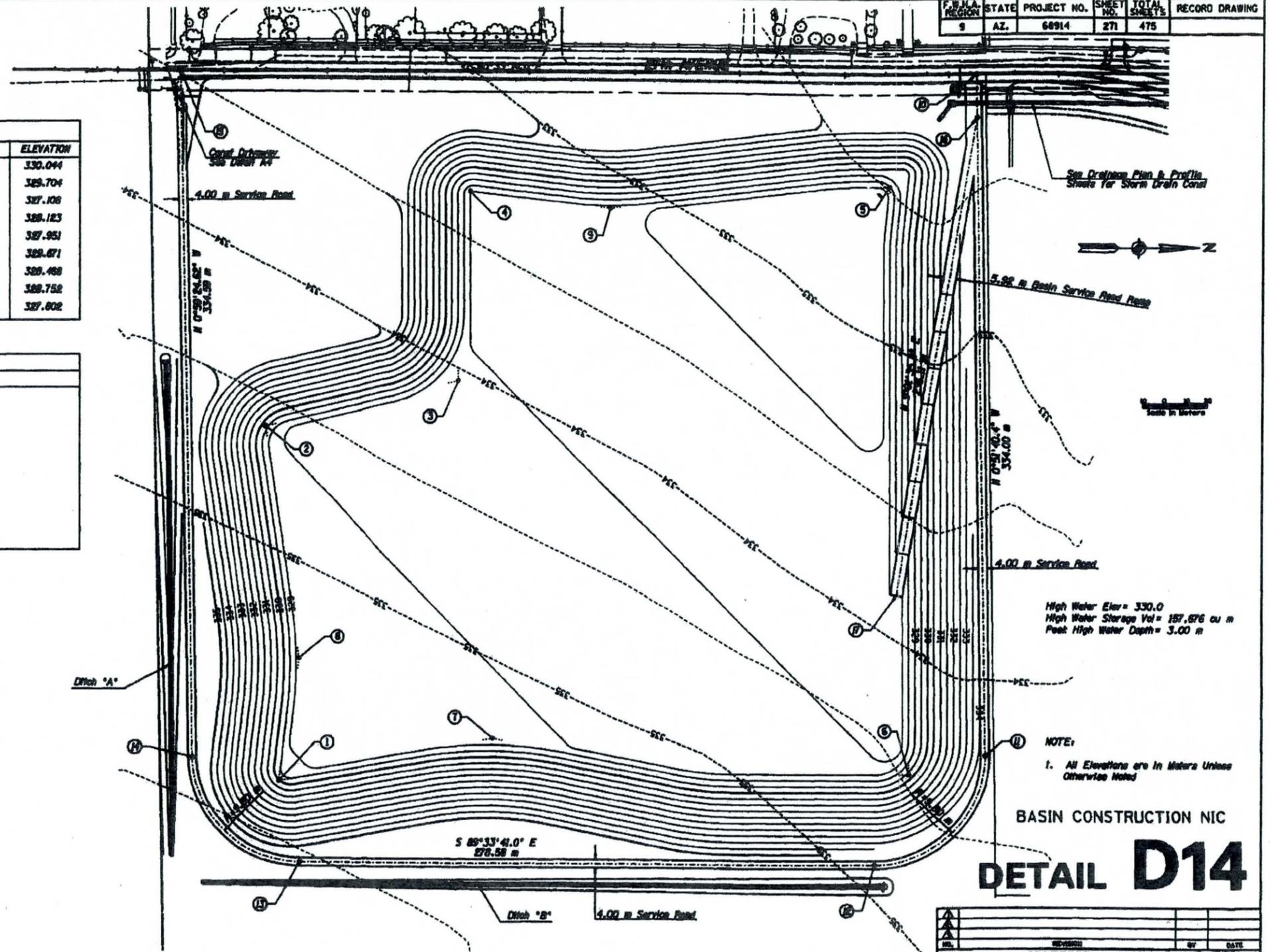
F.U.M.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	68914	271	475	

BASIN LAYOUT COORDINATES			
NORTHING	EASTING	DESCRIPTION	ELEVATION
① 882806.430	193013.974	PI 329.5 Contour (5.0 m R)	330.044
② 882806.451	194040.575	PI 329.0 Contour (11.7 m R)	329.704
③ 882806.435	194819.981	PI 329.0 Contour (40.8 m R)	327.108
④ 882806.435	194728.681	PI 329.0 Contour (1.4 m R)	328.123
⑤ 863189.225	194725.274	PI 327.5 Contour (5.5 m R)	327.951
⑥ 863206.197	193012.483	PI 329.5 Contour (18.6 m R)	329.671
⑦ 863208.72	194883.13	PI 329.0 Contour (182.8 m R)	329.488
⑧ 882912.408	194863.989	PI 329.0 Contour (180.9 m R)	329.752
⑨ 863085.843	194735.480	PI 329.0 Contour (152.2 m R)	327.802

SERVICE ROAD LAYOUT COORDINATES		
NORTHING	EASTING	DESCRIPTION
⑩ 883240.340	194881.793	Begin Service Road Sta 0+000.00 = 27th Avenue Sta 9+582.67
⑪ 883243.886	193003.708	PC Sta 3+33.00
⑫ 883181.044	193056.890	PT Sta 4+15.86
⑬ 882912.487	193052.911	PC Sta 6+94.435
⑭ 882881.116	193001.586	PT Sta 7+74.82
⑮ 882886.795	194867.027	End Service Road Sta 11+09.40 = 27th Avenue Sta 9+179.54
⑯ 883240.340	193001.586	Begin Basin Service Road Ramp
⑰ 883202.278	194881.793	End Basin Service Road Ramp

GENERAL NOTES

- All Basin Slopes shall be graded at 1:6 (Vertical to Horizontal)
- Basin Access Road to be Constructed of 100 mm Thick ABC



High Water Elev = 330.0
High Water Storage Vol = 157.576 cu m
Peak High Water Depth = 3.00 m

NOTE:
1. All Elevations are in Meters Unless Otherwise Noted

BASIN CONSTRUCTION NIC

DETAIL D14



PROFILE "A"



PROFILE "B"

REVISION		BY	DATE
MARBOPA COUNTY DEPARTMENT OF TRANSPORTATION ENGINEERING DIVISION			
BASELINE ROAD 51st AVENUE TO 7th AVENUE PROJECT NO. 68914 PHASE I			
DESIGNED	C. Mexas	07/31/00	
DRAWN	L. Wagner	07/31/00	
CHECKED	J. Martin	07/31/00	
URS Greiner Woodward Clyde			
27th AVENUE DETENTION BASIN			SHEET OF 1

A combination flow split / junction structure was needed in the Baseline Road storm drain at the intersection with 27th Avenue. This structure has a restrictor plate, or orifice, at its downstream (west) face. The 27th Avenue storm drain connects to the south side of this structure. The orifice plate creates a surge condition, or increased hydraulic grade, upstream (east) in the Baseline Road storm drain and south in the 27th Avenue storm drain. At the same time, the orifice acts as a restriction for flow in the downstream direction which allows for a reduction in storm drain from 84" diameter east of 27th Avenue to 66" diameter west of 27th Avenue. The orifice plate in the junction structure is 54" in diameter and the Baseline Road storm drain just east of the intersection is 84" diameter.

The increased hydraulic grade created by the orifice plate and smaller diameter storm drain to the west helps create the hydraulic gradient necessary to push flows south into the new 27th Avenue regional basin against the hydraulic grade in the basin from direct local flows entering and concurrently filling the basin from the south. In a sense, these flows are hydrologically competing for space in the new 27th Avenue regional basin. This was later found to not be an issue because the storage volume provided in the basin in final design was enough to accommodate the condition. In contrast to the original South Phoenix / Laveen Drainage Improvement Project, the Baseline Road storm drain, as designed and constructed, has a relatively uniform slope through the intersection at 27th Avenue. There is no significant drop in the storm drain profile which helped isolate the hydraulic function upstream from hydraulics downstream.

At the same time that flow is moving downstream in the Baseline Road storm drain from 27th Avenue, there is local flow directly entering the storm drain from areas to the south. The hydraulic grade line from the combined flow in the Baseline Road storm drain downstream from 27th Avenue also, to an extent, influences the surge function and hydraulics in the upstream direction. This concurrent combination of inflow, surge and on-line / off-line storage makes for a truly dynamic and unsteady flow condition that cannot be modeled by conventional hydrology and hydraulic tools such as HEC-1 and StormCAD.

3.3 - SWMM Model Assumptions and Approach

EPA's SWMM version 5.0 was used to develop the unsteady flow model for the project. This was due to the limitations and difficulties of modeling the storm drain and detention basin system using HEC-RAS with "lid" for unsteady conditions as mentioned in Sub-section 3.1. Model instability can be an issue with SWMM as it was with HEC-RAS. However, those issues were not encountered with the SWMM model for this project.

The model that was developed for the project has a downstream limit of the Salt River along 43rd Avenue and an upstream limit of 7th Avenue along Baseline Road. The model also includes the full storm drain along 27th Avenue, the proposed 27th Avenue and South Mountain Avenue basin, the proposed 43rd Avenue and Baseline Road basin, and the existing basin at 43rd Avenue and Southern Avenue. Similar to the HEC-RAS and the StormCAD models, as-built information was utilized to develop the model.

The as-built information consisted of URS plans for the Baseline Road and 27th Avenue section and plans developed by the District for the storm drain along 43rd Avenue. Invert elevations along with the pipe lengths were obtained from the as-built information. As previously mentioned, both as-built plan sets were based on a 1929 vertical datum and were converted to the project 1988 vertical datum by adding 2.1' to the elevations.

The storm drain system involved non-typical hydraulic structures that were included in the model. Included among these structures is a modified box culvert structure for the water transmission line crossing immediately west of 27th Avenue along Baseline Road. A 7.5' wide by 4.75' high box culvert was used for the transition sections of the structure and a 7.5' wide by 3' high box culvert was modeled between the transitions.

Two sumps were also modeled along 43rd Avenue. The first sump is located just south of Southern Avenue where the storm drain crosses under a large diameter (66") sewer line. The second sump is located at Broadway Road and 43rd Avenue. It was created by the storm drain being too deep to be able to outfall to the Salt River channel proper so the outfall is to the edge of the Salt River floodplain just north of Broadway Road.

Both sumps include pump stations to evacuate the water that will not gravity drain. The pumps have been included in the SWMM model. Orifice plates have been modeled at the outlet for the proposed basin at 43rd Avenue and Baseline Road and at the junction structure at the intersection of 27th Avenue and Baseline Road. A Manning's "n" value of 0.014 was used for the storm drain.

The model was run utilizing the 100-year, 24-hour HEC-1 hydrology with hydrographs input at several locations. The following list details the location and source of each input hydrograph.

- 7th Avenue and Baseline Road (RCCBDE);
- Between 7th Avenue and 19th Avenue along Baseline Road (BR19C split between 11 locations);
- Between 19th Avenue and 27th Avenue (BR27N split between 8 locations);
- At the proposed 27th Avenue basin;
- Between 27th Avenue and 35th Avenue (BR35CW split between 9 locations);

- 35th Avenue and Baseline Road (BR35C1);
- Between 43rd Avenue and 35th Avenue (BR43C split between 5 locations);
- 39th Avenue and Baseline Road (RSTG39);
- 43rd Avenue and Baseline Road (RB43C2);
- 43rd Avenue and Southern Avenue (RAV43B)

Head loss coefficients were entered at manholes and structures based on values obtained from the FCDMC Hydraulics manual. Head loss coefficients for the contraction from the 84" pipe upstream of the junction structure to the 54" pipe and for the expansion of the 54" pipe to the 66" pipe downstream of the junction structure were estimated based on Tables 4.4 and 4.3b of the manual, respectively. Expansion and contraction coefficients were also entered at four locations for the box culvert structure crossing of the water transmission main. Head loss coefficients for the straight-through manholes were entered based on equation 4.11 from the FCDMC Hydraulics manual.

The base hydraulic model is for the trunk line only and does not include storm drain laterals or catch basin inlets. However, rim elevations for the manholes along Baseline Road were set at the lip of gutter elevation of the adjacent low roadway catch basins which are typically less than 20' upstream or downstream of the trunk line manholes. Catch basin inlet information was not provided for inlets along 43rd Avenue. Therefore, manholes were set at the rim elevations shown on the as-built plans.

3.4 – Unsteady Flow Model Summary

The following items are a summary of the hydraulic observations and conclusions regarding SWMM modeling for this project.

- A re-creation of URS' SWMM model or a SWMM model that uses the URS SWMM model hydrology was not possible because electronic files corresponding to their input and hydrographs were not available.
- It does not appear that the 54" orifice plate is modeled in the URS SWMM model at 27th Avenue. The model also has a 354 foot section of 60" pipe modeled west of 27th Avenue in lieu of the orifice plate and box culvert structure for the water transmission main crossing mentioned previously.
- It does not appear that the URS Table 4 hydraulic summary included head losses for the box culvert structure crossing of the water transmission main or for the junction structure at 27th Avenue and Baseline Road.
- Based on the output provided from the URS SWMM model, it appears that the model utilized flows that are lower than the SP/LDIP Addendum base HEC-1 model flows.
- A SWMM model with the SP/LDIP Addendum base 100-year hydrology produced a hydraulic grade line above allowable elevations along Baseline Road.
- A SWMM model was prepared for each alternative (alternatives are summarized in Section 4 of this report) and did produce some minor flooding at nodes along Baseline Road. However, the majority of the flooding is very short in duration and either doesn't produce a measurable volume per the program's tolerances or produces a very small volume.

There were StormCAD models created for the storm drain in 27th Avenue during the early phase of the SWMM unsteady analysis to try and verify an element of the surge function involving the Baseline Road storm drain and the 27th Avenue and South Mountain Avenue regional basin. One StormCAD model was set up with the flow direction originating at Baseline Road and flowing south to the 27th Avenue regional basin. The other model was created with the flow direction originating at the 27th Avenue regional basin and flowing north to Baseline Road.

The model that flows south to the basin shows that the storm drain in 27th Avenue has the capacity to convey approximately 165 cfs prior to the HGL rising above manhole rim elevations along 27th Avenue. The model that originates at the basin and flows north was run with a flow rate of 207 cfs. That flow matched the (then current) output shown in the SP/LDIP Addendum HEC-1 model.

The model run from the north to south capacity of 165 cfs exceeds the peak flow reported in the URS SWMM model for the system running in that direction. The model run from south to north showed that the storm drain had the capacity to convey the discharge of 207 cfs from the (then current) HEC-1 model.

Tables, figures, model output and other supporting data for this section are found in Appendix B of this report.

3.5 – Baseline Road Inlet Capacity

An overview analysis of catch basin inlets along Baseline Road was prepared for this study to determine if they have the capacity to intercept the 100-year runoff that reaches Baseline Road during the regional storm event. The existing inlet system includes type M catch basins, per City of Phoenix detail P1569-1, along the north and south curb line as well as a rectangular orifice type inlet in the back side of several catch basins along the south side of Baseline Road that are fed by small collector ditches that parallel the roadway.

The curb opening inlet catch basins were analyzed in one mile segments where an average catch basin size and roadway slope was identified between each major mile street. The size was reduced by 20% to account for a clogging factor. The composite catch basin was then modeled in an at-grade condition at a depth of 6" (top of curb) and a total inlet capacity was calculated. Based on this analysis alone, the curb opening catch basins from 43rd Avenue to 35th Avenue and from 27th Avenue to 7th Avenue have enough capacity to capture the design 100-year storm event. Based on these conclusions, it was determined that including the analysis for the orifice type catch basins for these stretches would not be necessary.

This analysis did not produce enough capacity for inlets between 35th Avenue and 27th Avenue to capture the runoff from the 100-year design storm event. Therefore, the inlet analysis was expanded to include the rectangular orifice type inlets located on the back side of the catch basins along the southern curb line. Within this stretch there are two different sizes of these inlets. One is 3' wide by approximately 11" high and the other is 3' wide by approximately 17" high. An orifice calculation was performed with the depth set at the top of the inlet and the overall size reduced by 20% to account for clogging.

In addition to adding the orifice inlets in to the overall inlet capacity, the curb opening catch basins were analyzed at a depth of 9.2 inches which is the depth that would occur with water up to the crown of Baseline Road. Since existing ground slopes from south to north, flows within Baseline Road could potentially rise to this crown elevation for the inlets along the south side of the road. The addition of the orifice inlets along with the increased head on the curb opening inlets along the south side of Baseline Road produced enough inlet capacity to capture the 100-year design storm runoff for this section.

The catch basin laterals for the inlets along Baseline Road are 24" diameter. They vary in slope with a minimum slope of approximately 5.5%. A simple pipe flowing full calculation was performed for a 24" diameter pipe at 5.5% to see what its capacity is. This calculation produced a capacity of approximately 50 cfs. This is enough capacity to handle the 100-year discharge from the inlets along Baseline Road. Calculations supporting the inlet capacity are included in Appendix B of this report.

The catch basin inlet capacity analysis indicates that the inlets along the back side of the catch basins on the south side of Baseline Road are necessary for complete interception of flow. Since this analysis is based on future completely developed land use conditions with project hydrology, the conclusion is that they should remain in place to reduce the potential for flooding downstream (north) of Baseline Road. They should not be considered as interim features.

This is in contradiction to the URS Baseline Road storm drain report which seems to conclude that the collection ditches that drain to the catch basins on the south side of Baseline Road are interim features that can be deleted as development occurs adjacent to the south side of Baseline Road.

Section 4 – Initial Future Regional Infrastructure Alternatives

4.1 – Overview

Completion of the base regional hydrology update covered in Section 2 of this report and the creation of the base storm drain hydraulic model covered in Section 3 provided the project team with the initial models that were needed to begin the design phase of the two regional basins under Contract FCD2011C008. Preliminary grading plans were prepared for each basin and corresponding elevation-storage data representing each basin was inserted into the models. At that point in the project, there were still numerous issues related to performance of the regional drainage system and whether the goals of the original design concepts could be met.

The following issues were of concern at the time:

- The hydraulic analysis which Stanley re-created for the existing Baseline Road storm drain indicated it is overloaded based on the hydrology associated with Stanley's initial updated regional HEC-1 model. The Baseline Road storm drain would therefore not appear to meet its original regional goals. To the project team, it was important for Baseline Road and its storm drain to serve as the "hydrologic barrier" envisioned in its original concept and design. That is, future condition 100-year, 24-hour flows would be completely intercepted at Baseline Road with no flows passing across it to the north. This is important because it is the foundational assumption for all analysis and design of drainage facilities north of Baseline Road.
- It was not certain if the existing regional detention basin in the Phoenix South Mountain Regional Park had 100-year capacity as modeled. This was based on the lack of original documentation found, field reconnaissance including observation of sediment accumulation since construction and some preliminary hydrologic analysis.
- The feasibility of the future storm drain extension in 7th Avenue was unclear. It was unknown if the concept flow split for the storm drain at 7th Avenue and Dobbins Road in the HEC-1 model was realistic under current conditions.
- An alternative location for the future regional basin near 27th Avenue and Dobbins Road was being considered. However, at the time, that was not believed likely to have a significant impact on downstream regional hydrology.
- One of the largest questions was the extent and form of future infrastructure that would be needed to collect and convey flow to the 27th Avenue and South Mountain Avenue regional basin. Local direct runoff to that basin accounts for almost 75% of its inflow according to the various versions of the regional HEC-1 models.

The working HEC-1 and SWMM models with the preliminary configurations for the two basins were run using various assumptions regarding the above issues. The 43rd Avenue and Baseline Road regional basin is a true on-line basin which has only one source of inflow (the Baseline Road storm drain) and a conventional outlet. It was concluded with a fairly high level of confidence that its function was relatively unaffected by the conditions in the contributing

drainage area. It also does not significantly affect any of the regional design elements in the upstream direction. The project team, therefore, felt comfortable proceeding with the design phase for the 43rd Avenue regional basin on that basis. Stanley would refine the contributing hydrology for that basin throughout the duration of the Two Basins Project design phase as the upstream issues were resolved.

However, the 27th Avenue and South Mountain Avenue basin was a key element in the regional hydrology and strongly interactive with the rest of the system, primarily for the area upstream from the basin and moderately in the downstream direction. There is a strong hydrologic relation between each of the items of concern bulleted above. A systematic approach was needed to resolve those issues so that the design of the 27th Avenue regional basin could move forward. Initial alternatives were brainstormed by the project team, then developed and evaluated by Stanley to that end.

The outcome of the alternatives analysis was important as it related to the depth, side slopes, bottom configuration, volume and performance of the 27th Avenue regional basin. Those elements, in turn, potentially affect the basin layout in terms of incorporating aesthetic contouring and potential future multi-use features. Terracing the basin bottom was considered desirable if multi-use recreational features were to be incorporated in the future. These were important objectives based on feedback from the public as expressed at the first public involvement meeting held in December 2011.

The outflow from the existing South Mountain Park regional detention basin and the future extension of the 7th Avenue storm drain significantly affects the hydrology associated with the existing regional storm drain trunk line in Baseline Road, its performance in terms of the hydraulic criteria and objectives established in the South Phoenix / Laveen Drainage Improvement Project and the performance of the 27th Avenue and South Mountain Avenue regional basin. The bleedoff flow from the South Mountain Park regional basin was about 150 cfs according to the original HDR and updated Stanley base HEC-1 models. The volume associated with the bleedoff from that basin is significant.

