

FCD 2014C003, Assignment #1
Loop 303 Corridor/White Tanks Hydrology and Delineation Update
PHASE 1 – UPDATING THE EXISTING HYDROLOGY MODEL

FINAL HYDROLOGY REPORT



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Prepared For



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EXPIRES: 6/30/16

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EXHIBITS

- Exhibit 1 HEC-1 Schematic for Existing Conditions with Partially Completed CIP Hydrology (Electronic Copy Only)
- Exhibit 2 HEC-1 Schematic for Existing Conditions with CIP In Place Hydrology (Electronic Copy Only)
- Exhibit 3 HEC-1 Schematic for Future Conditions with CIP In Place Hydrology (Electronic Copy Only)

NOTE: HEC-1 MODELS and DATA COLLECTION ITEMS are included in Electronic Copy Only.

1.0 INTRODUCTION

Parsons Brinckerhoff (PB) performed this study under Contract FCD 2014C003 with the Flood Control District of Maricopa County (FCDMC). The purpose of this study is to update the hydrology model from the Loop 303 Corridor/White Tanks Area Drainage Master Plan Update (ADMPU) Area Hydrology Analysis (AHA), dated July 10, 2009 (Reference 1). This study is Phase 1 – Updating the Capital Improvement Projects (CIP) in Hydrology Model. The project scope include performing a complete and detailed hydrology model update of the project area to reflect the completion of the Loop 303 from Grand Avenue (US 60) to Interstate 10 (I-10) and the FCDMC’s Loop 303 Outfall Drainage System from Woodlands Avenue to Gila River. In addition, the Existing Conditions HEC-1 model will be updated to reflect those CIP projects completed after the completion of ADMPU AHA in 2009 up to 2014. There is also an Optional Task to be performed to the ADOT Basins Watershed regarding the construction of retention basins within the Suncor property locations.

2.0 LOCATION OF STUDY

The study area and watersheds for the ADMPU include 238 square miles in unincorporated Maricopa County, the City of Avondale, the City of Buckeye, the City of El Mirage, the City of Glendale, the City of Goodyear, the City of Litchfield Park, the City of Surprise, and Luke Air Force Base. The study area encompasses the Agua Fria River, Gila River, El Mirage Drain, Sun City Drains, Dysart Drain, Colter Channel, Watson Drain, Beardsley Canal, White Tanks FRS #3, and White Tanks FRS #4. Figure 1 contains a Project Location and Vicinity Map.

