STORM DRAIN MASTER PLAN REPORT

Entellus

PEORIA STORM DRAIN MASTER PLAN

PROJECT # EN00139

JANUARY 2014

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January 2014

Prepared by:

Intelligent Engineering

Innovative Solutions

Registered Professional Engineer (Civil)
CERTIFICATE NO. 46866
RYAN ANDREW SAUER
Date Signed 1/30/14
ARIZONA, U.S.A.
EXPIRES: 9/30/16

Registered Professional Engineer (Civil)
CERTIFICATE NO. 53293
ARBAN LONDO
Date Signed 01/30/14
ARIZONA U.S.A.
Expires: 6-30-15

Entellus™

2255 N 44th Street Suite 125

Phoenix, AZ 85008-3279

Phone (602) 244-2566

Fax (602) 244-8947

Web: www.entellus.com

Registered Professional Engineer (Civil) CERTIFICATE NO. 53293 ARBAN LONDO Date Signed 01/30/14 ARIZONA U.S.A. Expires: 6-30-15

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Registered Professional Engineer (Civil) CERTIFICATE NO. 40966 RYAN ANDREW SAUER Date Signed 1/30/14 ARIZONA, U.S.A. EXPIRES: 9/30/16

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SECTION 1. INTRODUCTION

This report presents a compilation and summary of the information collected and generated for the Peoria Storm Drain Master Plan (SDMP) project. The City of Peoria initiated the Peoria SDMP to update the original study that was completed in 1988. Since the original Storm Drain Master Plan was completed, many changes have occurred within the study area and the contributing watershed. These changes are mostly associated with the increase of residential developments in the recent years. In addition, the City has continued to upgrade and has completed several improvements to its storm drain system. The City of Peoria needed to evaluate its current storm drain networks and address the existing known drainage issues to prevent flood damage.

1.1 PROJECT AUTHORIZATION AND PURPOSE

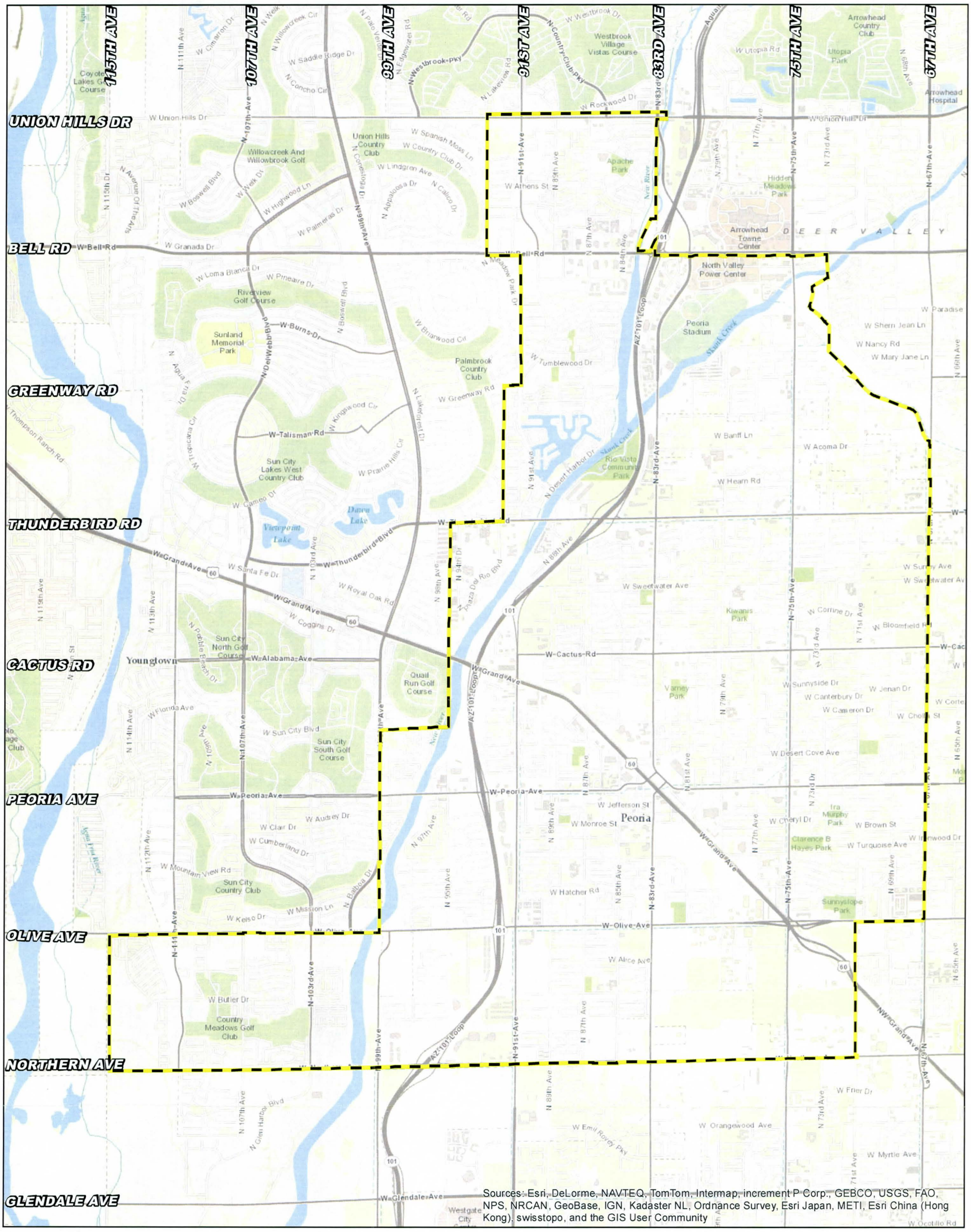
The information and analysis presented in this report are part of the Scope of Work performed by Entellus Inc. under contract (EN00139) with the City of Peoria. The purpose of this report is to present the findings of the Peoria SDMP as described in the contract Scope of Work. This entails developing a strategy for planning and implementing solutions that address drainage issues within the study area. The City of Peoria and the Flood Control District of Maricopa County (FCDMC) partnered to provide funding for this project.