Although the outflow from the existing South Mountain Park regional basin was somewhat indeterminate, the project team decided to stay with the original South Mountain / Laveen HEC-1 contributing hydrology and level pool routing step that represented the basin so that the other alternatives could be evaluated. Further analysis of the South Mountain Park basin was performed shortly after the initial alternatives phase. Documentation of that analysis is covered in Section 5 of this report.

Like the South Mountain Park detention basin, the future extension of the 7th Avenue storm drain has potentially significant impact on downstream hydrology. It is strategically located in the upper part of the watershed. And the various approaches that can potentially be made as to the proportion of flow it intercepts and the way in which the flow split is made at the intersection of 7th Avenue and Dobbins make it particularly significant. Further discussion and analysis regarding the future 7th Avenue storm drain extension is included in Section 6 of this report.

The various locations, configurations and outfall storm drains related to the potential future detention basins in the Western Canal / Dobbins Road area are numerous. The inflow and outflow hydrology from the future regional basin at 27th Avenue and Dobbins Road is somewhat independent of the hydrology related to the other items of concern stated above. The future 27th Avenue and Dobbins Road regional basin and storm drains are covered in more detail in Section 7 of this report.

The Baseline Road storm drain and the 27th Avenue and South Mountain Avenue basin have their own dynamic relation. All the elements above are interrelated hydrologically to varying extents.

The following is a brief list and description of the initial alternatives that were considered. More complete descriptions of these alternatives are found later in sub-section 4.5.

Initial Alternative 1: modified flow diversion at 7th Avenue and Dobbins Road restricting flow north in 7th Avenue in future storm drain to 150 cfs from 250 cfs in base HEC-1 model; add small future regional detention basin on parcel owned by the City of Phoenix where the future water treatment facility is planned; add two additional future regional basins adjacent to Dobbins Road (one north, one south) just east of the Western Canal joined by an equalizer pipe so they act as one basin; add future storm drain outfall west along Dobbins Road from the new basins east of the Western Canal to 19th Avenue, then north in 19th Avenue to South Mountain Avenue, then west in South Mountain Avenue to proposed 27th Avenue and South Mountain Avenue basin.

Initial Alternative 2: same as Initial Alternative 1 but flow diversion at 7th Avenue and Dobbins Road was modified to restrict flows continuing north to 100 cfs as opposed to 150 cfs.

Initial Alternative 3: upstream portion identical to Initial Alternative 1 with regard to the future 7th Avenue storm drain, flows in the existing Baseline Road storm drain and proposed future Dobbins Road / Western Canal regional basins. Initial Alternative 3 adds another future regional detention basin adjacent to the north side of the Western Canal west of 19th Avenue intended to collect and attenuate flows from sub-basins WC1A and DR2C and discharge to a future 24" diameter storm drain along 19th Avenue that flows north to Dobbins Road where it joins the storm drain in Alternative 1.

Initial Alternative 4: same as Initial Alternative 1 but uses a smaller volume version of the 27th Avenue and South Mountain Avenue basin with a raised terraced bottom.

Initial Alternative 5: another variation of basic components similar to Initial Alternative 4 intended to test the H & H dynamics of the 27th Avenue and South Mountain Avenue regional basin and storm drains in Baseline Road and in 27th Avenue by eliminating two of the four future regional basins that were in Initial Alternative 3 resulting in an increase in surface flow peak discharge going directly into the 27th Avenue regional basin from the southeast. The two future basins that were eliminated were the two basins on the future City of Phoenix water treatment plant site. Initial Alternative 5 retained the future regional basin on the south side of Dobbins Road just west of the Humane Society and the one on the north side of the Western Canal just west of 19th Avenue. Initial Alternative 5 also used a variation of the 27th Avenue regional basin with a slightly larger volume compared to Initial Alternative 4 accomplished by raising the entire floor up one foot and flattening the side slopes a little from a 6 : 1 average to an 8 : 1 average.

4.2 – Initial Future Regional Basins and Storm Drain Alternative Components

The future regional drainage facilities under consideration include both detention basins and storm drains, typically in connection or combination. Some of the most significant concentrations of flow in the project area are in the vicinity of 19th Avenue and Dobbins Road. Some of the hydrologically most strategic locations for future detention basins are along the Western Canal in the area stretching from about South Mountain Avenue southwest to the vicinity of Dobbins Road and 19th Avenue.

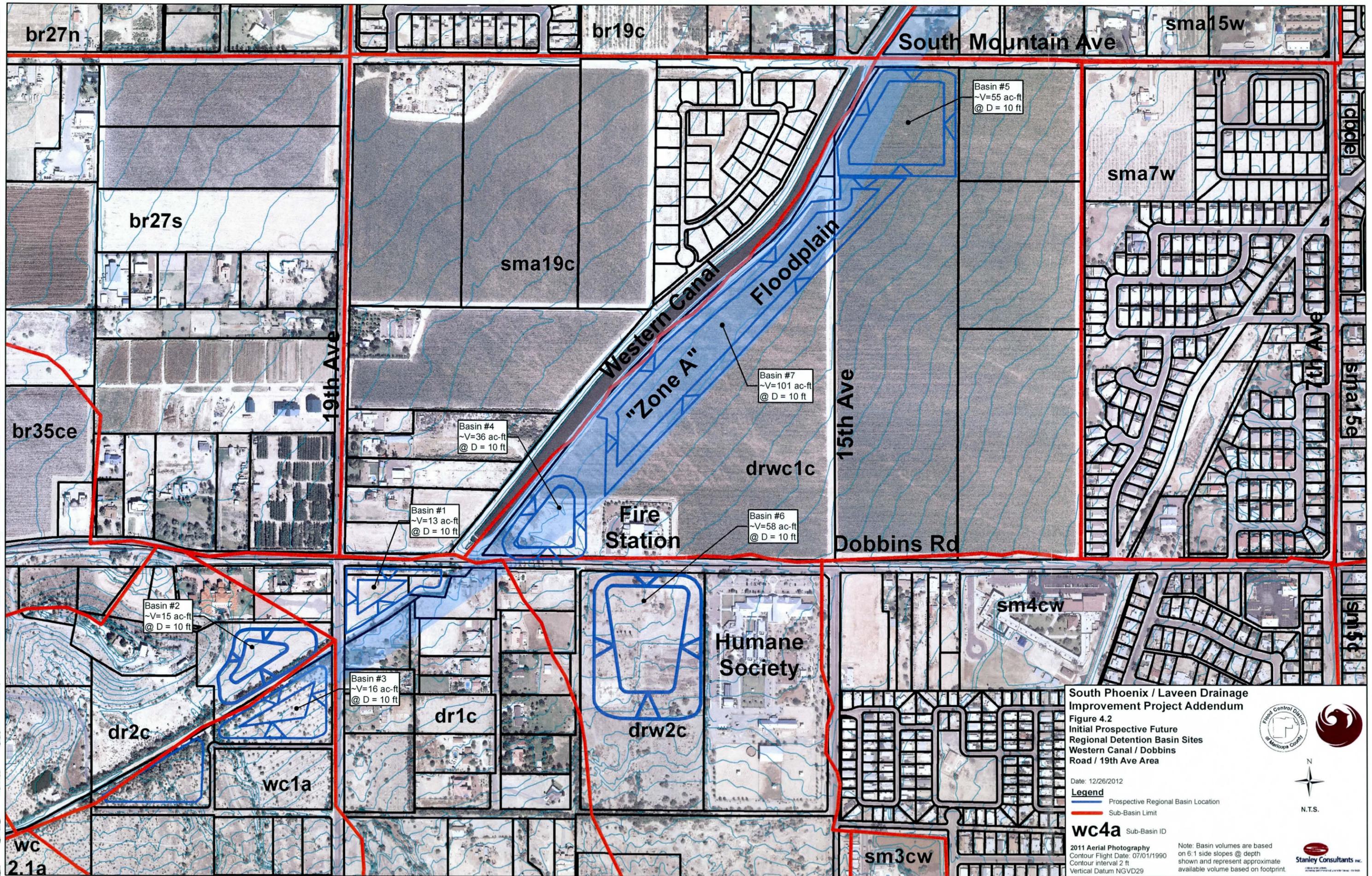
This area is also strategically intermediate in location at about the mid-point between the 7th Avenue future storm drain extension and the new regional basin at 27th Avenue and South Mountain Avenue. Future roadway improvements along Dobbins Road and along 19th Avenue will almost certainly include storm drains, at least for roadway drainage. And with consideration to the large offsite flows that are present in this area and the needs of the regional basin and storm drain system, there is more than one reason to consider future regional facilities in this general area.

The primary storm drain alignments considered for the initial alternatives were Dobbins Road from 19th Avenue west to 27th Avenue and 19th Avenue from Dobbins Road north to South Mountain Avenue then west on South Mountain Avenue to the 27th Avenue and South Mountain Avenue regional detention basin. The storm drain in the Dobbins Road alignment would outfall to an up-sized version of the outfall storm drain for the future 27th Avenue and Dobbins Road regional detention basin.

A number of prospective detention basin sites had been identified by the project team. Those prospective sites are illustrated on Figure 4.2 found on the following page. Most of these basin sites are situated on the south, or "high" side of the canal. The canal has an impact on local drainage approaching it from the south because its banks are elevated. The raised banks tend to intercept local drainage.

There is a floodplain delineated on the Flood Insurance Rate Map (FIRM) along the Western Canal (and one of its laterals) which is an indication of the drainage condition(s) described above. This floodplain is discussed in more detail in Sub-section 4.3. A number of the future regional detention basin sites being tentatively considered for the initial alternatives were on property owned by the City of Phoenix that was planned for a major future water treatment facility. The future water treatment plant is discussed in more detail Sub-section 4.4.

The project team shifted its focus to alternatives that would not only achieve South Phoenix / Laveen Drainage Improvement Project objectives but might also help address floodplain and drainage requirements that would be applicable to development of the proposed water treatment facility and alternatives that would mesh better with the proposed water treatment facility layout and have a greater possibility of resolving common goals.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 4.2
Initial Prospective Future Regional Detention Basin Sites
Western Canal / Dobbins Road / 19th Ave Area

Date: 12/26/2012

Legend

- Prospective Regional Basin Location
- Sub-Basin Limit

wc4a Sub-Basin ID

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour interval 2 ft
 Vertical Datum NGVD29

Note: Basin volumes are based on 6:1 side slopes @ depth shown and represent approximate available volume based on footprint.

Flood Control District of Maricopa County

Stanley Consultants Inc.

N.T.S.

4.3 – Western Canal Approximate Zone “A” Floodplain

The existing floodplain delineated along the Western Canal and one of its laterals within the South Phoenix / Laveen Drainage Improvement Project area are approximate flood insurance Zones “A” that are situated along the south side of the raised canal embankments. Within the project area, the Zone A along the Western Canal is generally in the range of 100 feet to 300 feet wide. It terminates (or begins) near about 19th Avenue and runs continuously along the canal to the northeast beyond Baseline Road and extends beyond the SP/LDIP watershed boundary.

The south side of the canal is the high side so the canal flood zone corresponds to offsite drainage from the southeast that would either pond along the elevated canal bank or that would flow along it. There is no floodplain on the low (north) side of the canal that might be an indication of overflow from the canal or overtopping of the canal bank. In addition to the flood zone along the south side of the Western Canal, there is also a relatively local approximate Zone A floodplain along the south side of the Western Canal Lateral just east of 27th Avenue around 700 feet south of Dobbins Road.

Figure 4.3 found at the end of this sub-section is a “Firmette” showing the floodplain as illustrated on the FIRM panel. The Western Canal Zone A floodplain is illustrated on the various figures Stanley has created from GIS data received from the Flood Control District of Maricopa County. GIS metadata indicates the Western Canal Zone A delineation was digitized from the flood insurance map.

It is not clear what the technical basis of the canal Zone A delineation is. Approximate A Zones are typically based on fairly simple hydrology and hydraulic approach and assumption. Based on the topography, height of bank and limit of floodplain, the A Zones appear to be based on a simple horizontal projection of the high top of bank. Based on the project mapping and field reconnaissance, the Zone A along the Western Canal does not appear to be due to ponding, at least in the area south of South Mountain Avenue. In that area, the flood zone appears to be more associated with local runoff that collects and flows along the bank. The direction of flow appears to be toward Dobbins Road which looks like where the flow would outfall.

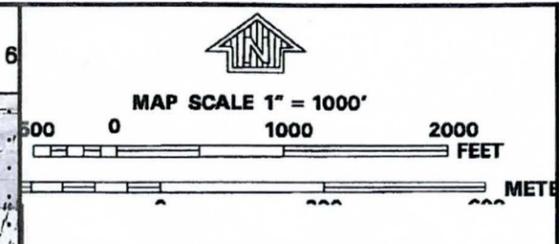
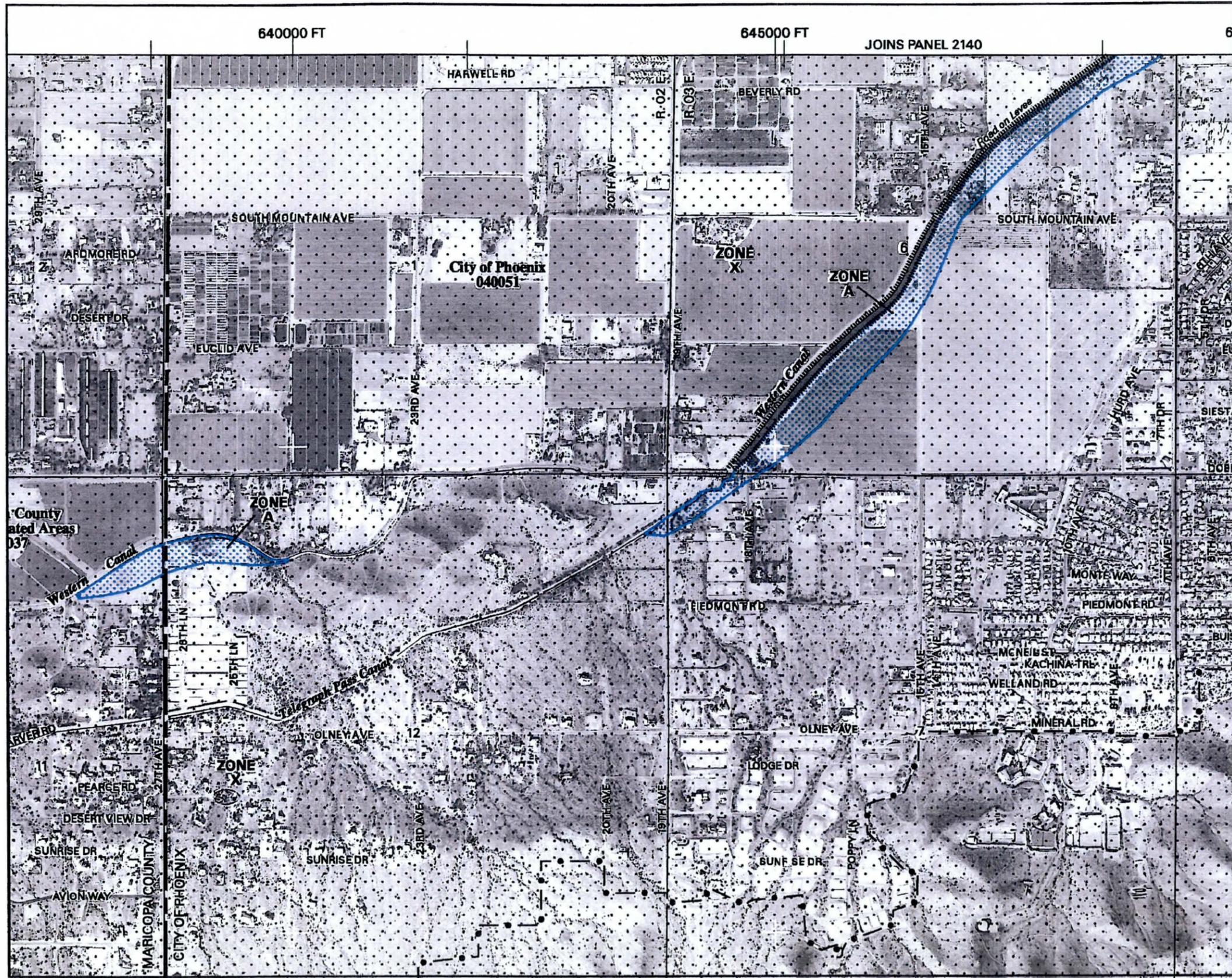
From the South Phoenix / Laveen Drainage Improvement Project Addendum HEC-1 base model, the 100-year, 24-hour future condition flow rate along the Western Canal at South Mountain Avenue is around 75 cfs and at Dobbins Road, around 275 cfs. The present condition flow rate could be greater than the future condition flow rate. If there was any hydrology analysis performed as the basis of this approximate Zone A, it would have assumed (then) present conditions.

Based on field reconnaissance and the regional project hydrology, it appears that there may be both shallow local ponding and shallow conveyance along the Western Canal in the area north of South Mountain Avenue. Existing condition flows that could potentially be entering the project area watershed along the Western Canal from beyond (northeast of) Baseline Road were not examined.

There is evidence that potentially indicates flows have topped the south bank of the Western Canal and entered the canal in the area several hundred feet west of 7th Avenue. There is no physical evidence that the south bank of the Western Canal has been overtopped between South Mountain Avenue and Dobbins Road. There is an existing small diameter pipe inlet, probably for irrigation tailwater, that is mostly clogged with debris just south of South Mountain

Avenue on the high side of the Western Canal. It was not clear based on inspection where this drain outfalls to.

Based on field reconnaissance and project topography, it appears that the approximate Zone A along the Western Canal Lateral east of 27th Avenue south of Dobbins Road is due primarily to ponding. There is a small diameter pipe inlet present on the south side of the canal at this location. The pipe traverses under the canal lateral and discharges to the north.



NFP
PANEL 2605F

**FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY,
ARIZONA
AND INCORPORATED AREAS**

PANEL 2605 OF 4350

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2605	F
PHOENIX, CITY OF	040051	2605	F

Notice to User: The Map Numbers shown below should be used when placing map orders. The Community Numbers shown above should be used on insurance applications for the subject community.

**MAP NUMBER
04013C2605F
MAP REVISED
SEPTEMBER 30, 2005**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Figure 4.3

4.4 – Future City of Phoenix Water Treatment Facility

There is a City of Phoenix water treatment facility planned for the area bounded by Dobbins Road on the South, the Western Canal on the west, South Mountain Avenue on the north and the approximate 10th Avenue alignment on the east. The City of Phoenix owns an assembly of parcels where this future water facility is planned. The combined properties include the fire station constructed by the City of Phoenix a few years ago on the north side of Dobbins Road about 600 feet east of the Western Canal.

The preliminary master plan for the future City of Phoenix water treatment facility is shown on Figure 4.4 at the end of this sub-section. Figure 4.4 corresponds to Figure 12.6 prepared by City of Phoenix water consultant Carollo Engineers in 2006. The future water treatment facility concept involved treating both raw water taken from the Western Canal and also, potentially, groundwater piped into the site from multiple future wells that would be constructed in the vicinity. In 2012, City of Phoenix Water Services Department staff stated that the treatment technologies to be utilized at the plant remain under evaluation and that the master plan may change.