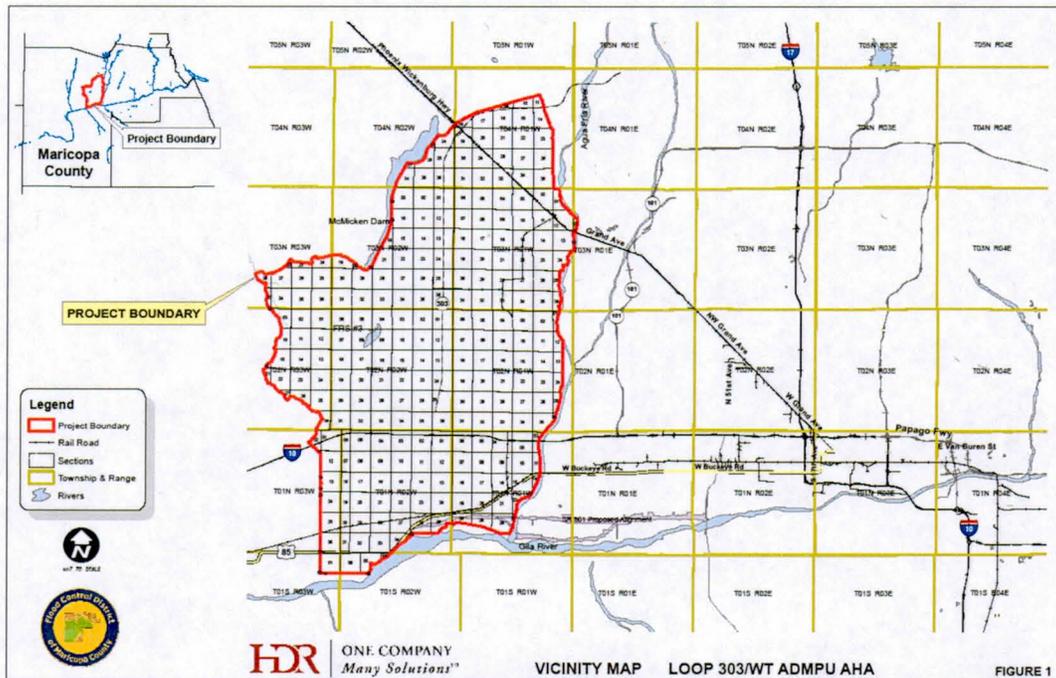


Figure 1: Project Location and Vicinity Map

3.0 HYDROLOGY MODEL UPDATE

PB performed updating existing hydrology models by using the existing hydrology models furnished by FCDMC, collecting as-built plans of the completed Loop 303 and pertinent data, and revising the hydrology models for existing and future conditions based on the existing partially completed CIP and fully completed CIP.

3.1 DATA COLLECTION

PB collected, reviewed and utilized the as-built plans, bid documents, CIP existing conditions, and FCDMC's furnished materials to update the existing hydrology models.

The FCDMC's furnished materials included the following items:

- 2009 ADMPU AHA three hydrology models including Existing Conditions, Existing Conditions with CIP In Place, and Future Conditions with CIP In Place.
- Two FCDMC's Interoffice Memoranda from John Holmes to Amir Motamedi dated October 16, 2009 and February 8, 2010, respectively.
- Figures 7 and 8 of ADMPU AHA including HEC-1 Schematic for Existing Conditions Hydrology and HEC-1 Schematic for Capital Improvement Project Conditions Hydrology.
- 2009 ADMPU AHA CAD and GIS files.

- Aerial photography with orthophotography tiles for FY 07/08 and FY 13/14.
- Inflow Design Flood Hydrology Report for White Tanks Floodwater Retarding Structure No. 4 Rehabilitation Project (FCD 2008C002).
- Northern Parkway Drainage Improvements – AT&SF Channel to Agua Fria River.

Collected as-built plans and bid documents included the following items:

- FCDMC's LOOP 303 OUTFALL DRAINAGE SYSTEM (WOODLANDS AVENUE TO GILA RIVER), PCN 470.14.31, FCD Contract No. 2011C015.
- ADOT's I-10 / SR 303L T.I. (PHASE I), Project No. 303 MA 104 H7139 01C, Federal Aid No. NH-303-A(206)N.
- ADOT's SR 303L, THOMAS ROAD - CAMELBACK ROAD, Project No. 303 MA 105 H7872 01C, Federal Aid No. STP-303-A(201)A.
- ADOT's SR 303L, CAMELBACK ROAD – GLENDALE AVENUE, Project No. 303 MA 107 H7873 01C, Federal Aid No. -303-A(202)A.
- ADOT's SR 303L, GLENDALE AVENUE-PEORIA AVENUE, Project No. 303 MA 109 H7874 01C, Federal Aid No. NH-303-A(203)N.
- ADOT's SR 303L, PEORIA AVENUE – WADDELL ROAD, Project No. 303 MA 112 H7875 01C, Federal Aid No. NH-303-A(204)N.
- ADOT's SR 303L, WADDELL ROAD – MOUNTAIN VIEW BOULEVARD, Project No. 303 MA 114 H7876 01C, Federal Aid No. STP-303-A(205)N.
- ADOT's I-10 FROM BULLARD AVENUE TO DYSART ROAD, Project No. I-IG-10-2(37).

The collected as-built plans and bid documents for this project are not printed, but they are included electronically on a compact disk in this report with other digital data files.

FCDMC has provided a revised Figure 4 – CIP Facilities from ADMPU AHA for Existing Completed CIP Projects. Figure 2 shows the partially completed CIP Facilities Map. A list of the CIP Projects, which have not yet been completed or have been removed, was provided as follows:

- Reems Road Channel between Waddell Road and Cactus Road.
- Waddell Channel (CAR).
- AT&SF Channel between the Northern Parkway Curve and approximately Waddell Road.
- AT&SF Basin.
- Northern Parkway Drainage Improvement (and basin) between Dysart Road and El Mirage Road.
- Northern Channel.
- Luke Air Force Base Improvements.
- Bullard Wash north of Camelback Road.
- I-10 West Diversion Channel from approximately 183rd Avenue to approximately 190th Avenue.