The main objective of this study is to identify and quantify the extent of existing drainage issues and develop solutions to resolve them. This was accomplished by evaluating the existing storm drain system, reviewing the existing hydrologic models, quantifying the drainage issues, developing alternative solutions, selecting the most feasible alternative and preparing preliminary conceptual designs for the preferred alternatives.

1.2 STUDY AREA

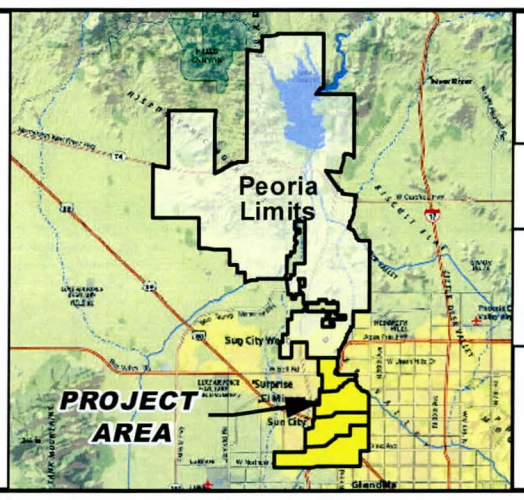
The overall study area for the Peoria SDMP is approximately 23 square miles consisting almost entirely of fully developed urban area. There are a few undeveloped areas (mostly active agricultural fields) located in the southeastern portion of the study. As shown in **Figure 1.1 – Study Area**, the study's focus is on drainage issues in the area south of Union Hills Drive, within the jurisdictional limits of the City of Peoria. The study area also includes the entire respective contributing watersheds to this focus area, without regard to the City limits in order to analyze potential drainage issues within the focus area.

This study focuses on the areas south of Union Hills Drive because no recent drainage master plan addresses this area and the existing drainage improvements in the area were developed based on outdated standards.



LEGEND

Project Boundary



CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 0.5 1 Miles

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

FIGURE 1.1
STUDY AREA

1.3 PROJECT GOALS

The goals of this project are as follows:

1. **Data Collection**: Develop a comprehensive collection of studies, reports, and other information that is relevant to identifying and resolving drainage issues.
2. **Facilities Inventory**: Update the City's facility inventory database to include missing storm drain information.
3. **Hydrology**: Update the hydrologic models from the *Glendale Area Stormwater Management Plan* (**Reference 004**) and modify the models for use as the base models for identifying drainage issues and developing alternatives.
4. **Hydraulics**: Prepare a hydraulic model for all storm drains that are 24-inch or larger within the study area.
5. **Existing Drainage Issues**: Utilize data collection, facilities inventory, hydrology, hydraulics, and drainage issue information provided by the City to identify and evaluate existing drainage issues.
6. **Alternatives Development**: Develop and evaluate potential solutions to the identified drainage issues.
7. **Recommended Plan**: Select and prioritize solutions (projects) to identified drainage issues and provide conceptual design plans and cost estimates.
8. **Operations and Maintenance Guidelines**: Develop a set of guidelines that summarizes the appropriate maintenance activities for all existing and future drainage facilities within the City.
9. **Stormwater Pollution Management Review**: Review the current City Stormwater Management Plan (SWMP), Municipal Separate Storm Sewer System (MS4) permit, and the existing City Code to determine if City has the proper authority to enforce regulations set forth by their MS4 permit and SWMP.

1.4 PROJECT ADMINISTRATION

Progress meetings were held monthly with some exceptions. The meeting agendas and minutes as well as the project schedule and significant event calendar can be found in **Appendix I Administration Report**.

SECTION 2. DATA COLLECTION

2.1 TOPOGRAPHIC AND AERIAL MAPPING

Topographic information and aerial mapping was provided to Entellus from the Flood Control District of Maricopa County.

The aerial imagery provided is from Fiscal Year 2010/2011 at a resolution of 0.8 feet per pixel. Entellus received 135 image tiles, each approximately one mile square that provides coverage for the entire City of Peoria. The City also provided aerial photography at a resolution of 0.32 feet per pixel for most of the project area.

Topographic information was provided digitally in dxf, ASCII, and shapefile format. The coverage's include contours, cartographic features, and points and breaklines for generating digital terrain models (DTM). The topographic information covers the entire project area; however, it is comprised of multiple mapping projects from various years. The FCDMC projected all the topographic data sets so that they were all on a uniform horizontal datum (NAD83 State Plane Arizona Central Zone International Feet). The Vertical Datum varies by mapping project and is either on the North American Vertical Datum of 1988 (NAVD88) or National Geodetic Vertical Datum of 1929 (NGVD29). See **Section 6.2 Hydraulic Modeling Data** for details on how this data was utilized for this project.

2.2 AS-BUILTS

As-built information was provided by the City in electronic format covering the entire project area. These electronic files included paving plans, water, sewer, and storm drain facilities citywide.

The GIS storm drain data provided by the City included a reference to its corresponding as-built. The numerous as-builts were sorted and the relevant stormwater facilities were separated (see **Appendix A.1 Data Collection Log**). This data was used to link a particular storm drain segment to its corresponding as-built file. Due to the large number of as-builts for any particular geographic location, it was assumed that the as-built referenced in the GIS data was the latest and most recent data and therefore was utilized to populate any missing information needed for the hydraulic model of the storm drains in StormCAD (See **Section 2.7 Data Deficiencies** for GIS data deficiencies).

Some of the issues encountered while reviewing the as-built data included missing pages, missing as-built files for a particular storm drain network, and elevation differences possibly due to the use of different datums. In cases where elevation differences were encountered, the as-built data was compared to the nearest surveyed elevation. All assumptions were documented in the GIS attribute table.

2.3 SURVEY AND GIS DATA

GIS data was provided to Entellus from the Flood Control District of Maricopa County, and the City of Peoria.

GIS data received from the FCDMC included topographic and aerial Mapping (see **Section 2.1 Topographic and Aerial Mapping**) administrative boundaries, natural and environmental features, survey control locations, data generated from completed FCDMC studies and projects, and various other applicable coverages.

The City of Peoria GIS data included basemap information such as street network, parcel data, and corporate limits, as well as sewer, water and storm system layers including pipe location and size, manholes, junctions, and nodes. It is understood that the majority of the storm and sewer infrastructure location and attributes were generated from historic as-built records. The City has indicated that much of this information has been previously field verified.

Entellus completed a field survey of 116 storm drain manholes, 17 storm drain junctions and numerous other survey points and channel facilities throughout the project area. Rim and invert elevations were surveyed, and pipe sizes and directions were also recorded when they were safely accessible. The intent of the survey was to obtain current and accurate information on the storm drain network, and to cross check and verify the data from as-builts and GIS layers to provide an accurate model. Additionally, Entellus performed continuous point capture survey for many roadway centerlines. Details of these survey points including the locations are provided in **Appendix B Additional Survey Data**.

2.4 EXISTING STUDIES

Numerous studies were collected from both the City of Peoria and the Flood Control District of Maricopa County. Studies that are relevant to this SDMP are described in the following sections.