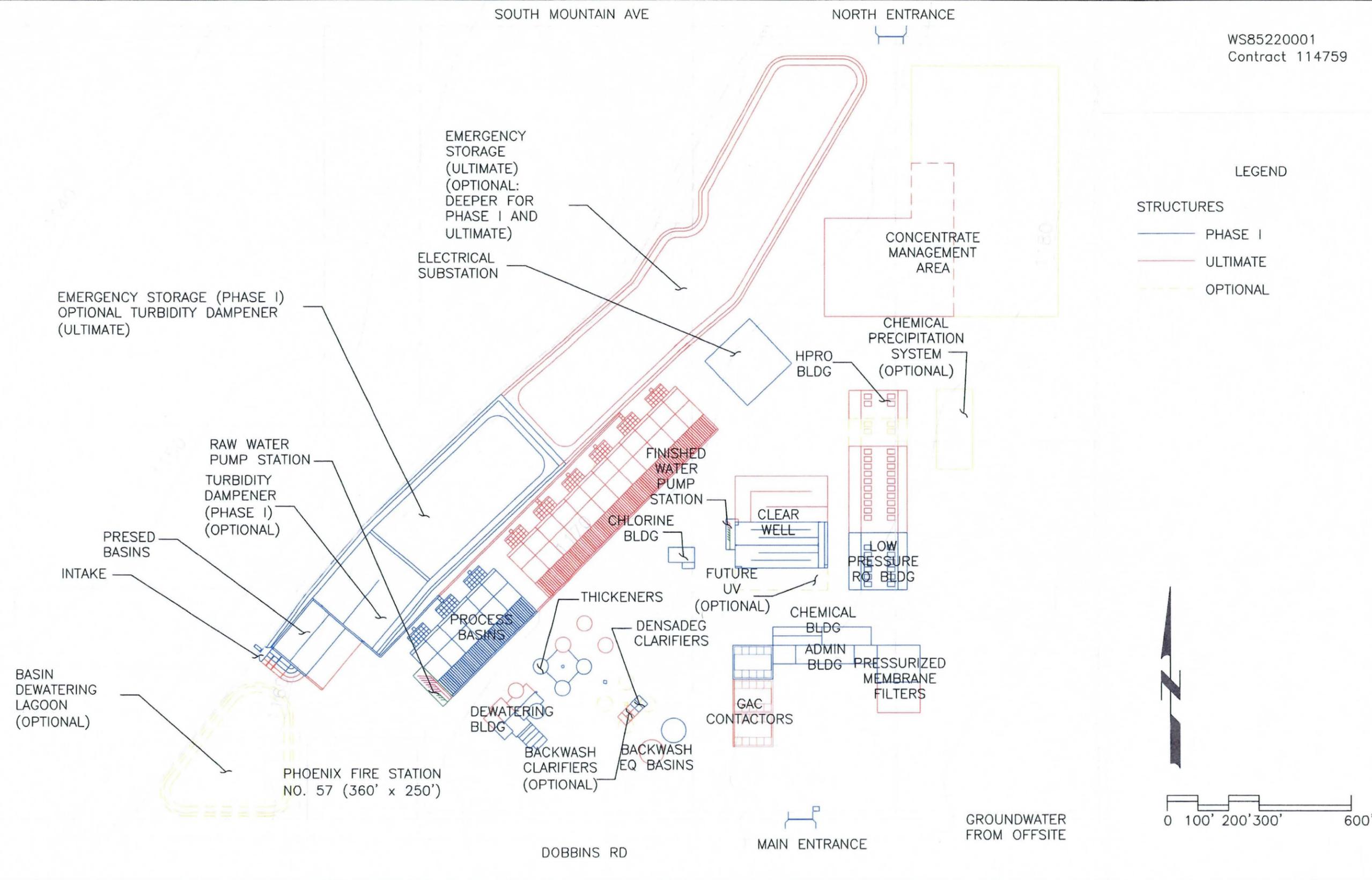
The water treatment plant layout proposes certain facilities within the floodplain, including a basin de-watering lagoon, intake, pre-sediment basin(s) and turbidity dampener basin(s). The floodplain development requirements that are assumed to apply here based on the City of Phoenix Floodplain Regulation would be basic elevation and / or flood proofing of structures. The City's floodplain regulation does not appear to contain any requirement involving compensatory displaced volume for canal bank flood zones. Since this canal A Zone does not seem to be a ponding area, compensatory volume would not appear to really be applicable anyway, even if the City's regulation contained that requirement.

However, some incorporation of the existing condition storm flows conveyed along the canal would be needed so those flows could be safely routed through the future water treatment facility. In addition to flows along the canal, there are offsite flows that would enter the water facility site from the area to the east including flows along South Mountain Avenue and flows from the subdivision developments directly to the east. There is also offsite drainage flowing west along Dobbins Road adjacent to the future water facility that may have some impact to the site.

The residential subdivisions directly east of the future water treatment facility incorporate stormwater retention basins in their designs. These retention basins would typically be sized based on the runoff volume onsite to the subdivisions only. In this case, there is offsite runoff that enters the subdivisions from the east and south in a few locations that would combine with the onsite runoff as it passes through. There are two locations where the combined onsite / offsite runoff would outfall from the subdivisions into the future water treatment facility property. These outfall points correspond to the two retention basins situated along the west side of the subdivisions. Spillways were constructed with these basins when the subdivisions were developed to allow overflows to exit to the west.

The City of Phoenix will apply their normal requirement for onsite retention to be incorporated in the future development of the water treatment facility. The volume associated with that could be in the range of 10 to 18 acre-feet. A logical place for that retention would be at the lowest point in the property which would be in the area along Dobbins Road between the Western Canal and existing City of Phoenix fire station where the water treatment plant layout shows the optional "basin dewatering lagoon".

WS85220001
Contract 114759



City of Phoenix Western Canal Water Treatment Plant Master Plan



Selected Master Site Layout (Option 2B)

Figure 12.6

Figure 4.4

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4.5 – Initial Regional Infrastructure Alternatives 1 Through 5

The initial alternatives were intended to provide a range of different hydrologic results based on an array of assumptions coupled with two different versions of the 27th Avenue and South Mountain Avenue Basin, one with a lower floor and larger volume and one with a higher floor and smaller volume.

Alternatives 1, 2 and 3 presented on the following pages used the elevation –vs- storage relation for the 27th Avenue regional basin corresponding to the larger volume layout. Alternative 4 used the smaller volume version of the basin layout. Alternative 5 used a version of the basin with a volume between the other two in size but more closely resembling the larger volume version.

The summary descriptions of each of the initial Alternatives 1 through 5 are found on the following pages along with figures depicting those alternatives and cost estimates, where applicable. All the supporting HEC-1, SWMM models and other H & H data for initial Alternatives 1 through 5 are in Appendix C of this report. All of the initial Alternatives 1 through 5 reflect the same future regional basin and storm drains at 27th Avenue and Dobbins Road corresponding to the basin site in the agricultural field at the southwest corner of 27th Avenue and Dobbins Road.

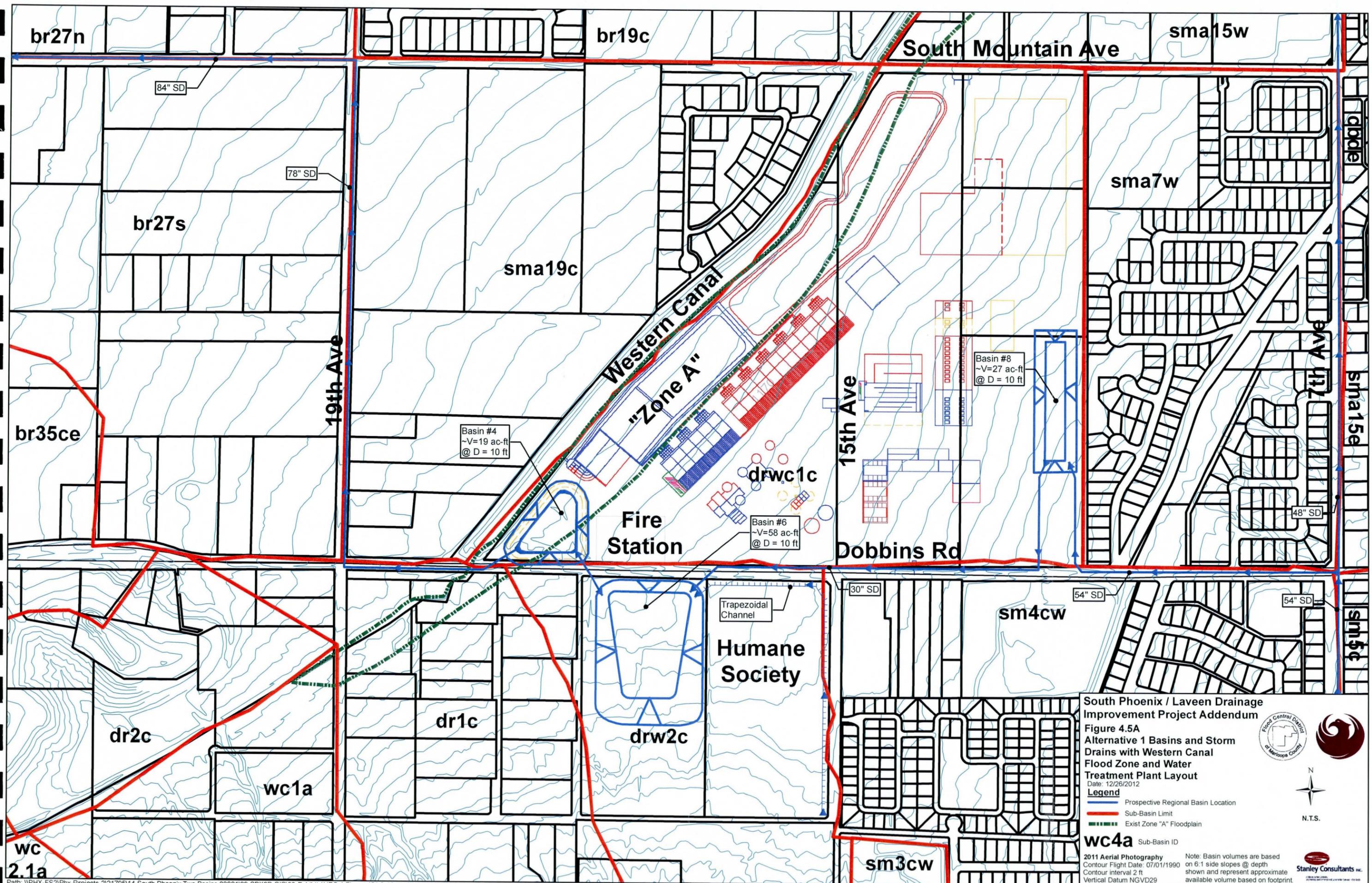
Initial Alternative 1 - modifications to the updated base HEC-1 model included changing the flow diversion at 7th Avenue and Dobbins Road by restricting flow that would continue north in 7th Avenue in the future storm drain to 150 cfs as opposed to the 250 cfs in the base HEC-1 model. The remaining flow from this diversion associated with Dobbins Road was directed west about ¼ mile then north to a small future regional detention basin on the parcel owned by the City of Phoenix where the future water treatment facility is planned. There are also two additional future regional basins adjacent to Dobbins Road just east of the Western Canal. These future basins are opposite each other on the north and south sides of Dobbins Road and are joined by an equalizer pipe so they act as one basin. The outlet for these combined basins is a future 48" diameter storm drain routed west along Dobbins Road to 19th Avenue, north in 19th Avenue via 78" diameter pipe to South Mountain Avenue then west in South Mountain Avenue via 84" diameter pipe to where it would discharge into the proposed 27th Avenue and South Mountain Avenue basin. The results of the HEC-1 and SWMM models showed that this alternative eliminated flooding of the Baseline Road storm drain node near 7th Avenue and reduced flooding at Baseline Road storm drain node at the 27th Avenue intersection.

Figures 4.5A and 4.5B on the next pages depict the various elements of initial Alternative 1 and resulting HEC-1 peak discharges and times and are followed by Table 4.5A containing the Alternative 1 cost estimate.

Note: *“Alternative 1” is also used to refer to one of the two alternatives considered for the future 27th Avenue and Dobbins Road regional basin covered in Section 7 of this addendum report. Although they have the same label, they are two separate elements.*

Initial Alternative 2 - was based on the Alternative 1 model but included changing the flow diversion at 7th Avenue and Dobbins Road by restricting the flows that would continue north to 100 cfs (from 150 cfs in Alternative 1). The objective of this reduction was to address the remaining flooding in the Baseline Road storm drain at 27th Avenue. Similar to Alternative 1, the remaining flows from the intersection split were routed west along Dobbins Road to proposed future detention basins. The volume of the Dobbins Road portion of this split is significant because it is associated with the discharge from the South Mountain Park regional basin and is

drawn out over a long period of time (in excess of 72 hours). This volume overwhelmed the proposed future basins downstream and negated their ability to reduce peak flows. For this reason, Alternative 2 was not developed any further or recommended for consideration. There are no figures or cost estimates corresponding to Initial Alternative 2.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 4.5A
Alternative 1 Basins and Storm Drains with Western Canal Flood Zone and Water Treatment Plant Layout
 Date: 12/26/2012

Legend

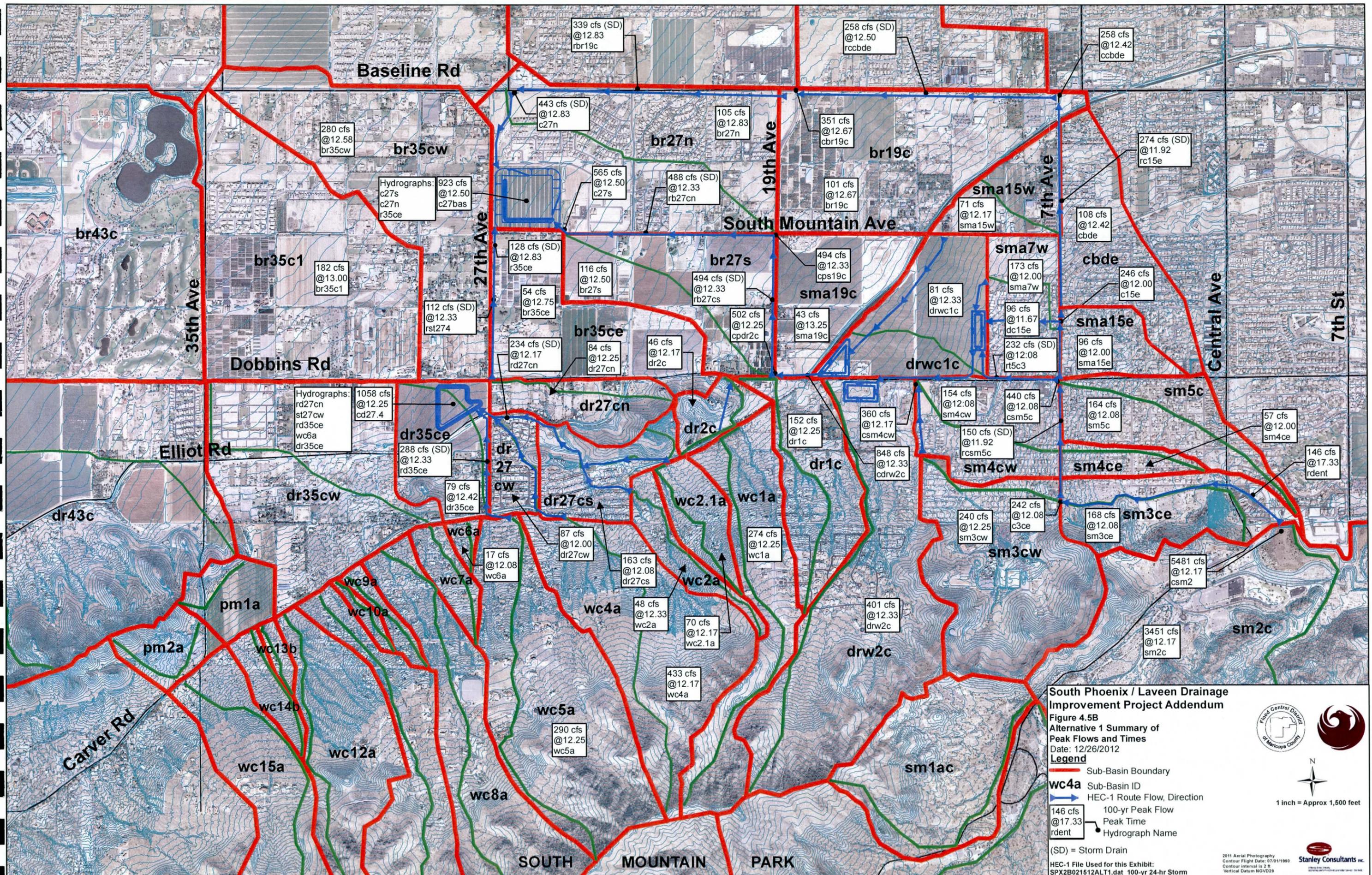
- Prospective Regional Basin Location
- Sub-Basin Limit
- - - Exist Zone "A" Floodplain

wc4a Sub-Basin ID

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour interval 2 ft
 Vertical Datum NGVD29

Note: Basin volumes are based on 6:1 side slopes @ depth shown and represent approximate available volume based on footprint.

Stanley Consultants Inc.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 4.5B
Alternative 1 Summary of Peak Flows and Times
 Date: 12/26/2012

Legend
 — Sub-Basin Boundary
 wc4a Sub-Basin ID
 → HEC-1 Route Flow, Direction
 146 cfs @17.33 rdent 100-yr Peak Flow Peak Time
 ● Hydrograph Name

(SD) = Storm Drain
 HEC-1 File Used for this Exhibit:
 SPX2B021512ALT1.dat 100-yr 24-hr Storm



Table 4.5A

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - INITIAL ALTERNATIVE 1**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	201,667	\$5	\$1,008,333
3	HUMANE SOCIETY CHANNEL OUTFALL STR	EA	1	\$75,000	\$75,000
4	EQUALIZING STR @ DOBBINS & WESTERN CANAL	EA	1	\$75,000	\$75,000
5	INLET STRUCTURE @ DOBBINS & 19TH AVENUE	EA	1	\$75,000	\$75,000
6	30" SD	LF	2,500	\$60	\$150,000
7	48" SD	LF	1,000	\$120	\$120,000
8	54" SD	LF	1,300	\$160	\$208,000
9	78" SD	LF	2,600	\$320	\$832,000
10	84" SD	LF	4,000	\$380	\$1,520,000
11	MANHOLE	EA	22	\$3,200	\$70,400
12	HEADWALL	EA	5	\$80,000	\$400,000
13	LANDSCAPING	AC	6.2	\$5,000	\$31,000
14	AESTHETIC TREATMENT	LS	1	\$50,000	\$50,000

Subtotal Construction		\$4,639,733
Construction Contingency	25%	\$1,159,933
Design	7%	\$405,977
Construction Admin	6%	\$347,980
Total Construction Costs		\$6,553,623

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-52-001	South side Dobbins Rd just west of Humane Soc	6.2	Part (vac)	\$2.50	\$675,180
					\$675,180

Total Construction Costs	\$6,553,623
Total ROW Acquisition Costs	\$675,180
Total Estimated Cost	\$7,228,803

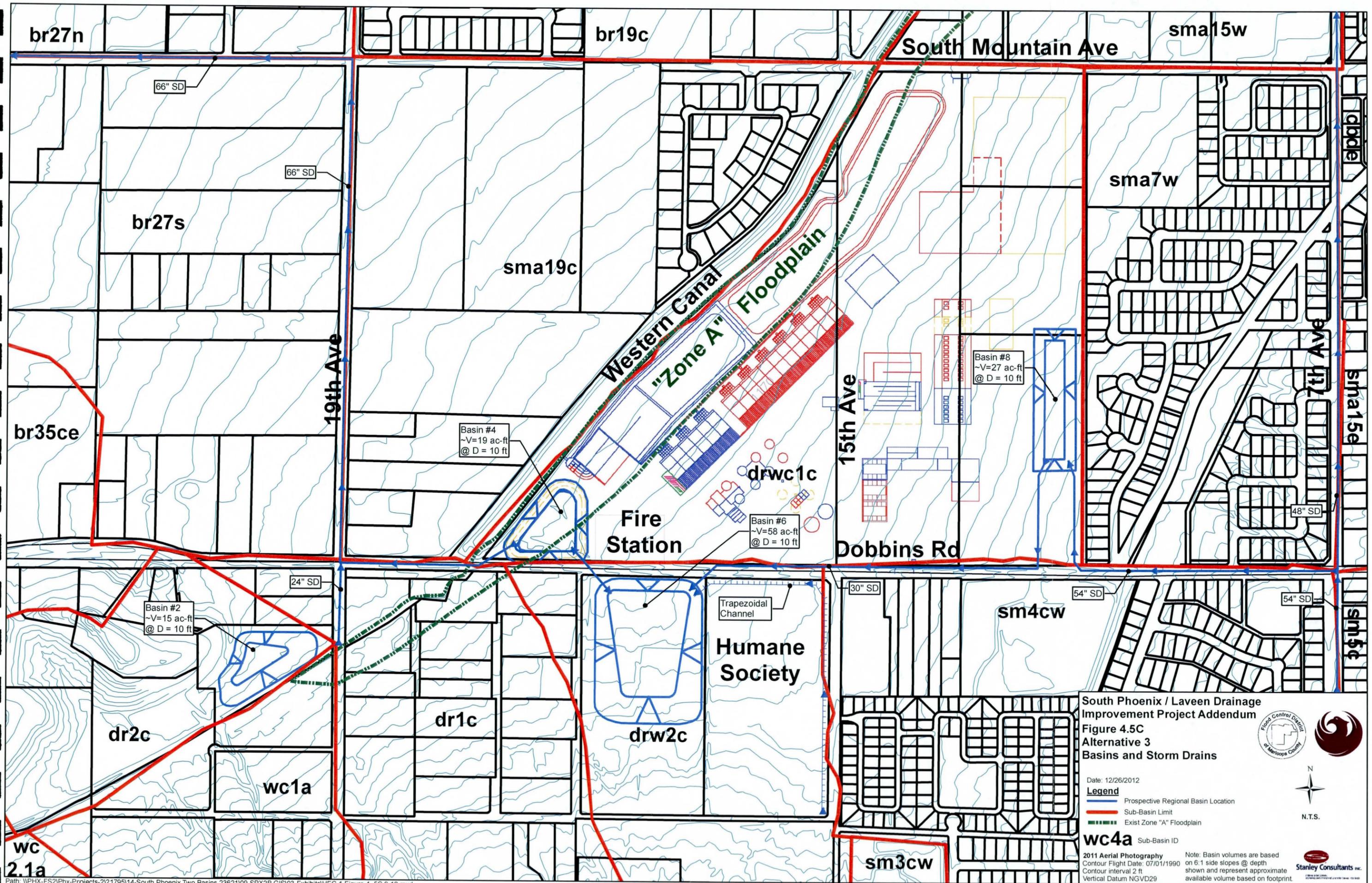
Notes:

1. Estimate does not include costs associated with street improvements.
2. Estimate does not include R/W acquisition costs or landscape / aesthetic treatment on property owned by City of Phoenix.
3. Estimate does not include 7th Ave storm drain or 27th Ave regional basin.