- Bullard Wash Channel (and Basin) between McDowell Road and Lower Buckeye Road.
- Olive Avenue Basin and the East Camelback Basin have been removed from the CIP Plan.

3.2 EXISTING HYDROLOGY MODELS

The existing Hydrology Models from ADMPU AHA were prepared by HDR, Inc. in August 2009. The study area for the ADMPU AHA, approximately 238 square miles in size, has been divided into two major basins (Major Basin 01 and Major Basin 02).

Major Basin 01 consists of drainage sub-basins with milder terrain, while Major Basin 02 consists of White tank Mountain and Foothills. Therefore, the ADMPU AHA has two distinct hydrology models (Major Basin 01 and Major Basin 02) to allow for different hydrologic parameters (Such as precipitation, flow split calculations, etc.).

The scope of work for this project is to update only the Major Basin 01 hydrology models. Therefore, no modifications have been made to the Major Basin 02 hydrology models.

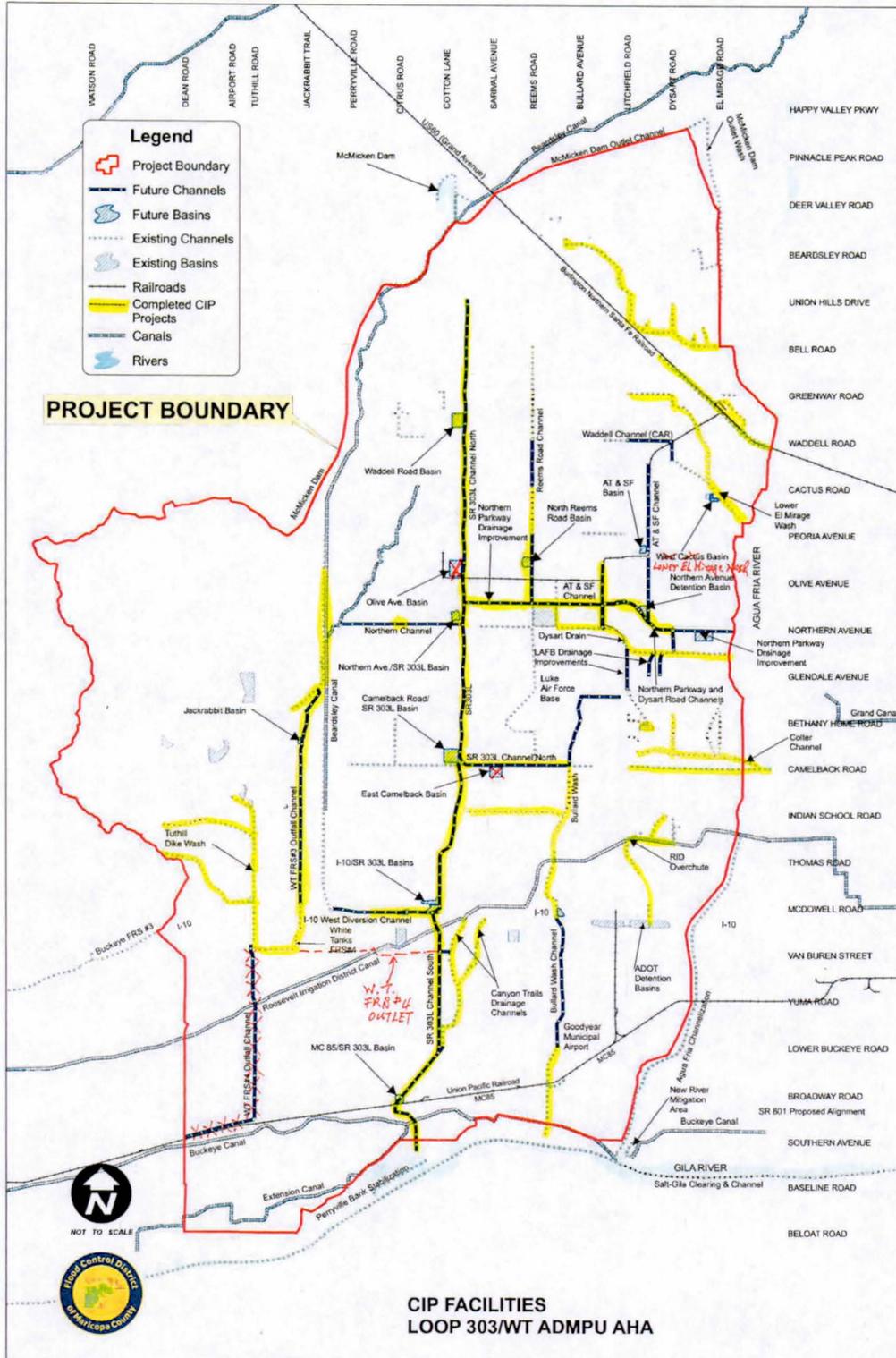


Figure 2: Existing Partially Completed CIP Facilities Map

The ADMPU AHA hydrology models were further updated by Hydrology and Hydraulics Branch of FCDMC in October 2009 and January 2010 with a new HEC-1 model names through each update. Table 1 shows the HEC-1 model names with descriptions.

Table 1: Existing HEC-1 Model Names with Model Descriptions

Description	HEC-1 Name (Used by HDR)	HEC-1 Name (Used by FCDMC)
Existing Conditions	EX-MB1.DAT	WT1E02.DAT
Existing Conditions with CIP in Place	ECIP-MB1.DAT	WT1EC02.DAT
Future Conditions with CIP in Place	FCIP-MB1.DAT	WT1FC02.DAT

3.3 UPDATING HYDROLOGY MODELS

PB used the existing 2010 hydrology models for Major Basin 01 furnished by FCDMC for this study. The U.S. Army Corps of Engineers’ HEC-1 computer software program, Version 4.1, June 1998 was used for the hydrological analyses (Reference 2). PB made changes and updated these hydrology models by keeping their same HEC-1 Model names with slightly different descriptions that ADMPU AHA used.

It should be noted that the land use and soil and bedrock maps have not changed from previous iterations of this project, and as such do not need to be updated as a part of this project.