2.4.1 Regional Drainage Studies

City of Peoria, Arizona Storm Water Master Plan, Hydrology Report, 1985 **(Reference 042)**: Documents parameters and methodology used for the hydrologic analysis used to develop drainage solutions for the City of Peoria.

Glendale-Peoria Area Drainage Master Plan and Addendum, 1987 **(Reference 124)**: The study area includes both the City of Glendale and the City of Peoria, as well as the portions of the contributing watershed that fall outside of the cities' boundaries. The report recommends storm drains on Cactus Road, Olive Avenue, Northern Avenue, and Orangewood Avenue with a 10-year level of protection.

City of Peoria Master Plan of Storm Drainage, 1988 **(Reference 001)**: This study addresses drainage issues within the City of Peoria with specific attention to the area south of Pinnacle Peak Road. Major recommendations from this study include the following:

- Storm systems sized for the 2-year recurrence interval storm on Thunderbird Road, Cactus Road, Peoria Avenue, Olive Avenue, Northern Avenue, and 91st Avenue/Greenway Road.
- Regional Detention Basins.
- New detention regulations for all new subdivisions and developments.

West Valley Flood Control Structures Analysis, 2001 **(Reference 188)**: Analyzes ten existing flood control features in the west valley for effective use of landscaping and recreational open space multi-use.

Glendale Peoria Area Drainage Master Plan Update, 2001 **(Reference 126, 127, 128, 129, 130, 131, 132, 133 & 134)**: Report was performed to update the 1987 *Glendale-Peoria ADMP* listed above. This study breaks the area into four regions and provides recommendations for each, which are summarized below:

- Northwest Region:
  - Channel on the north side of Pinnacle Peak Road from 95th Avenue to the Agua Fria River.
  - Channel on the north side of Deer Valley Road from approximately 91st Avenue to Lake Pleasant Road.
  - Channel on the east side of Lake Pleasant Road from Deer Valley Road to Rose Garden Lane.
  - Channel on the north side of Rose Garden Lane from Lake Pleasant Road to the Agua Fria River.
  - Channel on the south side of Beardsley Road from approximately Lake Pleasant Road to the Agua Fria River.
- 83rd Avenue Region:
  - 58 ac-ft detention basin on the northwest corner of 83rd Avenue and Pinnacle Peak Road.
  - 18 ac-ft detention basin on Calle Lejos and 87th Avenue.
  - Storm drain and channel on the north side of Calle Lejos.
  - Storm drain on the east side of 83rd Avenue from Williams Road to Pinnacle Peak Road and channel on the west side of 83rd Avenue from Calle Lejos to Pinnacle Peak Road.
  - Storm drain on Pinnacle Peak Road between 87th Avenue and 83rd Avenue.
- 67th Avenue and Pinnacle Peak Region:
  - Combination of storm drain and open channel on the east side of 67th Avenue from Hatfield Road to Pinnacle Peak Road.
  - Combination of storm drain and open channel on the north side of Pinnacle Peak Road from 67th Avenue to the New River.

- Rock Springs Region:
    - No infrastructure was recommended. Instead, regulation and enforcement of floodplain/floodway delineation for Rock Springs Creek was recommended.

Glendale/Peoria ADMPU Northwest Region Update Hydrologic Study, 2007* (Reference 135, 136)*: Study area is bounded by Union Hills Drive to the south and Dynamite Boulevard alignment to the north and the Agua Fria River and the New River to the west and east, respectively. This study provides updated hydrology for the 10-year and 100-year, 6-hour and 24-hour storms for both the existing and future conditions of the study area.

***Glendale Area Stormwater Management Plan Hydrology Report, 2010* (Updated 2011) (Reference 004, 120, 121, & 122)**: This study was performed to update the hydrology from the *Glendale Area Stormwater Management Plan* of 1986 to include changes and improvements that had occurred in the elapsed time between the two studies. The District provided several electronic files from this study including, GIS coverages of the hydrology (subbasins, concentration points and routes) and the hydrologic models. The hydrologic models included the HEC-1 input and output as well as the DDMSW files. Models were included for both existing and future conditions of the Glendale/Peoria Watershed as well as the Maryvale Watershed. The models were created for the 6- and 24-hour storm durations of the 10-year and 100-year storm events.