Initial Alternative 3 - The upstream portion of this alternative is identical to Alternative 1 with regard to the future 7th Avenue storm drain, flows in the existing Baseline Road storm drain and proposed future Dobbins Road / Western Canal regional basins. Alternative 3 adds another future regional detention basin adjacent to the north side of the Western Canal west of 19th Avenue. This basin collects flows from sub-basins WC1A and DR2C and reduces the peak discharge from that area. The basin discharges to a future 24" diameter storm drain along 19th Avenue that flows north to Dobbins Road where it joins the storm drain in Alternative 1. The reduction in flow results in a down-sizing of the storm drain along 19th Avenue and South Mountain Avenue to a 66" diameter pipe and also lowers the peak stage in the 27th Avenue regional basin. The SWMM model results showed there is still flooding in the Baseline Road storm drain node at 27th Avenue but it is slightly reduced relative to Alternative 1.

Figures 4.5C and 4.5D on the next pages depict the various elements of initial Alternative 3 and resulting HEC-1 peak discharges and times and are followed by Table 4.5B containing the Alternative 3 cost estimate.

Initial Alternative 4 - is identical to Alternative 1 but uses the smaller volume version of the 27th Avenue and South Mountain Avenue basin with the raised terraced bottom. The results from this model showed an increase in flooding at the Baseline Road storm drain node at 27th Avenue compared to Alternative 1 and also introduced a new flooding node along the west side of 27th Avenue south of Baseline Road associated with the existing 60" storm drain that connects the Baseline Road storm drain with the 27th Avenue regional basin. The Baseline Road storm drain flooding at 27th Avenue is increased slightly when compared to Alternative 1. There are no figures or cost estimates corresponding to Initial Alternative 4.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 4.5C
Alternative 3
Basins and Storm Drains

Date: 12/26/2012

Legend

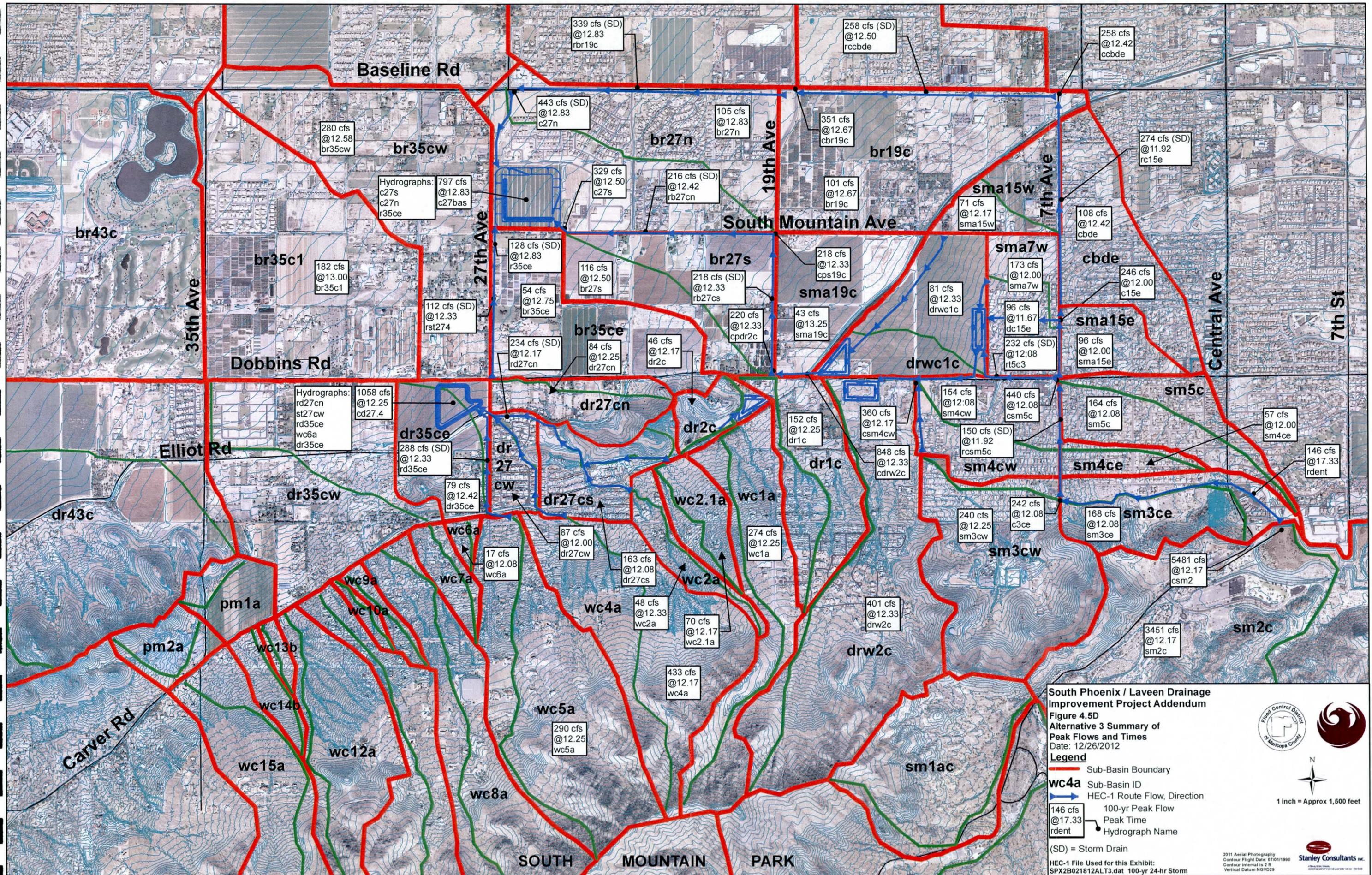
- Prospective Regional Basin Location
- Sub-Basin Limit
- Exist Zone "A" Floodplain

wc4a Sub-Basin ID

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour interval 2 ft
 Vertical Datum NGVD29

Note: Basin volumes are based on 6:1 side slopes @ depth shown and represent approximate available volume based on footprint.

Stanley Consultants Inc.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 4.5D
Alternative 3 Summary of Peak Flows and Times
 Date: 12/26/2012

Legend

- Sub-Basin Boundary
- wc4a** Sub-Basin ID
- HEC-1 Route Flow, Direction
- █ 100-yr Peak Flow
- Peak Time
- Hydrograph Name

(SD) = Storm Drain

2011 Aerial Photography
 Contour Flight Date: 8/7/11/1990
 Contour Interval: 1.2
 Vertical Datum: NGVD29

Stanley Consultants Inc.

Table 4.5B

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - INITIAL ALTERNATIVE 3**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	250,067	\$5	\$1,250,333
3	HUMANE SOCIETY CHANNEL OUTFALL STR	EA	1	\$50,000	\$50,000
4	EQUALIZING STR @ DOBBINS & WESTERN CANAL	EA	1	\$50,000	\$50,000
5	30" SD	LF	2,850	\$60	\$171,000
6	48" SD	LF	1,000	\$120	\$120,000
7	54" SD	LF	1,300	\$160	\$208,000
8	66" SD	LF	6,600	\$220	\$1,452,000
9	MANHOLE	EA	22	\$3,200	\$70,400
10	HEADWALL	EA	6	\$75,000	\$450,000
11	LANDSCAPING	AC	11.7	\$5,000	\$58,500
12	AESTHETIC TREATMENT	LS	2	\$50,000	\$100,000

Subtotal Construction		\$4,005,233
Construction Contingency	25%	\$1,001,308
Design	7%	\$350,458
Construction Admin	6%	\$300,393
Total Construction Costs		\$5,657,392

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-52-001	South side Dobbins Rd just west of Humane Soc	6.2	Part (vac)	\$2.50	\$675,180
300-16-013E	North side Western Canal just west of 19th Ave	5.5	Whole (vac)	\$2.50	\$598,950
		11.7			\$1,274,130

Total Construction Costs	\$5,657,392
Total ROW Acquisition Costs	\$1,274,130
Total Estimated Cost	\$6,931,522

Notes:

1. Estimate does not include costs associated with street improvements.
2. Estimate does not include R/W acquisition costs or landscape / aesthetic treatment on property owned by City of Phoenix.
3. Estimate does not include 7th Ave storm drain or 27th Ave regional basin.

Table 4.5C below summarizes peak flows at key locations as well as the peak stage in both the 27th Avenue and South Mountain Avenue basin and the 43rd Avenue and Baseline Road basin for Initial Alternatives 1, 3 and 4.

Table 4.5C – Initial Alternatives Peak Flow and Peak Stage Summary

ID	Location	Base		Alternative 1		Alternative 3		Alternative 4	
		Peak Stage ¹	Q _{100yr}						
		(ft)	(cfs)	(ft)	(cfs)	(ft)	(cfs)	(ft)	(cfs)
C27BAS	27th Ave & South Mtn Ave Basin Inflow	1086.12	1748	1085.68	923	1085.78	797	1087.18	923
CBR43C	43rd Ave & Baseline Rd Basin Inflow	1033.03	473	1032.78	473	1032.74	461	1033.14	518
Varies ²	7th Ave SD north from Dobbins Rd	-	250	-	150	-	150	-	150
Varies ²	Dobbins Rd west from 7th Ave	-	161	-	233	-	233	-	233
Varies ²	Vicinity 19th Ave and Dobbins Rd	-	1319	-	502	-	220	-	502
RCCBDE	Baseline Rd SD at 7th Ave	-	302	-	258	-	258	-	258
RBR19C	Baseline Rd SD at 19th Ave	-	387	-	339	-	339	-	339
RPB27C	Baseline Rd SD just west of 27th Ave	-	195	-	194	-	195	-	204
Node 218 ³	Baseline Rd SD just west of 27th Ave	-	199	-	196	-	196	-	200
RPB352	Baseline Rd SD at 35th Ave	-	430	-	429	-	417	-	473
RSTG43	Baseline Rd SD at 39th Ave	-	455	-	455	-	443	-	500

Notes: 1) Peak stages for basins are from SWMM models developed for the base hydrology and alternatives.
2) HEC-1 ID varies by model.
3) Peak flow for storm drain downstream of 27th Avenue junction structure from SWMM models which were developed for the base hydrology and alternatives.

According to the Baseline Road SWMM models for Alternatives 1, 3 and 4, the hydraulic grade line still exceeds the high elevation of Node 219 which corresponds to the storm drain junction structure at the intersection of Baseline Road and 27th Avenue. The length of time this node elevation is exceeded ranges from about 0.32 to 0.42 hours and corresponds to a volume of between 0.63 and 1.92 acre foot. Table 4.5D below summarizes the SWMM results.

Table 4.5D – Initial Alternatives SWMM Flooding Node Summary

SWMM ID	Location	Base		Alternative 1		Alternative 3		Alternative 4	
		Time Flooded (hr)	Volume (ac-ft)						
238	Intersection of Baseline Rd / 7th Ave	0.83	1.19	-	-	-	-	-	-
219	Intersection of Baseline Rd / 27th Ave	0.50	1.56	0.32	0.90	0.30	0.63	0.42	1.92
300	27th Ave Node 570 ft South of Baseline Rd	-	-	-	-	-	-	17.22	35.69

The cost estimates prepared for Initial Alternatives 1 and 3 include major design items, a construction cost contingency and costs for design, construction administration and right-of-way acquisition, where applicable. There was not a specific cost for utility conflict resolution in any of the estimates. That was assumed to be covered by the contingency cost. The cost for Initial Alternative 1 is approximately \$7.23 million. The cost for Initial Alternative 3 is approximately \$6.93 million. A cost estimate was not prepared for Initial Alternative 2 because that alternative was not considered to be a feasible solution. A cost estimate was also not prepared for Initial Alternative 4 because that alternative only investigates what the hydrology and hydraulic impact

of the smaller terraced basin at 27th Avenue and South Mountain Avenue would have on the system.

The costs above do not include any costs associated with the future 7th Avenue storm drain or for the 27th Avenue and South Mountain Avenue regional basin. Those costs would be the same between Initial Alternatives 1 and 3. The difference in excavation cost between the larger and smaller versions of the 27th Avenue regional basin, assuming \$5 per cubic yard, would be about \$600k.

Initial Alternative 5 - Initial Alternative 5 was another variation of basic components similar to Initial Alternative 4 intended to test the H & H dynamics of the 27th Avenue and South Mountain Avenue regional basin and storm drains in Baseline Road and in 27th Avenue. Initial Alternative 5 eliminated two of the four future regional basins that were in Initial Alternative 3 which results in an increase in surface flow peak discharge going directly into the 27th Avenue regional basin from the southeast. The two future basins that were eliminated were the two basins on the future City of Phoenix water treatment plant site. Initial Alternative 5 retained the future regional basin on the south side of Dobbins Road just west of the Humane Society and the one on the north side of the Western Canal just west of 19th Avenue.

Initial Alternative 5 also used a variation of the 27th Avenue regional basin similar to the larger volume version. For Initial Alternative 5, the basin was modified by raising the entire floor up one foot and flattening the side slopes a little from a 6 : 1 average to an 8 : 1 average. This reduced the volume of the basin a bit but it was still much closer in volume to the larger volume version of the basin that was used in initial alternatives 1 – 3 than the smaller volume version that was used in initial alternative 4.

Raising the basin bottom up one foot would result in less frequent flooding of potential future multi-use improvements in the basin. It would also reduce the associated severity and duration that those future multi-use facilities would be inundated. The flatter side slopes would provide a little more leeway for aesthetic contouring. The raised bottom and flatter side slopes would also potentially improve the overall safety when the basin floods.

Initial Alternative 5 modified the elevation – storage relationship for the 27th Avenue regional basin in both the HEC-1 model and in the corresponding SWMM model. The revised HEC-1 inflow hydrograph was also input into the Initial Alternative 5 SWMM model.

The larger surface inflow component from the southeast that results from eliminating two of the future upstream basins would require larger storm drain to carry it to the 27th Avenue basin. The total inflow to the basin increases from 797 cfs in Initial Alternative 3 to 1,143 cfs in Alternative 5. The Initial Alternative 5 peak stage in the basin increases about 0.75' over the Alternative 3 peak stage. The outflow from the basin to the Baseline storm drain is virtually the same in all alternatives. The SWMM flooding nodes are still present at the Baseline Road storm drain at 27th Avenue and also at the 27th Avenue storm drain south of Baseline Road but they are improved relative to Alternative 4.

The results from Initial Alternative 5 were another indication in favor of using some form of the larger volume version of the 27th Avenue and South Mountain Avenue basin. It did a better job of meeting the project objectives and provided more flexibility to deal with the uncertainties of the contributing hydrology that were still present at that time. There was no cost estimate or figure prepared for this alternative.

4.6 – Initial Alternatives 1 - 5 Conclusions and Recommendations

The alternatives investigated showed that modifying the flow split at 7th Avenue and Dobbins Road would be necessary to alleviate flooding concerns at 7th Avenue and Baseline Road. Limiting the flow that would continue north in 7th Avenue to 150 cfs proved to be the lower limit of the flow split which would accomplish that objective. Limiting the flow to less than that diverted too much volume west along Dobbins Road that comes from the existing South Mountain Park regional basin. The increase in volume greatly reduced the effectiveness of future prospective basins west (downstream) from 7th Avenue and Dobbins Road.

The remaining hydraulic grade line exceedance at Baseline Road and 27th Avenue that exists in Alternatives 1, 3 and 4 is still somewhat of a concern. However, it is improved from the flooding condition in the base regional hydrology / hydraulics and is relatively minor and isolated. It varies slightly with each alternative but the results suggest that it is not particularly sensitive to the various elements at play in each of the alternatives.

The costs for Alternatives 1 and 3 are nearly identical. Therefore, costs don't appear to be a very strong deciding factor between those two alternatives. Alternative 1 utilizes large diameter storm drains for conveyance in 19th Avenue and South Mountain Avenue. Alternative 3 reduces the size of the storm drains along 19th Avenue and South Mountain Avenue.

Alternative 3 also provides a significant benefit in attenuating local flows with the addition of the detention basin south and west of the Dobbins Road and 19th Avenue intersection. The peak flow that is intercepted by this basin is just over 300 cfs.

Each alternative 1 through 4 involves future regional detention incorporated within the assembly of parcels owned by the City of Phoenix along the Western Canal north of Dobbins Road which is planned for a future regional water treatment facility. This is a key regional hydrologic location. It was concluded at the end of the initial alternatives evaluation phase that the project team should collaborate with the City of Phoenix Water Services Department to explore alternatives that could benefit both projects with regard to the regional drainage and the existing flood zone along the Western Canal. This was done in a subsequent phase of analysis and is covered in more detail in Section 8.2 later in this addendum.

The grading design of the 27th Avenue regional basin will incorporate a layout that will facilitate future multi-use. The larger volume version of the basin would also be a better hedge against the still somewhat (at the time) unsettled regional hydrology. For these reasons, the larger basin, or a close version of it, is recommended over the smaller basin.

Existing utilities and potential conflict resolution have not been extensively investigated at this stage of the alternatives analysis. This needs to be done concurrent with the next phase of alternatives evaluation after the project team has reviewed the conclusions and recommendations contained herein and a preferred alternative is identified for promotion to the next level of consideration.

Although there were still many unresolved hydrologic variables at the end of the initial alternatives phase, the combined conclusions provided the project team with the comfort level to proceed with the design of the 27th Avenue and South Mountain Avenue Basin. The results indicated that the design of the basin should incorporate as large a volume as reasonably possible with a low floor elevation. Remaining issues were resolved in subsequent phase of analysis and is covered in more detail in Section 8 later in this addendum.

Section 5 – Existing South Mountain Park Regional Basin

5.1 – Summary of Initial and Final Analyses

The original objective of the investigation in this section was to verify if there was any freeboard in the existing South Mountain Park regional detention basin. If so, the project team would consider reconstructing the basin outlet pipe to reduce the outflow from the basin. Stanley's preliminary findings indicated the basin may not have any freeboard meaning it may not have capacity to contain the entire 100-year, 24-hour storm.

An additional task was authorized to survey and analyze the South Mountain Park basin. Aerial mapping with a 2-ft contour interval was flown on April 10, 2012. This was followed by field survey of key elevations around the northwest perimeter of the basin and of the outfall pipe. All mapping and survey was done based on 1988 vertical datum. Presented herein is a summary of the analysis. The complete initial and final analysis documentation for this section is found in Appendix D of this report.

A new elevation – storage relationship was developed for the basin based on the new mapping and survey. Stanley reviewed the grading plan and drainage report for the Mineral Canyon subdivision just north of the basin. The original basin outlet pipe had been extended sometime between 2007 and 2011 per improvement plans for the Mineral Canyon subdivision immediately north of the basin. The basin's outlet pipe was re-analyzed based on data from Stanley's survey. This analysis was based on both inlet control and outlet control assumptions. It was determined that outlet control prevails and the elevation - discharge rating curve was revised using StormCAD.

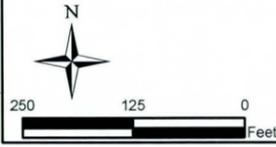
The HEC-1 model was updated with the revised rating curves. The base original South Phoenix / Laveen Drainage Improvement Project three sub-basin inflow hydrology was replaced by the two sub-basin hydrology which had been developed based on hydrology for the adjacent Hohokam ADMSP.

5.2 – Conclusions

The revised regional HEC-1 model indicates complete containment of the 100-year, 24-hour inflow hydrograph within the existing regional basin. The peak stage is about 2.1 feet below the high perimeter elevation near the northwest corner of the basin indicating that no modifications to the basin volume or low level outlet pipe are necessary to meet downstream regional objectives. There would be no high level spill from the basin. The peak discharge from the outflow pipe was just less than 90 cfs. This conclusion plays a significant part in all of the downstream regional alternatives, most notably the future extension of the 7th Avenue storm drain and the storm drain flow split at 7th Avenue and Dobbins Road. The updated hydrology relative to the South Mountain Park regional basin is reflected in all of the downstream alternative analyses from this point forward.

The new mapping and survey data are reflected on Figure 5.2 on the next page. Tables 5.2A and 5.2B which are found after Figure 5.2 reflect the updated elevation – storage and elevation – discharge relations based on the new mapping, survey and outlet pipe hydraulics.