Table 2 presents comparison between FCDMC’s 2010 HEC-1 Model names and PB’s 2015 updated HEC-1 Model names.

Table 2: Updated HEC-1 Model Names with Model Descriptions

ADMPU AHA Model Description	HEC-1 Model Name (Used by FCDMC)	Updated Model Description	Updated HEC-1 Model Name
Existing Conditions	WT1E02.DAT	Existing Conditions with Partially Completed CIP in Place	WT_EXST.DAT
Existing Conditions with CIP in Place	WT1EC02.DAT	Existing Conditions with CIP in Place	WT_EXCIP.DAT
Future Conditions with CIP in Place	WT1FC02.DAT	Future Conditions with CIP in Place	WT_FUCIP.DAT

Major changes to the existing FCDMC's HEC-1 models for the updated HEC-1 models are summarized as follows:

Olive Avenue Basin and East Camelback Basin Elimination

The Olive Avenue Basin located at west of the SR303L between Peoria Avenue and Olive Avenue has been eliminated. East Camelback Basin (it was called Reems Road Basin in the FCDMC's HEC-1 models) located at south of Camelback Road between Sarival Avenue and Reems Road has been eliminated. These two basins were removed from the updated HEC-1 models.

Prasada Development Considerations

The Prasada development, which will retain only the first flush volumes (first 0.5 inch runoff), has been reflected in the updated HEC-1 models. Two sub-basins were changed in the HEC-1 models including Sub-Basin L13 (bounded by Greenway Road on the north, SR303L on the east, Cotton Lane on the west, and Waddell Road on the south) and Sub-Basin L19 (bounded by Waddell Road on the north, SR303L on the east, Cotton Lane on the west, and Cactus Road on the south) to reflect the proposed Prasada development. The Sub-Basin L13 is divided into two Sub-Basins (L13A and L13B) based on the Prasada Development Drainage Report. Impervious areas for these Sub-Basins (L13A, L13B, and L19) are set at 80% per ADOT's direction. On-Site retention requirements for these three sub-basins are first flush volumes only instead of the 100-year 2-hour retention requirements.

Changes to Detention Basins

Waddell Road Basin, Northern Avenue Basin, and Camelback Road Basin have been changed to from off-line basins to in-line basins. Basin storage routing data (SQ, SV, and SE records) were estimated based on the SR303L as-built plans.