2.4.2 Wastewater

***Wastewater Master Plan City of Peoria, 1984* (Reference 043)**: This wastewater master plan proposes the following infrastructure:

- New parallel sewers to existing sewers are proposed on:
    - 75th Avenue from Cholla Street to Mountain View Road.
    - 91st Avenue from Peoria Avenue to Northern Avenue.
    - 75th Avenue from Mountain View Road to Olive Avenue.
- A new sewer is proposed on Northern Avenue from 75th Avenue to 83rd Avenue.
- Increased size of the proposed sewer on Beardsley Road between 83rd and 111th Avenues.

2.4.3 Drainage Improvements

***91st Avenue Channel Improvement Alignment Study, 1989* (Reference 044)**: This report analyzes either making improvements to the existing channel between Bell Road and Greenway Road or constructing a new closed storm drain to be located in the 91st Avenue alignment.

Drainage Report for Bell Road Section 6, 1991 **(Reference 215, 216, 217)**: This report describes the parameter and methodologies used to develop a drainage improvement plan for onsite and offsite runoff on Bell Road near 67th Avenue.

Design Data Report for the Cactus Road Storm Drain (67th Avenue to the Agua Fria Freeway), 1992 **(Reference 142)**: This summarizes the design data and details for the Cactus Road storm drain.

69th Avenue Improvements from Olive Avenue to Sunnyslope Lane, Storm Drain Report, 1997 **(Reference 045):** This report provides storm drain design for both onsite and offsite flows for 69th Avenue between Sunnyslope Lane and Olive Avenue. The report recommends 760 ft of 24-inch storm drain and 1000 ft of 30-inch storm drain on 69th Avenue.

83rd Avenue/Pinnacle Peak Road Drainage Improvements, 2006 **(Reference 138 & 139)**: This is a project identified in the *Glendale/Peoria ADMPU, 2001* described in **Section 2.4.1 Regional Drainage Studies**. Revisions to the original recommendations included the following:

- Extension of the flood protection facilities to 91st Avenue, which caused the Calle Lejos detention basin to be relocated to 87th Avenue and Avenida del Sol.
- Additional 10-year level protection storm drains on Avenida del Sol, Cielo Grande, and Pinnacle Peak Road.

83rd Avenue/Pinnacle Peak Road Drainage Improvements Maintenance Plan, 2007 **(Reference 146)**: This is a maintenance plan for design improvements.

Rose Garden Lane Drainage Improvements, 2008 **(Reference 140)**: This is a project that was indentified in the *Glendale/Peoria ADMPU, 2001* described in **Section 2.4.1 Regional Drainage Studies**. Revisions to the original recommendations included the following:

- Refinement of the detention storage hydrologic routing east of 95th Avenue.
- Development of project outfall on 109th Avenue and the Agua Fria River.
- Additional 100-year retention basin at the Agua Fria River.

Pinnacle Peak Road and Channel 99th Avenue to the Agua Fria River, 2009 **(Reference 144)**: This is preliminary design report that evaluates drainage alternatives on Pinnacle Peak Road from 99th Avenue to the Agua Fria River as identified in the *Glendale/Peoria ADMPU, 2001*.

Glendale/Peoria ADMPU 107th Avenue and Union Hills Design Concept Report Phases 1 & 2, 2010 & 2011 **(Reference 119 & 098)**: This design concept report was performed to address flooding issues in subdivisions and roadways near the 107th Avenue and Union Hills Drive intersection. The area of interest is located between the Agua Fria River and 107th Avenue to the west and east and Beardsley Road and Bell Road to the north and south. The report proposes two detention basins on Union Hills Drive; one to be located at 115th Avenue and the other to be located at Bell Road.

Additional Drainage Improvement Projects: Several drainage improvement facilities that are currently under design, under construction, or have been recently completed are listed below.

- ***83rd Avenue Street and Drainage Improvements Project*** **(Reference 248)**
- ***Pioneer Park*** **(Reference 261)**
- ***75th Avenue and Thunderbird Road Intersection*** **(Reference 250)**
- ***Grand Avenue L101 to 85th Avenue Drainage Plans*** **(Reference 249)**

2.4.4 Transportation Plans

West Valley Multi-Model Transportation Corridor Master Plan, 2001 **(Reference 238)**: This master plan proposes a 42-mile network of pedestrian, equestrian, and bicycle trails along the New River and Lower Agua Fria River.