South Phoenix / Laveen Drainage
Improvement Project Addendum
Aerial Mapping
South Mountain Park
Regional Detention Basin
Figure 5.2



Date: 12/26/2012
Ground Control: Stanley
Aerial Mapping: Cooper
Flight Date: 4-10-12
Vertical Datum: 1988
C.I.: 2 ft

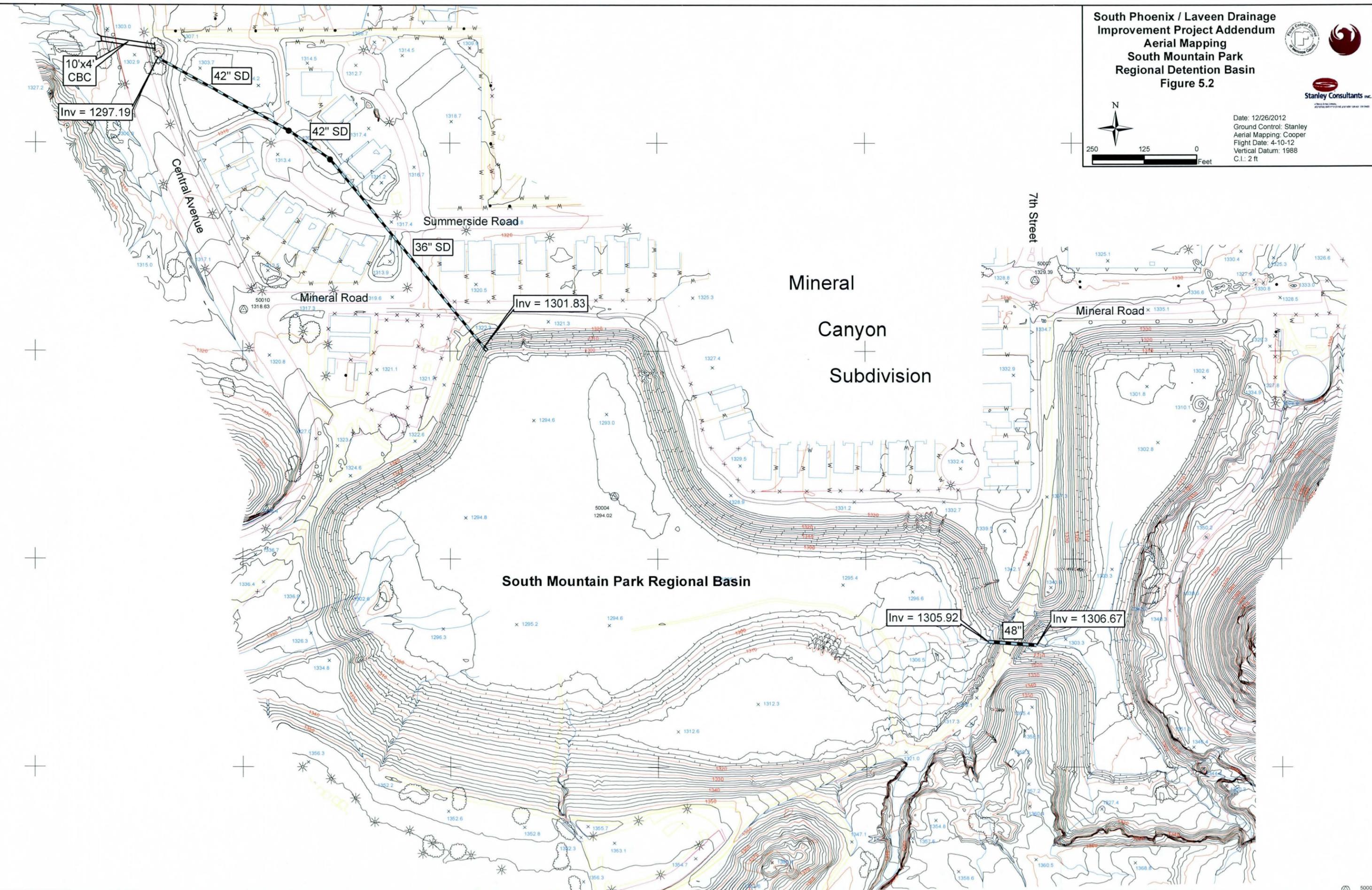


Table 5.2A - Elevation –vs- Storage Data

Column #	1	2	3	4	5	6	7	8	9
Elevation (ft)	1294.1	1296.0	1298.0	1300.0	1301.8	1302.0	1304.0	1306.0	1308.0
Storage (ac-ft)	1.0	12.6	38.2	67.9	96.9	100.1	136.6	177.8	221.8

10	11	12	13	14	15	16	17	18	19
1310.0	1312.0	1314.0	1316.0	1318.0	1320.0	1321.25	1321.5	1322.0	1322.5
268.3	317.6	371.4	429.5	489.7	552.0	592.3	600.5	616.9	633.5

20
1323.0
650.3

Table 5.2B - Elevation –vs- Discharge

HW Elev. (ft)	Q Pipe 36" (cfs)	Q Weir (cfs)	Q Total (cfs)
1294.1	-	-	-
1296.0	-	-	-
1298.0	-	-	-
1300.0	-	-	-
1301.8	0	-	0.0
1302.0	0.5	-	0.5
1304.0	20.6	-	20.6
1306.0	35.6	-	35.6
1308.0	48.1	-	48.1
1310.0	56.2	-	56.2
1312.0	64.4	-	64.4
1314.0	71.9	-	71.9
1316.0	78.1	-	78.1
1318.0	84.4	-	84.4
1320.0	90	-	90.0
1321.25	93.2	0	93.2
1321.5	94.4	1.38	95.8
1322.0	95.6	91.24	186.8
1322.5	97.4	473.2	570.6
1323.0	98.2	1138.42	1236.6

Section 6 – Future 7th Avenue Regional Storm Drain Extension

6.1 – Original Concept and Initial Analysis

The South Phoenix / Laveen Drainage Improvement Project included a storm drain extension in 7th Avenue from Baseline Road south about ½ mile past Dobbins road to a point just north of Olney Avenue. At this location, the storm drain would pick up the flow that concentrates at an existing dip in the 7th Avenue roadway profile which is where the outflow from the existing South Mountain Park regional basin and local runoff from sub-basin SM3CE combine. Prior to the update of hydrology for the existing South Mountain Park regional basin, the 100-year, 24-hour peak flow at this location was just less than 250 cfs.

This is a significant location because the outflow from the existing South Mountain Park regional basin, which, in the base HEC-1 model was about 150 cfs (out of the 250 cfs total) is sustained for well over than 24 hours for a 100-year event and represented a very large volume of runoff. Although this outflow discharge was identified as part of the original SP/LDIP, the project team felt it was very important to pick up and convey this type of flow via storm drain. It would not be desirable to pass the large, sustained volume of runoff through existing downstream neighborhoods or through the smaller future regional detention basins under consideration that would be consumed by the large volume, or through the new regional basin at 27th Avenue and South Mountain Avenue which will potentially have future multi-use recreation facilities within it.

Under the original SP/LDIP concept plan, the extended 7th Avenue storm drain would convey its flow to the Baseline Road storm drain. Part of this flow would be involved in the surge function at 27th Avenue associated with the new regional basin at 27th Avenue and South Mountain Avenue. But this would mainly be concurrent with relatively short duration peak flows from local sub-basins. The bulk of the sustained large volume flow from the South Mountain Park basin would just continue on past the new basin at 27th Avenue. Further downstream, this flow will pass through the new 43rd Avenue and Baseline Road regional detention basin but this would be acceptable because that basin and inflow and outflow storm drains are large enough to handle it, there is no future multi-use recreation facility planned for that basin and there would be a concrete lined low-flow channel in the bottom of the basin from the inlet to the outlet.

In the original SP/LDIP concept, the future extended 7th Avenue Storm drain would have a maximum capacity of 250 cfs. Flows in excess of this 250 cfs would overflow 7th Avenue at two locations, one at Dobbins Road and the other at a point about ¼ mile north of Dobbins Road. A portion of this overflow is attributed to local sub-basins SM5C and SMA15E east of 7th Avenue to the south and north (respectively) of Dobbins Road. This overflow would have totaled about 250 cfs between the two locations and would have flowed northwest to the Western Canal.

The 250 cfs in the original SP/LDIP concept delivered at the existing Baseline Road storm drain by the future 7th Avenue storm drain extension along with the local flow from sub-basin CBDE (108 cfs) totaled over 350 cfs. This rate of flow was a problem in two ways. First, it exceeded the capacity of the existing Baseline Road storm drain at its intersection with 7th Avenue. And second, it contributed to the Baseline Road storm drain exceeding its hydraulic grade line criteria downstream to the west at certain locations. There is a diversion step in the original

South Phoenix / Laveen HEC-1 hydrology model at 7th Avenue and Baseline Road corresponding to the limited capacity of the Baseline Road storm drain system.

One of the alternatives identified in the alternatives analysis phase of the SP/LDIP addendum was to reduce the capacity of the future 7th Avenue storm drain extension, hence reducing the flow at Baseline Road and improving or eliminating the Baseline Road storm drain capacity issues. Introducing a new additional flow split structure in the 7th Avenue storm drain at South Mountain Avenue was initially considered but it would have required a new storm drain and outfall to the west. The project team decided to stick with the original location at 7th Avenue and Dobbins Road for the flow split. This was one of the two flow split locations modeled in HEC-1 along 7th Avenue in the original SP/LDIP concept. Flows in excess of 150 cfs would be taken west in a new storm drain in Dobbins Road.

6.2 – Final Approach and Analysis

The lower peak discharge associated with the updated South Mountain Park regional basin hydrology is a significant benefit to the downstream infrastructure alternatives, especially the future 7th Avenue storm drain extension and the flow split operation at 7th Avenue and Dobbins Road which has been a part of the South Phoenix / Laveen Drainage Improvement project concept regional hydrology from the beginning.

For a brief time, the project team considered eliminating the flow split at 7th Avenue and Dobbins Road and limiting the flow going north in the storm drain from that intersection by reducing the size and intercept capacity of the storm drain south of Dobbins Road. Flow from east of 7th Avenue south of Dobbins Road that exceeded the capacity of the reduced storm drain would simply continue west through residential areas as it does currently only the flow rates would be reduced by an amount equal to the capacity of the new 7th Avenue storm drain. The outfall for this drainage would be the channel along the west side of 15th Avenue south of Dobbins Road and the Dobbins Road corridor to the west as it is currently.

However, a concept was finalized with the help of City of Phoenix Water Services Department staff to incorporate regional detention and conveyance facilities on the future water treatment plant site. This provided the outfall necessary for a storm drain in Dobbins Road west from 7th Avenue and that, along with the lower outflow from the updated South Mountain Park regional basin analysis allowed the project team to meet the original 100% intercept objective for the 7th Avenue storm drain south of Dobbins Road.

The reduced flow going north from Dobbins Road in the future 7th Avenue storm drain allowed for 100% intercept of flow from sub-basins east of 7th Avenue north of Dobbins but still allowed for a reduction in size of the original 66" storm drain to 48" from Dobbins Road north for about ¼ mile. In addition to cost savings, this was an improvement in performance over the original SP/LDIP concept and at the same time, still kept the storm drain discharge in the Baseline Road storm drain below its maximum target discharge. The storm drain south of Dobbins Road is also reduced from 66" to 60".

The original storm drain flow split concept at 7th Avenue and Dobbins has presented some challenges. The way it is modeled in the original HEC-1 models implies that a good portion of the flow intercepted in the future storm drain south of Dobbins Road would be directed to the intersection with 7th Avenue and simply allowed to escape and run overland northwest from that point.

There is no diversion structure at this location reflected in the SP/LDIP concept storm drain plan and profile. The flow split only appears to exist as a hydrograph step in HEC-1. It was not clear if the HEC-1 split was just attempting to approximate an existing overland flow pattern at that location or if it was implying a future flow split structure would need to be incorporated in the storm drain there.

Subsequent to the original SP/LDIP hydrology, residential subdivisions were constructed northwest of the 7th Avenue / Dobbins Road intersection. These subdivisions impact what would have been the overland component of the flow split in the original SP/LDIP HEC-1 model.

The diversion step operation representing the flow split in HEC-1 implied a structure operating as a weir under falling head that would "skim off" all the flow entering the structure from the south above a target flow rate and at its north end, deliver only that flow rate to the storm drain

going north. This operation would have been difficult to achieve and the underground structure would need to be quite large.

The flow split concept was changed to a more conventional arrangement using a vault having a weir wall within it so that flow entering would be directed north until the water surface reached the height of the weir. At that point, flow would go over the weir wall and exit the structure in the westerly direction in addition to the northerly direction. So the outflow when the water surface was higher than the weir wall would be a function of the pipe sizes going north and west under common head, a much more practical arrangement. The hydraulic design documentation along with concept dimensions and pipe diameters is contained in Appendix E of this report.

Section 7 - Future 27th Avenue and Dobbins Road Regional Basin

7.1 – Overview and Alternative 1 Basin and Storm Drain

The future 27th Avenue and Dobbins Road regional detention basin and associated storm drain was investigated per the authorized scope of work for this project. The basin and a bleed-off storm drain going north in 27th Avenue from Dobbins Road were envisioned at least as far back as 1997. They were both included as part of the South Phoenix / Laveen Drainage Improvement Project prepared by HDR Engineering, Inc. in July 1997. The future 27th Avenue / Dobbins Road Basin was included as a level pool routing step in the base HEC-1 model that was provided to Stanley for the South Phoenix Two Basins Project design phase. A routing reach for the outfall storm drain in 27th Avenue from Dobbins Road north to the 27th Avenue and South Mountain Avenue Basin was also included in the base HEC-1 model.

The original location of the future 27th Avenue / Dobbins regional basin according to the SP/LDIP was just east of 27th Avenue and immediately south of the Western Canal Lateral which is about 700 feet south of Dobbins Road. This was a hydrologically strategic location because it is in the natural path of significant drainage which historically concentrates along the south side of the canal lateral. Drainage along 27th Avenue from the south could also have been collected via storm drain and directed to the original basin location. Figure 7.1A near the end of this sub-section is the basin site plan from the original HDR concept plan from 1997.

Development of residential subdivisions beginning in the late 1990's and continuing up until present day has displaced the original basin location. The Citrus Mountain subdivision was the first of two subdivisions that occupy the area where the original basin was planned. Citrus Mountain is located immediately east of 27th Avenue and extends from the Western Canal on its south (near Olney Avenue) to the Western Canal Lateral on the north. Southern Highlands is the other subdivision which is immediately east of Citrus Mountain. New home construction is still active in the Southern Highlands subdivision.

By the year 2000, the basin site had been tentatively moved north to the area between the Western Canal Lateral and Dobbins Road east of 27th Avenue. This new location was illustrated on one of the drainage area maps in the storm drain design report produced by consultant URS in support of the Baseline Road Improvement Project in May 2000 which included the Baseline Road regional storm drain. However, there is significant residential development on several lot split parcels in this new location along with a local retail market at the southeast corner of the intersection that was established in 1908 and has historic status.

Some time prior to the start of the South Phoenix Two Basins Project, the future regional basin at 27th Avenue and Dobbins Road had been conceptually moved to the agricultural field on the southwest corner of the intersection of 27th Avenue and Dobbins Road. Although the basin location has changed twice since the late 1990's, its representation in the regional HEC-1 models has remained the same. It was still modeled the same way in the base HEC-1 model provided to Stanley for the Two Basins Project as it was in the 1990's.

In addition to the changes in basin site location, the Citrus Mountain and Southern Highlands residential subdivisions mentioned earlier have changed the drainage in the tributary area

between Olney Avenue and the Western Canal Lateral. Each of these two subdivisions incorporates onsite retention within their limits. The Citrus Mountain subdivision has a single retention basin at the southeast corner of 27th Avenue and the Western Canal Lateral. This basin takes both onsite and offsite runoff and is situated in a location that approximates the natural historic outfall for storm runoff from the contributing area.

The Southern Highlands subdivision has a number of retention basins throughout its limits, some of which take offsite runoff and others only onsite runoff. One of the larger basins is near the center of the subdivision and it takes both onsite and offsite drainage. The outfall basin for Southern Highlands is located along the south side of the Western Canal Lateral. It takes both onsite and offsite runoff and, like the Citrus Mountain basin, approximates the location of the natural historic outfall for its contributing area.

Stanley revised the HEC-1 model to reflect changes in drainage due to subdivision development. Some of the sub-basin boundaries and input parameters were revised. Routing steps were also added or revised. Retention storage was also reflected in the sub-basins where the Citrus Mountain and Southern Highlands subdivisions are located. The subdivision retention basins have very little impact on attenuating offsite flows because of the large volume of offsite runoff relative to the volume provided in them which is based on onsite runoff. These basins would likely have a beneficial downstream affect for only local or smaller more frequent storm events.

The HEC-1 model was also revised to reflect the new location for the regional basin at the southwest corner of 27th Avenue and Dobbins Road. Revisions were also made to depict a concept-level channel and storm drain system that would be needed to collect and convey drainage to the future regional basin location. The elevation-storage-discharge relation for the future regional 27th Avenue / Dobbins detention basin itself was updated to reflect its new location and configuration.

The contributing hydrology for the future regional basin at 27th Avenue and Dobbins Road and the outfall from that basin are relatively independent from the other future basin and storm drain infrastructure alternatives that are being evaluated as part of the South Phoenix / Laveen Drainage Improvement Project Addendum.

Notes within the HEC-1 model describe the various changes that were made. Figures 2E and 2F in Section 2 illustrate revisions made by Stanley to the sub-basin limits, flow paths and routing reaches and show the soil types that were involved in re-calculating rainfall loss parameters for sub-basins in the vicinity of the future regional detention basin at 27th Avenue and Dobbins Road. The updated feasibility analysis for this future regional basin for the SP/LDIP Addendum was done using new aerial mapping 2-foot contours in the vicinity of the basin. The mapping was flown on August 31, 2011 and is based on 1988 vertical datum. Field survey, utility quarter section map and utility as-built data collection and extensive field reconnaissance were also done for this analysis.

A fairly extensive storm drain system is needed to collect and convey all of the drainage from the original contributing area to the new basin at the southwest corner of 27th Avenue and Dobbins Road. This is necessary because the new basin location is not situated at a significant natural drainage concentration point. Without a drainage collection system of some kind, the new future regional basin by itself is in a location that would only intercept a fraction of the flow originally intended in the South Phoenix / Laveen Drainage Improvement Project.

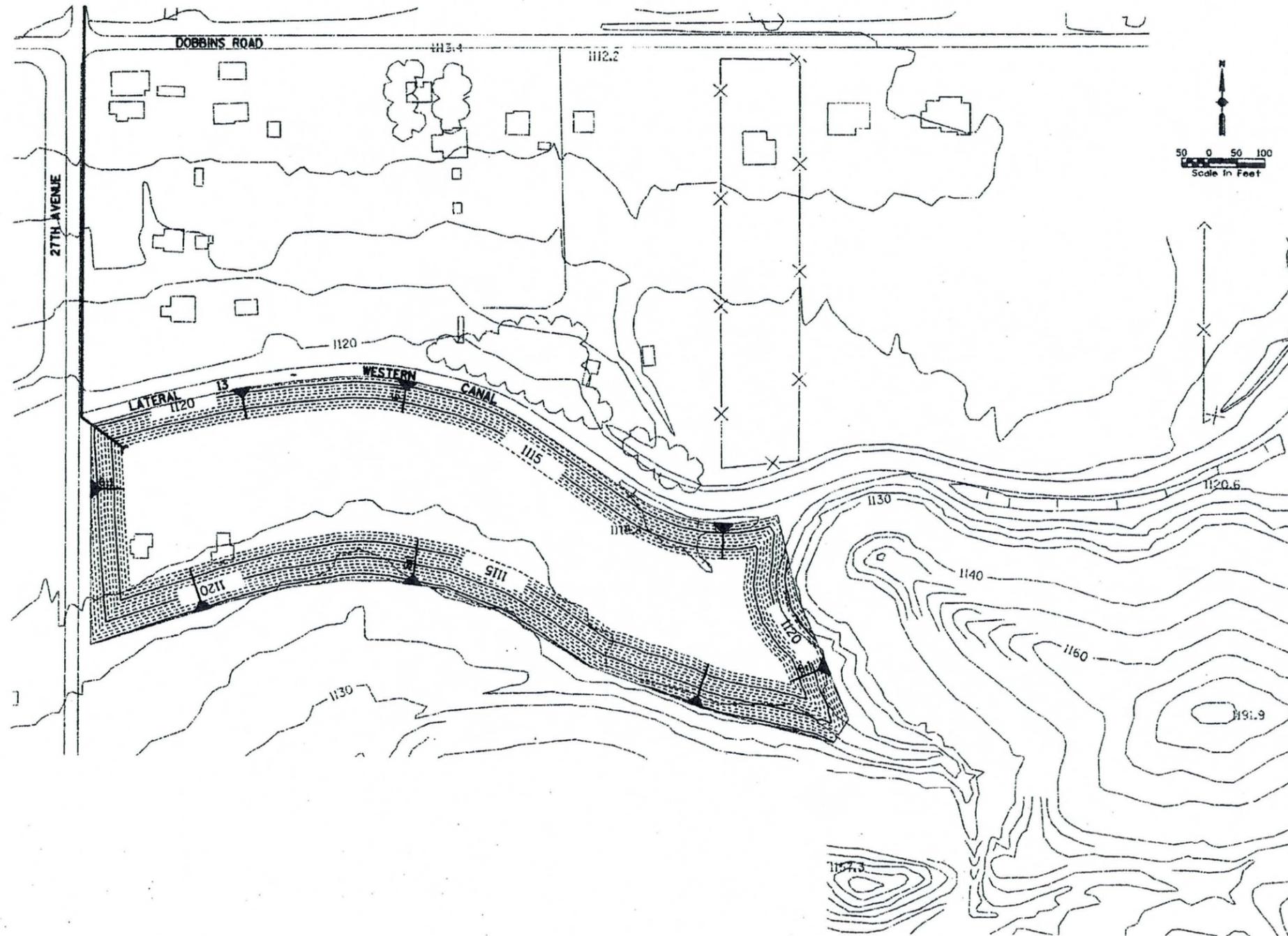
One particular utility of note in relation to the proposed concept storm drain system is the existing City of Phoenix 60" regional water transmission main in 27th Avenue. Part of the storm drain collector system would need to cross 27th Avenue at Olney Avenue and at a point just north of the Western Canal Lateral. These storm drains envisioned as crossing under the 60" regional water transmission main. The outlet pipe from the new regional basin would also need to cross under the water transmission main just south of Dobbins Road. The outfall storm drain for the basin going north in 27th Avenue will need to cross under an existing sanitary sewer on the east side of 27th Avenue north of Dobbins Road.