No Diversion to the East along Camelback Road

FCDMC's HEC-1 models follow the concept recommended in the *Loop 303 Camelback Basins Candidate Assessment Report* (Loop 303 Camelback Basin CAR), which was prepared by Aspen Consulting Engineers for FCDMC in August 2008 (Reference 3). It was recommended in the Loop 303 Camelback Basin CAR that flows from the SR303L drainage channel north of Camelback Road be diverted and discharged to the east via a drainage channel along Camelback Road and outfalls to Bullard Wash. The Camelback Road Basin recommended in the Loop 303 Camelback Basin CAR is a very small basin, which only accepts the flow from the west along Camelback Road. Revisions have been made per the completed SR303L drainage projects. All the flows in the SR303L drainage channel north of Camelback Road and the flow along the north side of Camelback Road west of SR303L will drain into the Camelback Road Basin. The basin outlet is the SR303L drainage channel to the south via a bleed-off pipe and an outflow structure. No flow is diverted to the east along Camelback Road. The values of "TAREA", the second field of HC records, were revised to reflect the changes of cumulative drainage areas.

I-10/SR303L T.I. Basin Modifications

The I-10 Basin size has been reduced from the I-10/SR303L Traffic Interchange (T.I) design. The I-10 West Basin has been eliminated. McDowell Road Upper Basin and McDowell Road Lower Basin have been combined and renamed to McDowell Road West Basin. A new basin located at Thomas Road between Cotton Lane and SR303L has been designed as the McDowell Road East Basin. The Sarival Avenue Basin has been moved from the northeast to northwest quadrant of the I-10/Sarival Avenue T.I. The Sarival Avenue Basin, RID Canal North Basin, RID Canal South Basin, and Basin 4 (located to the north of McDowell Road and east of SR303L), which were not modeled in the FCDMC's HEC-1 models, have been added to the updated HEC-1 models. The on-site detention basins, which drain the depressed directional ramps, were not modeled in the updated HEC-1 models. The McDowell Road East Basin, the McDowell Road West Basin, and the I-10 Basin were included in the updated HEC-1 models to function with a common water surface elevation. Connector reinforced concrete box culverts are provided to function as equalizers between these basins.

Channel Routing and Manning's "n" Value

Channel routings were updated based on channel dimensions shown on the six sets of SR303L as-built plans. Manning's "n" value used for the SR303L drainage channel was changed to 0.018 because the concrete-lined channel is unformed (tined or roughened) to discourage skate boarding.

Detention Basin Storage Routing

Detention basin storage routings were updated based on data included in the final drainage reports, as-built plans, and the HEC-1 models provided by the SR303L final designers.

Flow Routing Order Investigation for the Existing ADOT Basins

Per FCDMC's comment, PB performed investigation to ADOT's four detention basins located north of I-10 between Bullard Avenue and Dysart Road. Based on the field reconnaissance trip and review of the I-10 as-built plans, it was concluded that the FCDMC's comment regarding the ADOT Basins routing order is correct.

The existing ADMPU AHA HEC-1 models were modeled as from Basin B83 (or ADOT Basin 4) to Basin B84 (or ADOT Basin 3). ADOT Basins routing order has been updated as from Basin B84 (ADOT Basin 3) to Basin B83 (the east most basin – ADOT Basin 4). The reason is that there is a 48-inch outlet pipe from Basin B83 (Basin 4) to Agua Fria River running along Dysart Road and Van Buren Street per ADOT I-10 as-built plans (Project No. I-IG-10-2(37)).

Detailed Descriptions of Changes to ADMPU AHA HEC-1 Models

Detailed descriptions of changes to the HEC-1 records are documented in the updated HEC-1 models either marked with “*” or using KM records. Any changes to the original HEC-1 records from the ADMPU AHA are marked with “*” for reference. No records were deleted from the models.

Revised HEC-1 Schematics and Updated HEC-1 Models

The HEC-1 schematics have been revised for all three HEC-1 models. Three HEC-1 Schematic exhibits with 2014 aerial images are included on the compact disk in this report for three updated HEC-1 models including Existing Conditions with Partially Completed CIP in Place (WT_EXST.DAT), Existing Conditions with CIP in Place (WT_EXCIP.DAT), and Future Conditions with CIP in Place (WT_FUCIP.DAT).