There would also be four locations where new storm drain would need to cross under the Western Canal and / or its laterals. A significant part of the collector system east of 27th Avenue would need to be aligned within the Salt River Project's Western Canal Lateral right-of-way along its south side. SRP would benefit from the flood protection provided by the proposed future regional basin and storm drain system in that it would provide a high level of protection for the canal lateral from significant offsite flows.

The basin and storm drain layout corresponding to the basin site at the southwest corner of 27th Avenue and Dobbins Road is referred to as "Alternative 1". The Alternative 1 basin and storm drain layout is depicted in Figure 7.1B followed by Figure 7.1C depicting 27th Avenue typical roadway sections with the new storm drain alignment relative to existing wet utilities. These figures are followed by the Table 7.1 cost estimate for Alternative 1.

As mentioned previously, all of the initial alternatives covered in Section 4 of this report use the Alternative 1 form of the future 27th Avenue and Dobbins Road regional basin in their regional HEC-1 models. Supporting technical data for this section is found in Appendix F.

A second location and configuration for the future 27th Avenue and Dobbins Road regional basin referred to as 'Alternative 2' is covered in sub-section 7.2 following the figures and tables mentioned above.



REMOVE

7

CONSTRUCT

①

DETENTION BASIN DATA
 AREA AT MAX WSEL = 9.7 ACRES
 STORAGE VOLUME = 66.0 ACRE-FEET
 OUTFLOW = 45 CUFT/SEC
 MINIMUM ELEVATION = 1111.50
 MAXIMUM ELEVATION = 1128.13
 MAXIMUM WSEL = 1120.00

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT
 OF MARICOPA COUNTY
 ENGINEERING DIVISION**

**SOUTH PHOENIX/LAVEEN
 DRAINAGE IMPROVEMENT PROJECT
 PROJECT NO. 94-14**

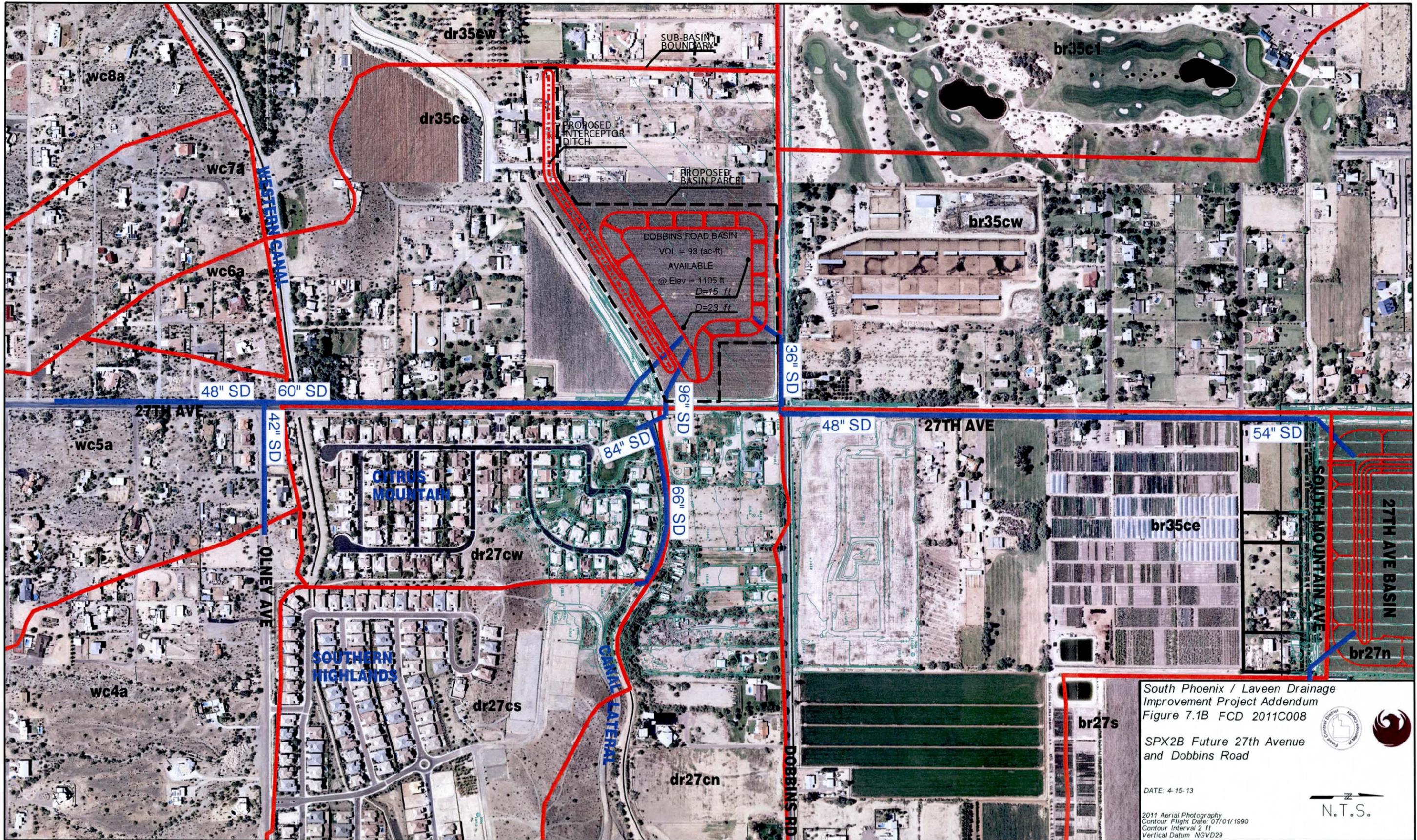
BY	DATE
DESIGNED S. MILLER	6/97
DRAWN K. JACOBSON	6/97
CHECKED M. HEATON	6/97

BASIN SITE PLAN SHEET OF 56 58
 27TH AVE AND DOBBINS RD

TRACE NO.

TE -
 Figure 7.1A

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 DATE: 18-July-97 14:34



South Phoenix / Laveen Drainage Improvement Project Addendum
 Figure 7.1B FCD 2011C008

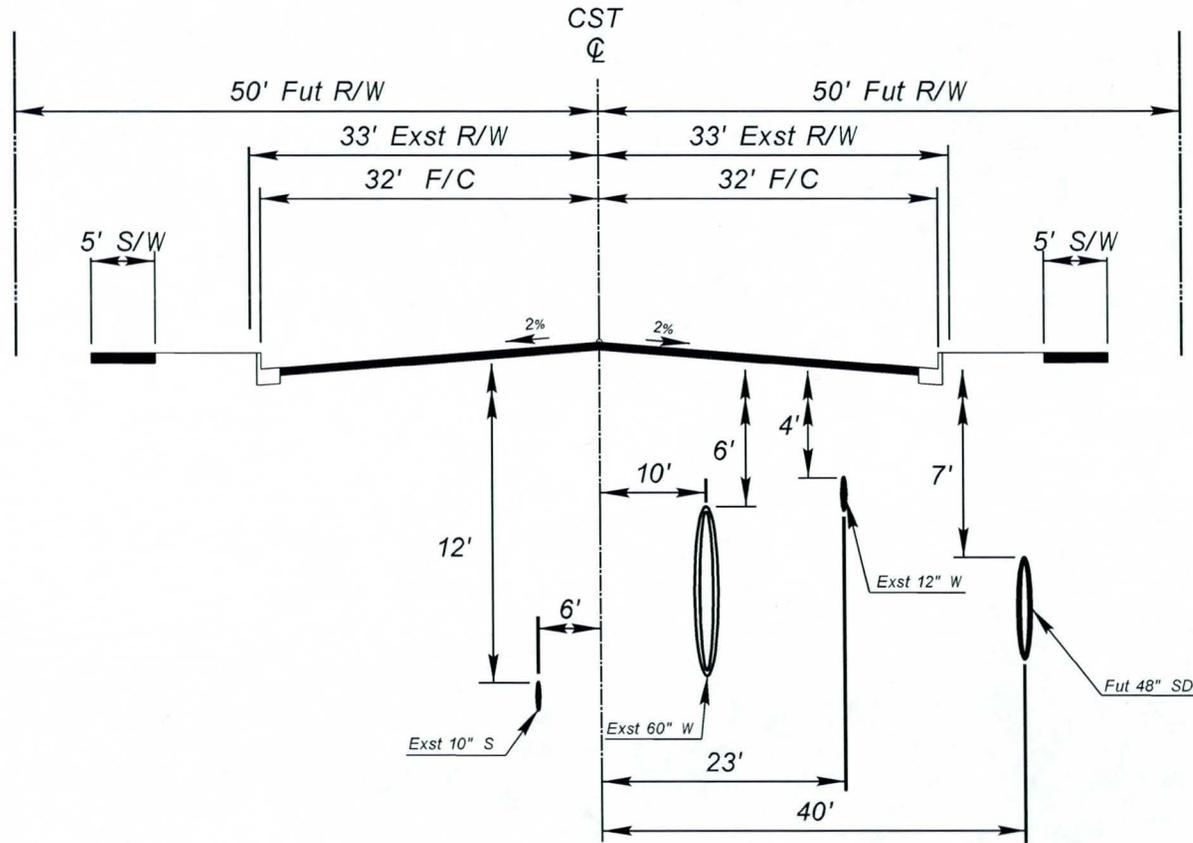
SPX2B Future 27th Avenue and Dobbins Road

DATE: 4-15-13

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour Interval 2 ft
 Vertical Datum NGVD29



//PHX-FS2/Ph-Projcts-2/2179/14-South Phoenix Two Basins 23621/12-SPX2B Design/01-SPX2B Exhibts/SPX2B-Dobbins Rd Basin Exhibts.dgn



Note:

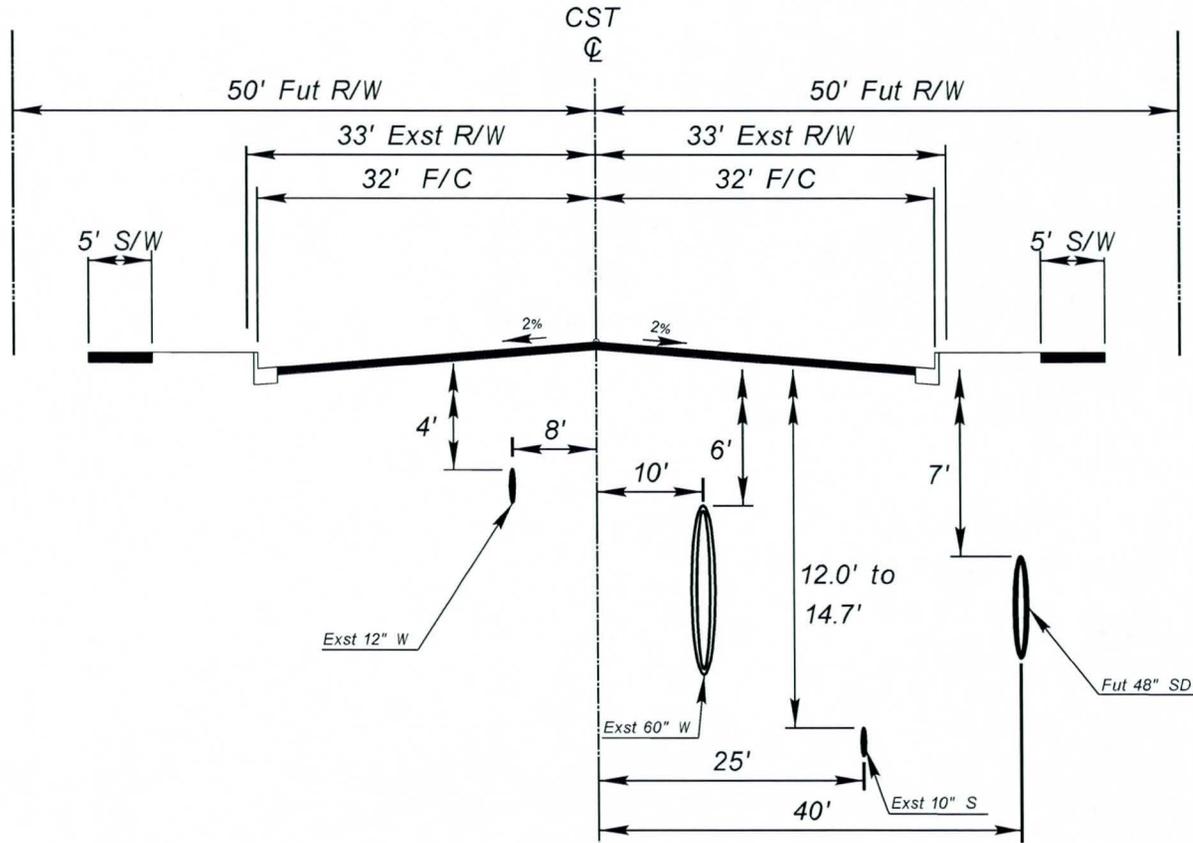
1. Depths below grade and offsets from center line shown approximate based on as-built files and quarter section maps.

2. Roadway typical section depicts anticipated ultimate future improvements.

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
27TH AVENUE NORTH OF DOBBINS ROAD TYPICAL SECTION
LOOKING NORTH FROM DOBBINS ROAD TO 1/4 MILE TO THE NORTH**

N.T.S.

DATE: 2-22-12



Note:

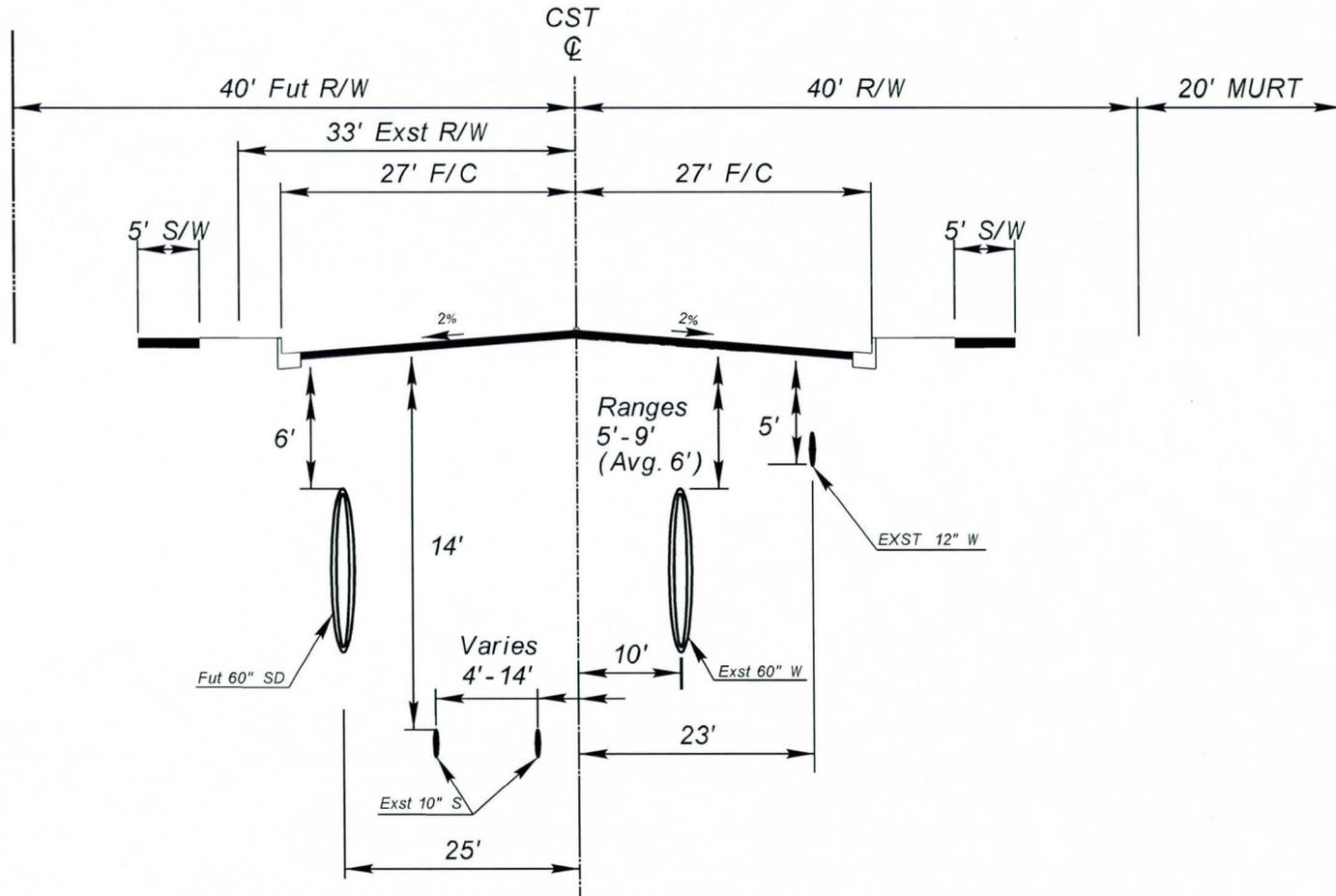
1. Depths below grade and offsets from center line shown approximate based on as-built files and quarter section maps.

2. Roadway typical section depicts anticipated ultimate future improvements.

**SOUTH PHOENIX / LAVERN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
27TH AVENUE SOUTH OF SOUTH MOUNTAIN AVE TYPICAL SECTION
LOOKING NORTH FROM SOUTH MOUNTAIN AVE TO 1/4 MILE TO THE SOUTH**

N.T.S.

DATE: 2-22-12



Note:
 1. Depths below grade and offsets from center line shown approximate based on as-built files and quarter section maps.
 2. Roadway typical section depicts anticipated ultimate future improvements.

SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
27TH AVENUE SOUTH OF DOBBINS ROAD TYPICAL SECTION
LOOKING NORTH ADJACENT TO CITRUS MTN SUBDIVISION

N.T.S.

DATE: 2-22-12



NOTES:
 1. POTHOLE EXCAVATIONS WERE PERFORMED BY CITY OF PHOENIX WATER SERVICES DEPARTMENT FIELD CREWS.
 2. ELEVATIONS/LOCATIONS WERE SURVEYED BY STANLEY CONSULTANTS. ELEVATIONS ARE NAVD 1988.

Pothole #	Pavement Elev (ft)	Measure Down to Top of Pipe (ft)	Top of Pipe Elev (ft)	Station
1	1122.01	9.30	1112.71	146+93
2	1114.51	7.95	1106.56	152+48

SOUTH PHOENIX / LAVEEN
 DRAINAGE IMPROVEMENT PROJECT
 ADDENDUM
 27TH AVENUE 60" CITY OF PHOENIX
 WATER TRANSMISSION MAIN
 POTHOLE LOCATIONS AND RESULTS
 OCTOBER 2012

FIGURE 7.1D

Table 7.1 (Note: Table 7.1 corresponds to Table 1H in Section 1 – Overview and Summary)

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
COST ESTIMATE - FUTURE 27TH AVE / DOBBINS ROAD BASIN ALTERNATIVE 1**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	CHANNEL GRADING	CY	2,777	\$5	\$13,885
3	DRAINAGE EXCAVATION (BASIN)	CY	164,798	\$5	\$823,988
4	PLAIN DUMPED RIPRAP, D50=6"	CY	500	\$60	\$30,000
5	STABELIZED GRANITE MAINT ACCESS RD	SY	2,881	\$15	\$43,215
6	5.5" AC PVMT @ 27TH AVE SD CROSSING	SY	450	30	\$13,500
7	4" AB BASE @ 27TH AVE SD CROSSING	SY	450	8	\$3,600
8	6" STBLZD SUB-G @ 27TH AVE SD CROSSING	SY	450	\$20	\$9,000
9	SPECIAL STR @ 27th AVE CROSSING (3x48 in)	EA	1	\$120,000	\$120,000
10	SPECIAL STR @ 27th AVE CROSSING (36 in)	EA	1	\$30,000	\$30,000
11	36" SD	LF	570	\$70	\$39,900
12	42" SD	LF	680	\$80	\$54,400
13	48" SD	LF	2,430	\$120	\$291,600
14	54" SD	LF	1,630	\$160	\$260,800
15	60" SD	LF	2,290	\$190	\$435,100
16	66" SD	LF	900	\$220	\$198,000
17	84" SD	LF	80	\$380	\$30,400
18	96" SD	LF	470	\$500	\$235,000
19	MANHOLE	EA	24	\$3,200	\$76,800
20	CONCRETE CATCH BASIN	EA	88	\$5,000	\$440,000
21	HEADWALL	EA	4	\$75,000	\$300,000
22	LANDSCAPING	AC	12.1	\$15,000	\$181,500

Subtotal Constrution		\$3,655,688
Construction Contingenc	25%	\$913,922
Design	7%	\$319,873
Construction Admin	6%	\$274,177
Total Construction Costs		\$5,163,659

ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
304-91-105E	Southwest corner Dobbins / 27th Ave	19.4	Part (vac)	\$2.00	\$1,690,128
		19.4			\$1,690,128

Total Construction Costs	\$5,163,659
Total ROW Acquisition Costs	\$1,690,128
Total Estimated Cost	\$6,853,787

Notes:

1. Estimate includes the cost of the collector storm drain system, the future regional basin and the outfall to the 27th / S Mtn Ave regional basin. Catch basins are assumed to be part of street improvements. Pavement replacement assumes conventional trenching.
2. Estimate does not include R/W cost from SRP or any R/W other than basin parcel.

7.2 – Alternative 2 Basin and Storm Drain

An alternative location for the future 27th Avenue and Dobbins Road regional basin was considered in the area east of 27th Avenue between Dobbins Road on the north and the Western Canal Lateral on the south. This is roughly the location of the basin site depicted by consultant URS in May of 2000 as mentioned in sub-section 7.1.

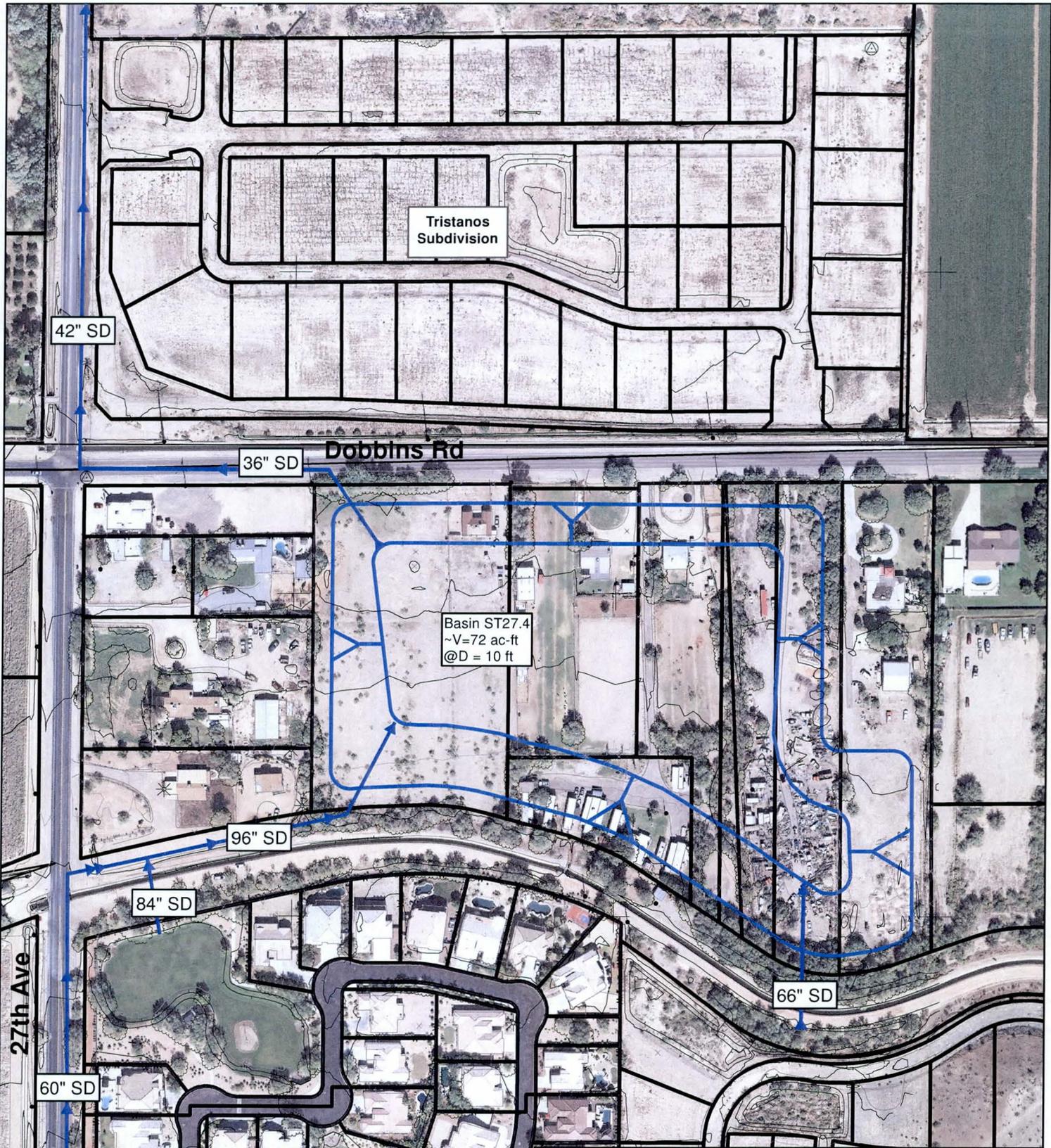
This alternative site is still strategically advantageous from a hydrologic standpoint. The alternative location would lend itself better to interception of flows from east of 27th Avenue as compared to the basin site west of 27th Avenue. And significant flows along 27th Avenue from the south could still be intercepted and directed to the alternative basin site location.

One potential advantage to the alternative basin site location is that the storm drain collection system is all situated to the east of 27th Avenue or could be aligned along the east side of 27th Avenue and would not have to cross the existing 60" City of Phoenix water transmission main. The outfall storm drain going north from Dobbins Road along 27th Avenue can be contained within right of way on the east side of the water transmission main and not have to cross it.

There would still be storm drain crossings under the Western Canal (and laterals). The drainage that outfalls from the Southern Highlands subdivision along the Western Canal Lateral could be collected in a storm drain and taken under the canal directly to the north in a relatively short run of pipe where it would outfall into the Alternative 2 basin site instead of being directed west along the south side of the canal. SRP would still benefit from the flood protection provided to their canal lateral.

The significant disadvantage is that a site of the size required to achieve the same level of function as the basin location west of 27th Avenue would have to be made up of a number of residential parcels. Some of these parcels do not appear to have any existing residential structures but there are three or four occupied parcels. One parcel along the canal appears to have seven or eight mobile homes on it.

The alternative basin site is illustrated on Figure 7.2. The Alternative 2 basin was sized and situated on the basis that it would have a volume similar to that of the basin on the west side of 27th Avenue assuming a 10 foot depth of water. A HEC-1 model was developed to verify the feasibility of the Alternative 2 basin.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 7.2
Future 27th Avenue and Dobbins Road Alternative 2 Regional Basin

Date: 1/8/2013

Legend

- Prospective Regional Basin Location
- Prospective Storm Drain

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour interval 2 ft
 Vertical Datum NGVD29

Note: Basin volume is based on 6:1 side slopes @ depth shown and represent approximate available volume based on footprint.



N.T.S.



Table 7.2

**SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM
FUTURE 27TH AVE / DOBBINS ROAD BASIN ALTERNATIVE 2 COST ESTIMATE**

Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	1	\$25,000	\$25,000
2	DRAINAGE EXCAVATION (BASIN)	CY	163,512	\$5	\$817,558
3	PLAIN DUMPED RIPRAP, D50=6"	CY	500	\$60	\$30,000
4	STABLIZED GRANITE MAINT ACCESS RD	SY	2,881	\$15	\$43,215
5	36" SD	LF	450	\$70	\$31,500
6	42" SD	LF	2,030	\$80	\$162,400
7	48" SD	LF	2,470	\$120	\$296,400
8	60" SD	LF	2,100	\$190	\$399,000
9	66" SD	LF	150	\$220	\$33,000
10	84" SD	LF	100	\$380	\$38,000
11	96" SD	LF	360	\$500	\$180,000
12	MANHOLE	EA	22	\$3,200	\$70,400
13	CONCRETE CATCH BASIN	EA	88	\$5,000	\$440,000
14	HEADWALL	EA	5	\$50,000	\$250,000
15	LANDSCAPING	AC	12.2	\$15,000	\$183,378

Subtotal Construction		\$2,999,852
Construction Contingency	25%	\$749,963
Design	7%	\$262,487
Construction Admin	6%	\$224,989
Total Construction Costs		\$4,237,290

ROW Acquisition					
Parcel APN #	Area (SF)	Area (AC)	Take	Cost per SF	Total Cost
300-16-046	152,196	3.5	Whole (res)	\$5.50	\$837,079
300-16-004A	83,597	1.9	Whole (res)	\$5.50	\$459,785
300-16-005A	42,270	1.0	Whole (res)	\$3.50	\$147,944
300-16-038A	66,548	1.5	Whole (res)	\$5.50	\$366,015
300-16-024K	13,614	0.3	Whole (vac)	\$3.00	\$40,843
300-16-024U	46,935	1.1	Whole (res)	\$3.50	\$164,274
300-16-024V	77,244	1.8	Whole (res)	\$3.50	\$270,353
300-16-024L	50,126	1.2	Part (res)	\$3.50	\$175,439
		12.2			\$2,461,733

Total Construction Costs	\$4,237,290
Total ROW Acquisition Costs	\$2,461,733
Total Estimated Cost	\$6,699,023

Notes:

1. Estimate does not include costs associated with street improvements except as noted.
2. Estimate does not include R/W cost from SRP or any R/W other than basin parcel.
3. (res) at \$3.50 SF for residential parcels developed with no apparent residents on the parcel.
4. (res) at \$5.50 SF for residential parcel developed with occupants.
5. (vac) defines a parcel as vacant land.
6. Residential parcel costs do not include relocation costs.

7.3 – Future 27th Ave / Dobbins Road Basin Conclusions and Recommendation

The cost of each alternative is very similar. Land acquisition costs are greater with Alternative 2 than with Alternative 1 but this is offset by lower cost of storm drain which is around 2,000 linear feet less than with Alternative 1. However, Alternative 1 is recommended because the basin property is unoccupied. The cost associated with relocation of existing residents in Alternative 2 has not been included in the tabulated estimate but it could be significant because of the number and type of relocations involved.

The future storm drains crossing the existing City of Phoenix 60" water transmission main in 27th Avenue will require coordination with the City's Water Services Department (WSD). Based on preliminary feedback from WSD staff, the storm drain would have to go under the water transmission main. This has been the assumption all along in developing the storm drain and basin layout. Because of the type of pipe used to construct the water main, its age and its strategic nature, the storm drain crossing must be done via jack and bore with a minimum of 4 feet of undisturbed soil between the two pipes. The City will also require acoustic monitoring or other monitoring as determined during construction.

Because of the magnitude of discharge and size of the pipe involved in the 27th Avenue crossing near the Western Canal lateral, this crossing is envisioned as multiple pipes of diameter smaller than the 96" storm drain main with a reinforced concrete vault on either side of 27th Avenue. A StormCad model was created for the storm drain run from the future regional basin crossing under the 60" water main to the east side of 27th Avenue, then jogging south under the Western Canal Lateral and turning east along the south side of the canal extending to the northwest corner of the Southern Highlands subdivision.

Different combinations of pipe diameter and number of pipes were analyzed under 27th Avenue to provide the required clearance between storm drain and water main. The recommended combination is a 3-barrel 48" arrangement.

The 27th Avenue and Dobbins Road future regional basin and storm drain does have outfall and hydrologic ties to the overall regional plan but is otherwise somewhat independent from the costs and decision process involving other alternatives and elements associated with this addendum. Its cost is independent from the cost of the improvements of recommended Alternative 6 covered in the next section of this addendum report.

Supporting technical data for this sub-section, including the StormCad model mentioned above, is found in Appendix F of this report.

Section 8 – Recommended Future Basin and Storm Drain Alternative

8.1 – Alternative Development, Overview and Recommendation

Alternative 6 is based primarily on Initial Alternative 3 covered in Section 4.5. It incorporates the updated South Mountain Park detention basin level pool routing step and contributing hydrology covered in Section 5 and the updated future 7th Avenue storm drain extension including the 7th Avenue / Dobbins Road storm drain flow split and Dobbins Road outfall storm drain covered in Section 6.

The basic components of Initial Alternative 3 have evolved through additional analysis, refinement and coordination among the project team. Potential issues have been resolved to the point where the system's various components have come together to form a single combined recommended alternative.

Alternative 6 is the recommended alternative. This would be in combination with the recommended 27th Avenue and Dobbins Road future basin covered in the previous section of this addendum report. The elemental components of Alternative 6 are summarized below, then presented in more detail in the sub-sections which follow as to the specifics regarding the development and issue resolution relating to each component.

Recommended Alternative 6 incorporates the following primary features:

- A future regional storm drain extension in 7th Avenue from just south of Baseline Road to approximately Olney Avenue which intercepts outflow from the existing South Mountain Park regional detention basin and local flow from east of 7th Avenue. This storm drain includes a flow split structure at the intersection of 7th Avenue and Dobbins Road. The outfalls are north to the existing Baseline Road storm drain and west in Dobbins Road via future storm drain that outfalls to a small future regional detention basin in the City of Phoenix future water treatment plant site.
- Two small regional detention basins within the future City of Phoenix water treatment plant site with associated storm drain and an open channel. The future Dobbins Road storm drain outfalls to this system. A future storm drain west in South Mountain Avenue provides the outfall for this system.
- A future regional detention basin on the south side of Dobbins Road just west of the Humane Society facility. This is an updated version of what had been part of Initial Alternative 3 at that location. A future storm drain west in Dobbins Road provides the outfall for this basin.
- A small regional detention basin and storm drain collector system on the south side of the Western Canal near 19th Avenue. This is an updated version of what had been part of Initial Alternative 3 at that location. A future regional storm drain north in 19th Avenue provides the outfall for this system.

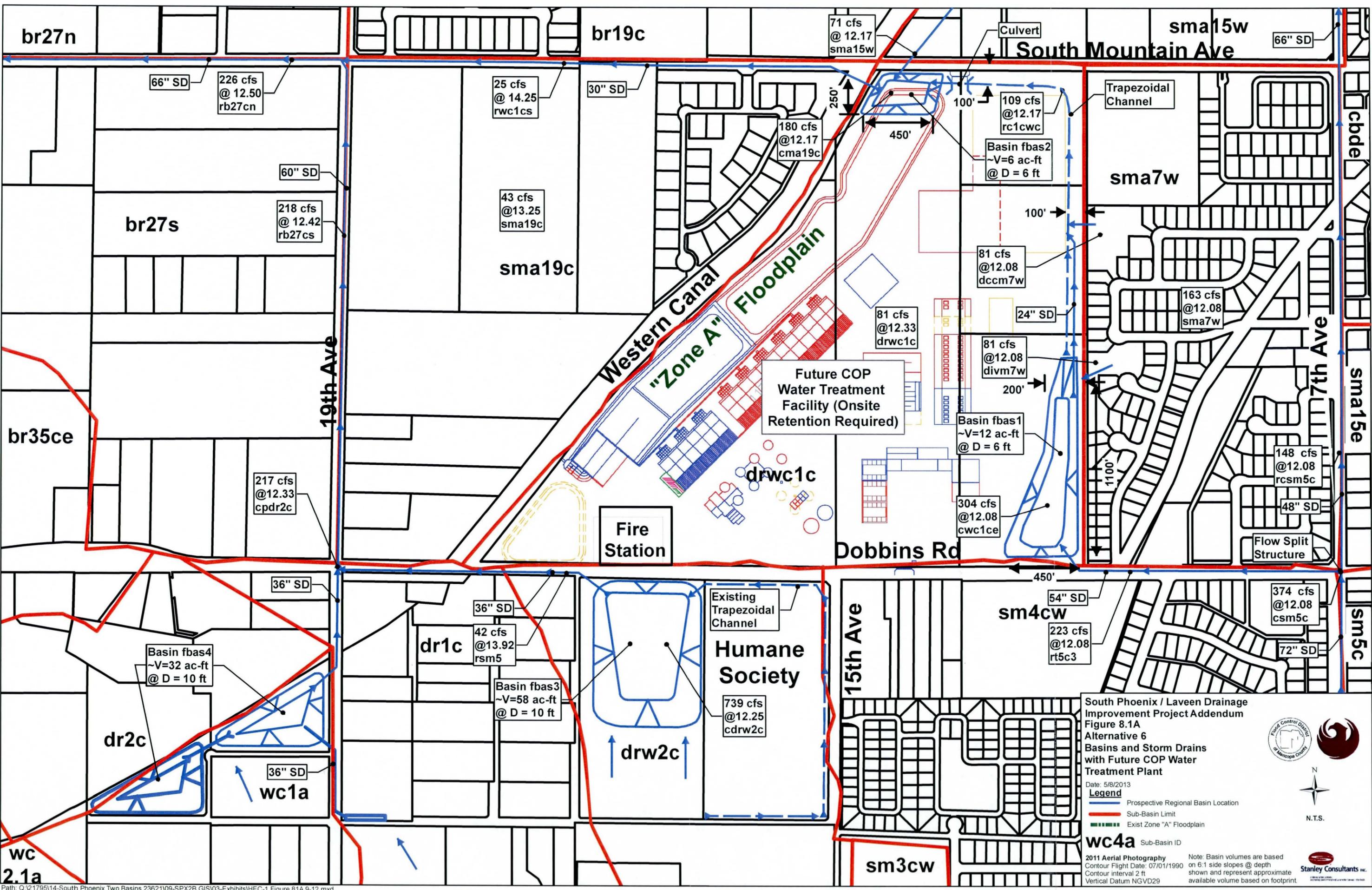
- A regional outfall storm drain in 19th Avenue from Dobbins Road north to South Mountain Avenue, then west to the new 27th Avenue and South Mountain Avenue regional basin provides the outfall for the contributing upstream future regional basin and storm drain systems mentioned above.

Alternative 6 incorporates the final elevation-storage-discharge relation for the regional basins located at 27th Avenue and South Mountain Avenue and at 43rd Avenue and Baseline Road.

Figure 8.1A on the following page illustrates the recommended Alternative 6 primary features including future regional facilities on the City of Phoenix water treatment plant site, the basin just west of the Humane Society, the twin basin and storm drain collector system in the Western Canal 19th Avenue vicinity and the future regional storm drain system. This is followed by Table 8.1 which is the recommended Alternative 6 cost estimate.

The two small basins on the City of Phoenix water treatment plant site have been conceptually configured based on the water treatment plant master plan layout from 2006 in Figure 4.4. The final configuration of these basins will need to recognize any future updates to the layout of the water treatment plant, especially the small basin at the southeast corner of South Mountain Avenue and the Western Canal.

The cost estimate includes all of the future basin and storm drain system south of Baseline Road and east of 27th Avenue. It does not include the recommended future 27th Avenue and Dobbins Road basin, collector storm drain and outfall storm drain in 27th Avenue to the 27th Avenue and South Mountain Avenue regional basin, the costs for which are summarized in Table 7.1 in the previous section.



South Phoenix / Laveen Drainage Improvement Project Addendum
Figure 8.1A
Alternative 6
Basins and Storm Drains with Future COP Water Treatment Plant

Date: 5/8/2013

Legend

- Prospective Regional Basin Location
- Sub-Basin Limit
- Exist Zone "A" Floodplain

wc4a Sub-Basin ID

2011 Aerial Photography
 Contour Flight Date: 07/01/1990
 Contour interval 2 ft
 Vertical Datum NGVD29

Note: Basin volumes are based on 6:1 side slopes @ depth shown and represent approximate available volume based on footprint.

Stanley Consultants Inc.