Following is a summary of the changes made in both the Existing Conditions and Future Conditions “with CIP in Place” schematics:

- Channel routing L02L05 has been divided into two segments: L0205A and L0205B.
- Followings have been revised due to the Prasada development:
 - 1) Sub-basin L13 has been divided into Sub-basins L13A and L13B.
 - 2) Storage routing SRL13B has been renamed as SRL13A.
 - 3) Diversion routine DL13BN and a new hydrograph combination CPL13B have been added to the schematic.
 - 4) Channel routing L13B13 has been renamed as 13A13B.
- Storage routing SRL34B, Diversion DL34BN, hydrograph combination CPL34, and channel routing L34B34 have been removed, and hydrograph combination CPL34 has been renamed as CPL34B due to the elimination of Olive Avenue Detention Basin.
- Diversion DSRL39 and hydrograph combination CPCHNL have been added to model the outflow from Northern Avenue Detention Basin.
- Followings have been revised to reflect the changes at the Camelback Road Detention Basin: Diversion DVL541 and DVL54, hydrograph combination COBFLW have been added to the schematic.
- Channel routing L67L68 has been removed due to the elimination of channel from CPL67 to CPL68.
- Channel routing L70L71, hydrograph combination CPL72A have been added and the hydrograph combination CPL72 has been renamed as CPL72B to reflect the change at I-10/SR303L TI.
- A flow direction line (dashed line with an arrow) has been added along the Van Buren Street to model the outflow from White Tanks FRS #4.
- New hydrograph combination CPRID and channel routing RIDS13 have been added.
- Followings have been revised to reflect the changes at RID Canal North Detention Basin: Storage routing SRB99 has been added. Channel routing B99S11 has been removed.
- Storage routing SRB100 has been added to reflect the storage routing at Sarival Avenue Detention Basin.

- Followings have been revised to reflect the changes at RID Canal South Detention Basin:
 - 1) Channel routing S11S14 and hydrograph combination CPS14A have been removed.
 - 2) Storage routing SR11 is connected to hydrograph combination point CPRID.
- Followings haven revised to reflect the ADOT Detention Basins routing order changes:
 - 1) Channel routing B83B84 has been renamed as B84B83.
 - 2) Flow routing order has been changed from CPB83→SRB83→B83B84→CPB84→SRB84 to CPB84→SRB84→B84B83→CPB83→SRB83.
- Channel routing S26S31 has been divided into S26S31A and S26S31B.
- Storage routing SRS31 has been removed to reflect the elimination of Railroad Detention Basin.
- Followings have been changed to reflect the elimination of White Tanks FRS #4 Outlet channel to the south: Storage routing SRS77 and SRS78, channel routing S77S78 and S78S79 have been added to the schematic.

4.0 OPTIONAL TASK NO. 1

The purpose of this optional task is to investigate and hydrologically analyze existing developments (such as Suncor Developments) within the ADOT Basins Watershed and to update hydrology models for the proposed White Tanks FRS No. 4 Outfall that was not analyzed in the ADMPU AHA.

A Technical Memorandum has been prepared to document the findings and recommendations of the Optional Task No. 1 (Reference 4). Figure 3 shows Suncor properties – A Planned Area Development, called Palm Valley, within ADOT Basins Watershed with HEC-1 Schematic.

ADOT Basins Watershed

PB reviewed the 2007/2008 aerial photography and the 2013/2014 aerial photography to identify any recent development within the ADOT Basins Watershed. PB researched the development plans within the ADOT Basins Watershed, which is primarily located within the Suncor Development – Palm Valley Master Plan inside the City of Goodyear.

PB researched and verified the existing developments with an on-site stormwater storage over 2 acre-feet in volume. PB utilized the HEC-1 Schematic, Palm Valley PAD Phasing Map and aerial photographs, and verified any development within the ADOT Basins Watershed providing the required on-site stormwater storage volume.

It should be noted that the Palm Valley PAD was proposed and developed by Suncor Development. However, the Suncore filed bankruptcy in February 2012. There are only three Suncore properties per the Maricopa County Assessor website and those Suncore properties are shown in Figure 3.

It is concluded that the Suncor Development – Palm Valley within the ADOT Basins Watershed has implemented the on-site retention requirements for the developments occurred north of McDowell Road. However, the developments south of McDowell Road have the on-site runoff directly draining into four ADOT Basins along I-10.