Table 8.1 (Note: Table 8.1 corresponds to Table 1A in Section 1 – Overview and Summary)

SOUTH PHOENIX / LAVEEN DRAINAGE IMPROVEMENT PROJECT ADDENDUM COST ESTIMATE SUMMARY - RECOMMENDED ALTERNATIVE 6 (TOTAL COST)					
Estimated Construction Costs					
Item No.	Description	Unit	Quantity	Unit Price	Cost
1	MISC REMOVALS - PVMT, CULVERTS, FENCE	LS	6	\$25,000	\$150,000
2	DRAINAGE EXCAVATION (BASIN)	CY	257,096	\$5	\$1,285,479
3	DRAINAGE EXCAVATION (CHANNEL)	CY	2,135	\$6	\$12,810
4	HUMANE SOCIETY CHANNEL OUTFALL STR	EA	1	\$50,000	\$50,000
5	24" SD	LF	850	\$40	\$34,000
6	30" SD	LF	2,850	\$60	\$171,000
7	36" SD	LF	2,850	\$70	\$199,500
8	48" SD	LF	1,300	\$110	\$143,000
9	54" SD	LF	1,800	\$160	\$288,000
10	60" SD	LF	4,950	\$190	\$940,500
11	66" SD	LF	7,400	\$220	\$1,628,000
12	FLOW SPLIT STRUCTURE (7TH AVE & DOBINS RD)	EA	1	\$50,000	\$50,000
13	CONCRETE INLET SPILLWAY	EA	5	\$12,000	\$60,000
15	CONCRETE INLET STRUCTURE	EA	2	\$25,000	\$50,000
16	MANHOLE	EA	56	\$3,200	\$179,200
17	HEADWALL	EA	9	\$50,000	\$450,000
18	CONCRETE CHANNEL LINING (6")	SY	1010	\$37	\$37,370
19	LANDSCAPING	AC	26.7	\$15,000	\$399,750
Subtotal Construction					\$6,128,609
Construction Contingency				25%	\$1,532,152
Design				7%	\$536,253
Construction Admin				6%	\$459,646
Total Construction Costs					\$8,656,660
ROW Acquisition					
Parcel APN #	Location	Area (AC)	Take	Cost per SF	Total Cost
300-52-001	South side Dobbins Rd just west of Humane Soc	11.8	Part (vac)	\$3.00	\$1,542,024
300-16-013F	South side Western Canal just west of 19th Ave	4.3	Whole (vac)	\$3.00	\$561,924
300-52-002W	Northeast corner of 19th Ave and Piedmont Rd (200'x50')	0.23	Part (vac)	\$3.00	\$30,056
300-16-013U	South side Western Canal west of 19th Ave	3.6	Whole (vac)	\$3.00	\$470,448
		19.9			\$2,604,452
Total Construction Costs					\$8,656,660
Total ROW Acquisition Costs					\$2,604,452
Total Estimated Cost					\$11,261,112
Notes:					
1. Estimate does not include costs associated with street improvements, including common roadway drainage catch basins and laterals. Larger regional size catch basin inlets / laterals are included at locations such as 7th Ave near Olney and at 19th Ave near Piedmont (see line item 15).					
2. Estimate does not include 27th Ave & South Mtn Ave regional basin or future 27th Ave and Dobbins Rd basin.					
3. Estimate does not include R/W acquisition costs on property owned by City of Phoenix.					
4. Landscaping acreage and costs in table above relating to drainage infrastructure improvements on COP water treatment plant site reflect only the actual drainage improvements and not to overall site.					
5. Estimate does not include future storm drain depicted as "optional" on Recommended Alternative 6 Storm Drain Concept Layout figure.					

8.2 – Future Regional Facilities at City of Phoenix Water Treatment Plant Site

Subsequent to the development of initial alternatives, the project team conducted coordination meetings with City of Phoenix Water Services Department staff to discuss alternatives that might serve common objectives between the SP/LDIP and development of the future water treatment plant site. A number of different initial basin and conveyance concepts were explored and refined. Then, specific elements were advanced including the proposed basin along the east side of the site which provides an outfall for the Dobbins Road leg of the storm drain flow split at 7th Avenue and Dobbins Road.

Once the outfall for the Dobbins Road leg of the storm drain flow split was conceptually finalized with City of Phoenix WSD, the storm drain flow split at the 7th Avenue and Dobbins Road intersection was completed. This split was conceptually designed through an iterative process to limit the flow going north in 7th Avenue so the flow in the Baseline Road storm drain at 7th Avenue would be the maximum that would still meet the project's hydraulic grade line target at that node and at nodes downstream in the Baseline Road storm drain. The flow rate in the Baseline Road storm drain is 298 cfs which meets the target objectives. The future storm drain extension in 7th Avenue in recommended Alternative 6 intercepts 100% of the regional future condition 100-year flow from east of 7th Avenue.

Proposed Alternative 6 future regional detention basins, storm drains and channels within the City of Phoenix water treatment plant site along its east and north perimeter will intercept 100% of 100-year future condition flows that would otherwise enter the site and impact the proposed water treatment facilities. The basin along the east side of the site, in addition to serving as an outfall for the Dobbins Road storm drain, will intercept flows from the southern-most of two drainage outfall points associated with the adjacent subdivision to the east. A small diameter storm drain going north provides the low-level outfall for that basin to an open channel which will also intercept flow from the northern-most of the two subdivision outfall points.

The City will need to recognize existing condition flows entering along the east boundary of the water treatment plant site through the subdivision to the east if the water treatment plant is constructed prior to the 7th Avenue storm drain extension. Existing condition flows are potentially greater than future (with project) flows along the east side of the site and likely also along the Dobbins Road frontage.

The second of the two small regional detention basins on the future water treatment plant site is located southeast of the Western Canal and South Mountain Avenue. The open channel along the east and north sides of the water treatment plant site outfalls to that basin. That basin is also located in a position to receive offsite flows that may overtop South Mountain Avenue from the north.

The combined offsite flows intercepted along the east and north sides of the water treatment plant site along with the Dobbins Road storm drain outfall flows are attenuated then discharged west via future 30" diameter storm drain pipe along South Mountain Avenue. That 30" storm drain outfalls to another future regional storm drain trunk line at the intersection of 19th Avenue and South Mountain Avenue which will discharge to the 27th Avenue and South Mountain Avenue regional basin.

Retention of onsite runoff has been assumed in the regional hydrology to be required for the City of Phoenix water treatment plant site when it is developed in the future. The volume of this onsite retention is estimated to be in the range of 10 – 18 ac-ft depending on the layout and

various components of the treatment plant and future regional drainage facilities. The arrangement and configuration of onsite retention within the water treatment plant site will need to be incorporated by the City's consultant in the future design of that facility.

Regional hydrologic analysis developed as part of the South Phoenix / Laveen Drainage Improvement Project Addendum is available for use by the City's consultant in developing and documenting the design of the water treatment plant site. If needed, this data could also be used in documenting the CLOMR / LOMR regarding the approximate flood insurance Zone A along the Western Canal, should that course need to be pursued. There is an abbreviated version of the HEC-1 existing (without project) condition hydrology that was prepared to estimate interim offsite flows to the 27th Avenue and South Mountain Avenue regional basin that is contained in Stanley's design report. That HEC-1 model may be of some use to the City's water treatment plant consultant regarding existing condition flows and the CLOMR / LOMR.

8.3 – Future Regional Basin South Side of Dobbins Road at Humane Society

The Dobbins Road / Humane Society basin is in a very strategic hydrologic location. It provides an outfall for flow from the Humane Society offsite channel which was constructed in 2011 and essentially terminates on the south side of Dobbins Road near the northwest corner of the Humane Society parcel. This basin also attenuates significant flows so that downstream outfall storm drains can be minimized in size and cost.

The Dobbins Road / Humane Society basin is a larger version of the Initial Alternative 3 basin at that location. The increase in size and volume is necessary because there is no longer a component of that basin on the future City of Phoenix water treatment plant site as there had been in the initial alternatives. The cost estimate for this basin and its outfall storm drain were therefore updated subsequent to the initial alternatives version. This basin is modeled and sized as an online basin but it could be considered as an offline basin when it reaches the design phase.

8.4 – Future Basin(s) and Storm Drain Vicinity of Western Canal and 19th Avenue

The single basin on the north side of the Western Canal just west of 19th Avenue per Initial Alternative 3 has been replaced in recommended Alternative 6 by a basin and collector storm drain system on the south side of the canal. Basin sites on the south side of the canal are strategically more advantageous than the Initial Alternative 3 basin site on the north side of the canal. Drainage from regional sub-basin DR2C on the north side of the canal would not be intercepted. It would continue to drain north to Dobbins Road as it currently does.

A basin of about 16 ac-ft in volume was evaluated on the triangular shaped parcel along the south side of the canal just west of 19th Avenue. Other basin sites were considered, one on the adjacent triangular parcel immediately to the west of the first parcel and another on the rectangular parcel at the northeast corner of 19th Avenue and Piedmont Road. All three basin sites are vacant residential parcels.

The three basin sites were considered both individually and in combination with each other along with a storm drain inlet / collector system to intercept flows from regional sub-basins WC1A and DR1C. The primary objective was to find the most cost effective way to intercept and attenuate as much flow as possible from those two sub-basins in order to minimizing the future regional storm drain that would convey the flow to the 27th Avenue and South Mountain Avenue regional basin.

The largest and most significant point of concentration in this area is about 800 feet west of 19th Avenue where there is an existing overchute of the Western Canal. That overchute is on the flow path for the majority of flow from sub-basin WC1A. The basin that was being considered on the parcel at the northeast corner of 19th Avenue and Piedmont Road is directly on the flow path corresponding to the majority of runoff from sub-basin DR1C.

Basins on the two triangular shaped parcels immediately south of the canal west of 19th Avenue were combined as a single basin in recommended Alternative 6 that together effectively attenuates the flow approaching the Western Canal from sub-basin WC1A. But there is also enough volume in that twin basin to take the majority of flow from sub-basin DR1C.

The basin that had been considered at the northeast corner of 19th Avenue and Piedmont Road was deleted. Instead, a collector storm drain would be constructed along 19th Avenue from the twin Western Canal basins south to Piedmont Road, then east in Piedmont Road a short distance to the existing wash that conveys the majority of flow from sub-basin DR1C. A large inlet would be placed at that location. The outlet from the twin basins south of the canal west of 19th Avenue would be a 36" storm drain pipe north in 19th Ave to Dobbins Road where it would join the future storm drain in Dobbins Road coming in from the east.

Section 9 – Future Regional Storm Drains

9.1 – Future Regional Storm Drains Approach and Assumptions

Per the project scope of work, once the hydrology concluded with the recommended future regional drainage system, a hydraulic analysis was performed for the future storm drains to verify their sizes and hydraulic function. This was done using SWMM version 5.0 assuming steady state flow conditions.

SWMM hydraulic models were prepared for proposed future storm drains along 7th Avenue, 19th Avenue, 27th Avenue, Dobbins Road, and South Mountain Avenue. Horizontal and vertical alignments were chosen using City of Phoenix right-of-way quarter section maps and as-built information of existing utilities within the roadway corridors. Stanley field survey was also used in addition to the as-built information.

The as-built information included quarter-section maps from the City of Phoenix for both water and sewer, SRP irrigation record drawings and Southwest Gas quarter-section maps. The quarter-section maps from the City of Phoenix included invert information for sewer and top of nut information and depth to top of pipe for water. The SRP irrigation records included invert information. As-built roadway and storm drain improvement plans were also provided for portions of the corridors by the City of Phoenix.

In May of 2012, Stanley was provided with an advance set of GIS storm drain shape files and metadata that was also used in establishing horizontal and vertical alignment of future storm drains for this addendum.

The SWMM models were set up as branching extensions of the SWMM model that had been created earlier in the project for the existing Baseline Road and 43rd Avenue regional storm drains. The profile node data for the SWMM model extensions are based on 1988 vertical datum. This required some of the as-built information that was on 1929 vertical datum to be converted to 1988 vertical datum by adding 2.1 feet to the elevations. The 1988 vertical datum is consistent with the previous Baseline Road and 43rd Avenue regional storm drain SWMM models.

Once alignments were chosen along each roadway corridor, manholes were placed based on City of Phoenix criteria for manhole spacing shown in Table 6.4.1 of the City of Phoenix Stormwater Policies and Standards manual. Manhole rim elevations were estimated based on the 1990 2-foot contour interval project topography which is on 1929 vertical datum. Elevations were adjusted for datum and outlined previously.

Head loss coefficients were entered at manholes based on values obtained from the FCDMC Hydraulics manual. Head loss coefficients for the straight-through manholes were entered based on equation 4.11 from the FCDMC Hydraulics manual and head loss coefficients for bends were based on Figure 4.8 of the manual. The base hydraulic models are for the trunk lines only and do not include storm drain laterals or catch basin inlets. A Manning's "n" value of 0.014 was used for the storm drain.

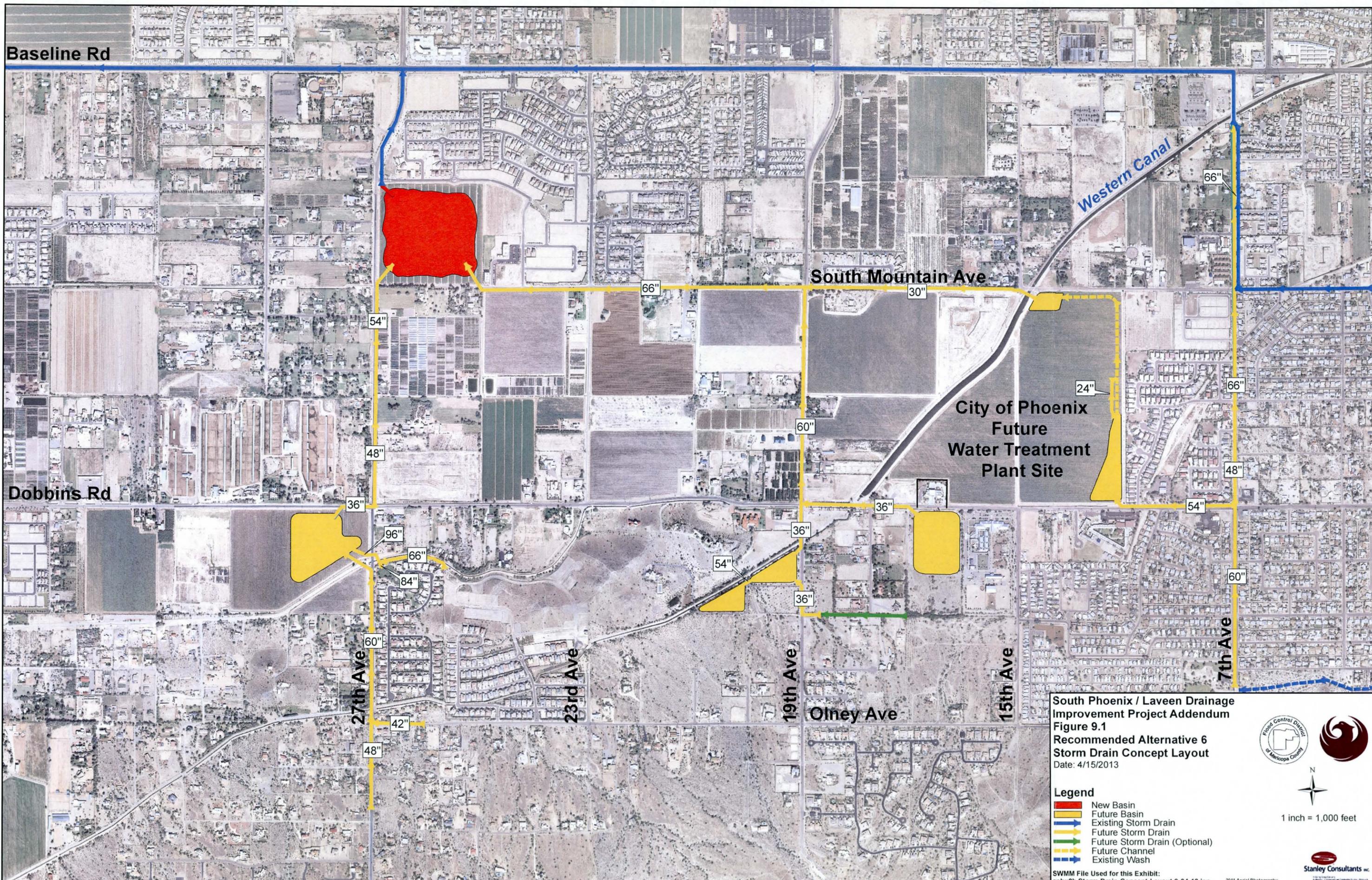
Starting tailwater conditions were established for each system based on the proposed outfall condition. For storm drains that discharge to proposed detention basins, the estimated 100-year water surface elevation for the basin at the storm drain routing peak flow time was used as the starting tailwater elevation. For the storm drain in 7th Avenue, the upstream hydraulic grade line from the SWMM unsteady flow model for the existing storm drain in Baseline Road was used.

The model includes the junction at 7th Avenue and Dobbins Road which has one inlet storm drain with two outlet storm drains. The design of this structure is intended to limit the total flow that reaches 7th Avenue and Baseline Road to 298 cfs and prevent flooding at the intersection. A non-standard diversion structure is required at 7th Avenue and Dobbins Road to accomplish the requirements. SWMM does not have the ability to model the diversion structure, so the model is broken up into three segments at the intersection. The starting flow rate for the segments that continue downstream and the starting tailwater condition for the upstream segment is from an independent analysis of the diversion structure.

Storm drains were sized to create systems where the pipes are flowing full with no surcharge. This condition allows for flexibility in the future when the systems go to the design phase.

Figure 9.1 on the following page illustrates the future storm drain system that is needed in conjunction with the recommended future 27th Avenue and Dobbins Road regional basin and recommended Alternative 6. The SWMM model covering each of the branch storm drains along with other supporting technical data is contained in Appendix H.

The profiles from the SWMM model represent actual concept level design profiles based on 1988 vertical datum. Concept level profile sketches are also provided in Appendix H illustrating existing water, sewer and irrigation facilities from quarter section maps, as-builts and survey. Alignments, typically offsets from section lines, mid-section line or street centerline, are illustrated on .jpg image files in Appendix H.



South Phoenix / Laveen Drainage Improvement Project Addendum
 Figure 9.1
 Recommended Alternative 6
 Storm Drain Concept Layout
 Date: 4/15/2013

- Legend**
- New Basin
 - Future Basin
 - > Existing Storm Drain
 - > Future Storm Drain
 - - -> Future Storm Drain (Optional)
 - > Future Channel
 - - -> Existing Wash



SWMM File Used for this Exhibit:
 sphx2b Storm Drain-Concept Layout 9-24-12.inp
 2011 Aerial Photography

9.2 – Existing 7th Avenue Storm Drain

A portion of the storm drain extension in 7th Avenue has already been constructed. The URS Baseline Road storm drain plans depict a short stub of storm drain south on 7th Avenue from Baseline Road. There are catch basins visible along 7th Avenue south from Baseline Road for a distance of about ¼ mile.

The original HDR South Phoenix / Laveen Drainage Improvement Project concept plans indicate the future storm drain extension to be 66" diameter all the way from Baseline Road south to the termination point near Olney Avenue. The City of Phoenix storm drain quarter section maps have not been updated to reflect any storm drain either in Baseline Road or in 7th Avenue. The City's GIS data base is in the process of update and in May of 2012, it was provided to Stanley Consultants for reference. The GIS metadata containing City of Phoenix project numbers was queried and a list of projects was requested of the Street Transportation Department. These projects were provided to Stanley in the form of .pdf files. These plans were reviewed by Stanley and the paragraphs below summarize what was found.

Sometime around 2004, there was a local City of Phoenix drainage improvement project consisting of 30" diameter storm drain constructed in South Mountain Avenue from 2nd Avenue to 7th Avenue and 7th Avenue north from South Mountain Avenue. This was apparently to address local flooding along South Mountain Avenue and the area to its north from local drainage from the south. The storm drain in 7th Avenue from South Mountain Avenue is 30" diameter at South Mountain Avenue and 66" diameter at Baseline Road and was designed and constructed under three different projects.

URS Baseline Road plans sealed in 2000 and as-built in 2002 includes a 66" diameter storm drain in 7th Avenue extending about 75' south of the Baseline Rd section line. From that point south, the storm drain extension was built from DeLeuw Cather plans "7th Ave Bridge Over Western Canal" sealed May 12, 2000. The City of Phoenix project numbers are BR-964841 and ST85110007. The 66" diameter storm drain was extended another +/- 570' south from the end of the URS storm drain to a point about 300' south of the Western Canal. From that point, it was extended about another 150' at 30" diameter which appears to have been just far enough to cover the roadway improvements needed for the Western Canal Bridge project.

Paving and storm drain in the DeLeuw Cather plans from a point about 100' south of the Western Canal Bridge was designed and constructed from plan sheets prepared by O'Neill Engineering for the City of Phoenix that DeLeuw Cather incorporated in their plan set. O'Neill plans were sealed April 18, 2000 and correspond to City of Phoenix project number ST85110007. The 30" diameter storm drain goes south to Gary Way (about 2,000' south of Baseline Rd) where it apparently ended. The Stanley request to the City of Phoenix for storm drain plans did not include the O'Neill plans that cover this stretch because it was not realized at the time from the GIS metadata that it was a separate plan.

Where the 66" diameter storm drain extension in 7th Avenue ends about 645' south of Baseline Rd and the 30" storm drain begins, there is a manhole. The 66" storm drain is stubbed to the south from that manhole a short distance and plugged and the 30" storm drain enters the manhole well above the top of the 66" pipe, as if possibly leaving room for the 66" storm drain to be extended in the future.

Per the original South Phoenix / Laveen Drainage Improvement Project concept, Stanley looked at the 7th Ave corridor for possible future extension of the 66" storm drain south from where it

currently ends but the corridor is somewhat crowded. There is the 30" storm drain and a 12" sewer on the east side of the center line and a multiple water and irrigation pipes on the west side. It is possible that the existing 30" diameter storm drain would need to be removed to construct the 66" storm drain per the original concept.

The 30" storm drain extension south from Gary Way to South Mountain Avenue (about 625') was designed by Sunrise Engineering under plan "South Mtn Ave, 7th Ave to Central Ave" City of Phoenix number ST87110069 (pavement) and number ST83130205 (storm drain) sealed January 15, 2004. The 30" storm drain turns east on South Mountain Avenue from 7th Ave and goes about 1,650' to 2nd Ave. The South Phoenix Two Basins Project Data Collection report under separate cover includes the above plan sheets.