The three HEC-1 models, WT_EXST.DAT, WT_EXCIP.DAT, and WT_FUCIP.DAT have been updated to reflect the removing of the on-site retention for the developed area located at Drainage Sub-Basins B73, B74, B84 and B83. ADOT Basin freeboard reductions due to removal of the on-site retention were identified for all three HEC-1 models. For the three conditions considered, the ADOT Basins have enough freeboards (from 6.8 to 11.7 feet of freeboards) to hold the additional storage volumes needed for the developed areas located in Drainage Sub-Basins B73, B74, B84 and B83.

White Tanks FRS #4 Outfall

A 90” Pipe was proposed by FCDMC along the Van Buren Street from White Tanks FRS #4 to the Loop 303L Outfall Drainage Channel to convey the outflow from the White Tanks FRS #4 to the east then to the south into Gila River. This proposed pipe was modeled in the Existing Conditions within CIP in Place Model (WT_EXCIP.DAT) and Future Conditions with CIP in Place Model (WT_FUCIP.DAT).

The outflow hydrograph from White Tanks FRS No.4 has been developed using the HEC-1 model FC24BASD.DAT provided by FCDMC. This model was developed by Wood, Patel & Associates, Inc. for the White Tanks FRS #4 Remediation Project.

The drainage area at White Tanks FRS #4 has been revised in the updated the Existing Conditions within CIP in Place Model (WT_EXCIP.DAT) and Future Conditions with CIP in Place Model (WT_FUCIP.DAT). Since the White Tanks FRS #4 accepts the flow from White Tanks FRS #3, the total drainage area at White Tanks FRS #4 has been increased from 19.97 to 41.49 square miles ($19.97+21.52=41.49$).

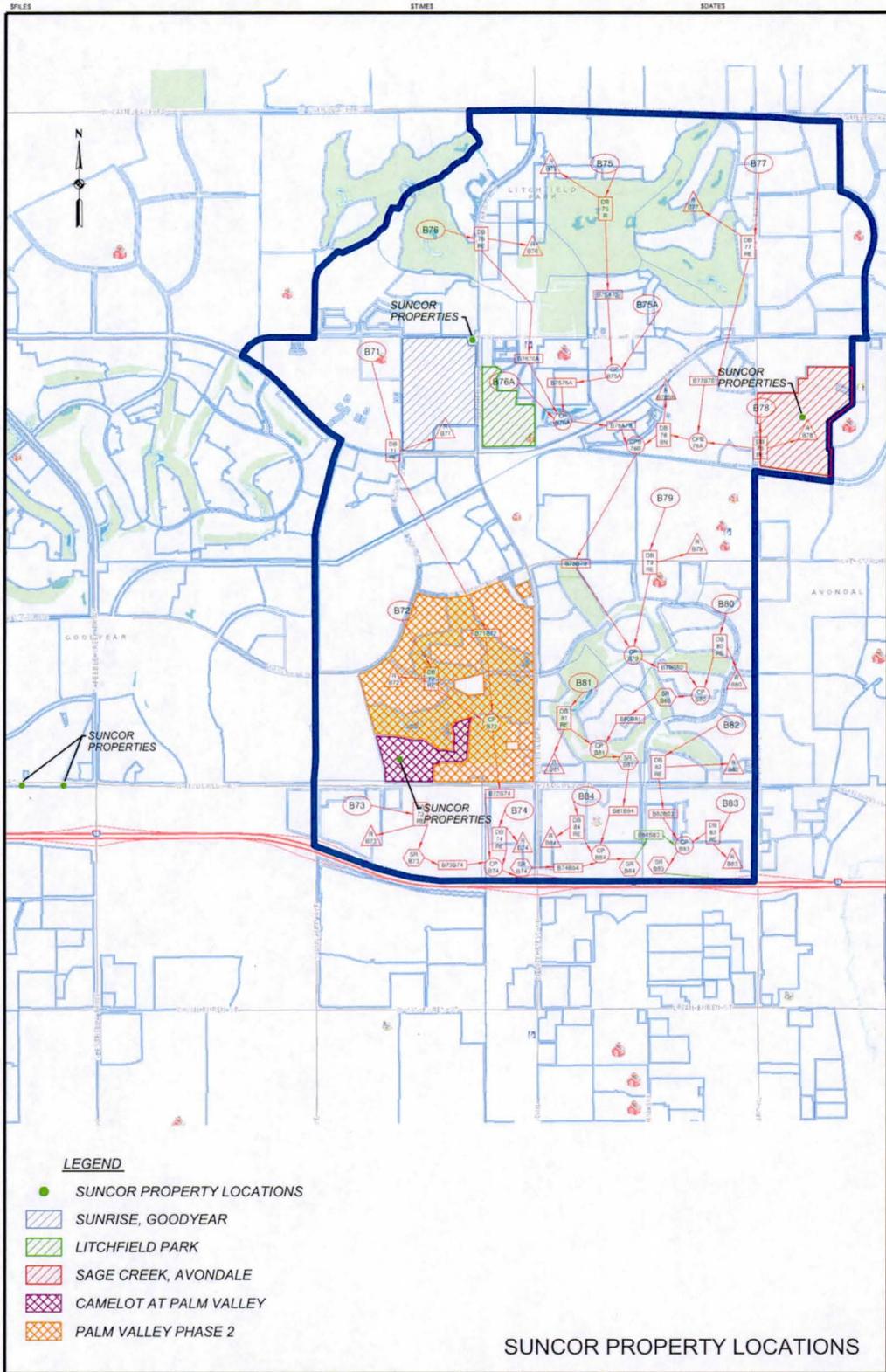


Figure 3: Suncor Properties in ADOT Basins Watershed with HEC-1 Schematic

5.0 FINAL RESULTS

Three HEC-1 models were updated three conditions for the 100-year, 24-hour storm event. Although there are two major basins (Major Basin 01 and Major Basin 02) for the ADMPU AHA study area, but only the Major Basin 01 hydrologic models were updated. In addition, this project did not update the land use and soil and bedrock maps because they have not changed from the ADMPU AHA study conditions.

It should be noted that the updated model descriptions and HEC-1 model names were changed. The HEC-1 model names are summarized below:

ADMPU AHA Model Description	Updated Model Description	Updated HEC-1 Model Name
Existing Conditions	Existing Conditions with Partially Completed CIP in Place	WT_EXST.DAT
Existing Conditions with CIP in Place	Existing Conditions with CIP in Place	WT_EXCIP.DAT
Future Conditions with CIP in Place	Future Conditions with CIP in Place	WT_FUCIP.DAT

There were four major changes made in the updated hydrology models as follows:

1. **Completion of the SR303L Freeway and Drainage Systems** – As-built plans were collected and used including six ADOT SR303L projects from I-10 to Mountain View Boulevard near Grand Avenue (US 60). In addition, the bid documents of the FCDMC’s Loop 303 Outfall Drainage System from Woodlands Avenue to Gila River were obtained and used.
2. **Additional completion of the Capital Improvement Projects** – There are approximately 12 miles of additional completion of capital improvement projects since the completion of the ADMPU AHA in 2009.
3. **Optional Task No. 1** – Based on the findings, the three HEC-1 models have been updated to reflect the removing of the on-site retention for the developed area located between McDowell Road and ADOT Basins. A 90” Pipe proposed by FCDMC along the Van Buren Street from White Tanks FRS #4 to the Loop 303L Outfall Drainage Channel was modeled in two HEC-1 CIP in Place Models (WT_EXCIP.DAT & WT_FUCIP.DAT). A Technical Memorandum has been prepared to document the findings and recommendations of the Optional Task No. 1 (Reference 4).

The HEC-1 schematics have been revised for all three HEC-1 models. Three HEC-1 Schematic exhibits with 2014 aerial images are included on the compact disk in this report. The HEC-1 output files are not printed, but the electronic files for all three HEC-1 models are provided on the compact disk in this report.

6.0 REFERENCES

1. Flood Control District of Maricopa County, *Final Hydrology Report for Loop 303 Corridor/White Tanks Area Drainage Master Plan Update Area Hydrology Analysis in Maricopa County, Arizona (FCD 2007C031)*, prepared by HDR Inc.
2. U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package, Version 4.1*, June 1998.
3. Flood Control District of Maricopa County, *Loop 303 Camelback Basins Candidate Assessment Report*, prepared by Aspen Consulting Engineers, August 2008
4. Flood Control District of Maricopa County, *Final Technical Memorandum for Optional Task #1 – ADOT Basins Watershed and White Tanks FRS No. 4 Outfall, associated with Loop 303 Corridor/White Tanks Hydrology and Delineation Update, Phase 1 – Updating the Existing Hydrology Model (FCD 2014C003, Assignment #1)*, Prepared by Parsons Brinckerhoff, June 2015.