2.4.5 Earth Fissures and Subsidence

Earth Fissure Map of Maricopa County, Arizona, 2009 **(Reference 245)**: According to this map, there are no identified earth fissures in the study area and there is currently no detailed earth fissure study for the Peoria area.

Land Subsidence in Western Metropolitan Phoenix, 2012 **(Reference 246)**: Subsidence in the range of zero to two centimeters is shown in the area between approximately Union Hills Drive and Northern Avenue to the north and south and 51st Avenue and 111th Avenue to the east and west. A small pocket of two to three centimeters is identified around the Dell Webb Boulevard alignment between Greenway Road and Thunderbird Road. Subsidence is also identified farther to the west, but falls outside of the study area.

Regional subsidence maps prepared by the Arizona Department of Water Resources were also downloaded in GIS format and reviewed (**Reference 260**).

2.5 EXISTING FACILITIES

A major existing facility within the study area is the Salt River Project. The ***Salt River Valley Water Users' Association Zanjero Area Maps, 2009*** **(Reference 247)** provided information regarding the location of these facilities. According to these maps, piped laterals exist on nearly all major arterial roads within the study area. One open canal exists within the study area and its location extends from approximately one half mile north of Thunderbird Road on 67th Avenue to approximately one half mile north of Greenway Road on 75th Avenue. Numerous wells also exist within the study area.

2.6 DRAINAGE ISSUES AND COMPLAINTS

The City provided a database of existing and potential drainage issues reported by staff from various City groups including Police, Engineering, Utilities, Community Services,

and Public Works. City Maintenance and Operations staff provided a separate list of "hotspots", or areas where drainage related issues have required corrective maintenance activities. A drainage template worksheet was created as a tool for collecting additional drainage problem information. A map showing all drainage issues was created to facilitate further discussion and evaluation.

On 8/21/2012, a meeting was held to discuss the drainage issue information provided by the City and to collect any available additional information, particularly from the City's Maintenance and Operations staff. Each of the drainage issues previously provided by the City were discussed and, where applicable, additional drainage issues were added. During the discussion, the City indicated that several issues on the list had either been recently resolved or were in the process of being resolved by current or near future City projects. These issues were removed from the list of issues that would be considered further during the alternatives formulation and evaluation stages of this project. Also, generally, drainage issues on private property that were related to the property's own deficiencies were removed from the list of issues for further consideration. The discussion also revealed several issues that were caused by the same deficiencies in the same areas. These issues were combined into single drainage issues for further consideration. See **Section 4 Existing Drainage Issues** for details on the drainage issues.

In collaboration with the City, the drainage issues map and drainage issues list were revised to only include drainage issues that would be considered further during this study. The preliminary Drainage Issues points of interest list, maintenance "hot spots" and map are included in **Appendix A.2 Drainage Issues and Complaints**. The final revised Drainage Issues list and map can be found in **Appendix C.1 Drainage Issues Color Coded List and Exhibit**.

2.7 DATA DEFICIENCIES

Much of the GIS data received by the City was not adequate to directly import into StormCAD to model the hydraulics of the storm drains. Some of the issues encountered included the following (see **Appendix A.3 Data Collection Deficiencies** for examples):

- Missing invert and rim elevations
- Numbers entered in the attribute table were out of order making the elevations off by several hundred feet (data entry errors)
- Multiple line segments with the same upstream and downstream elevations
- Downstream storm drain elevations well above the upstream segments
- Bottom of manhole elevations attributed to incoming laterals and not lowest elevation
- Elevation discrepancies due to different datums

Most of the City's GIS data was reviewed and missing or insufficient information was supplemented using as-built information. Some of the updates made to the GIS data included pipe size corrections, length, shape, invert and/or ground elevation corrections.

In locations where missing or inadequate data was found in the attribute table, and the invert elevations were not annotated on the as-built file, the points were interpolated between the two nearest known data points and assumptions were documented in the GIS data. The GIS files used for the hydraulic modeling include the updated and corrected information and are contained on the report DVD in **Appendix J Report DVD**. See **Section 6 Hydraulic Review And Storm Drain** for details regarding the storm drain modeling.

SECTION 3. FACILITY INVENTORY

An inventory of existing drainage facilities within the project boundaries was completed by gathering and developing drainage system information to supplement the previously documented inventory. Information added to the inventory includes the hydraulic capacities of storm drains within the study limits. The inventory of existing facilities and evaluation of hydraulic capacities was utilized in the examination and evaluation of the drainage facilities and alternatives.

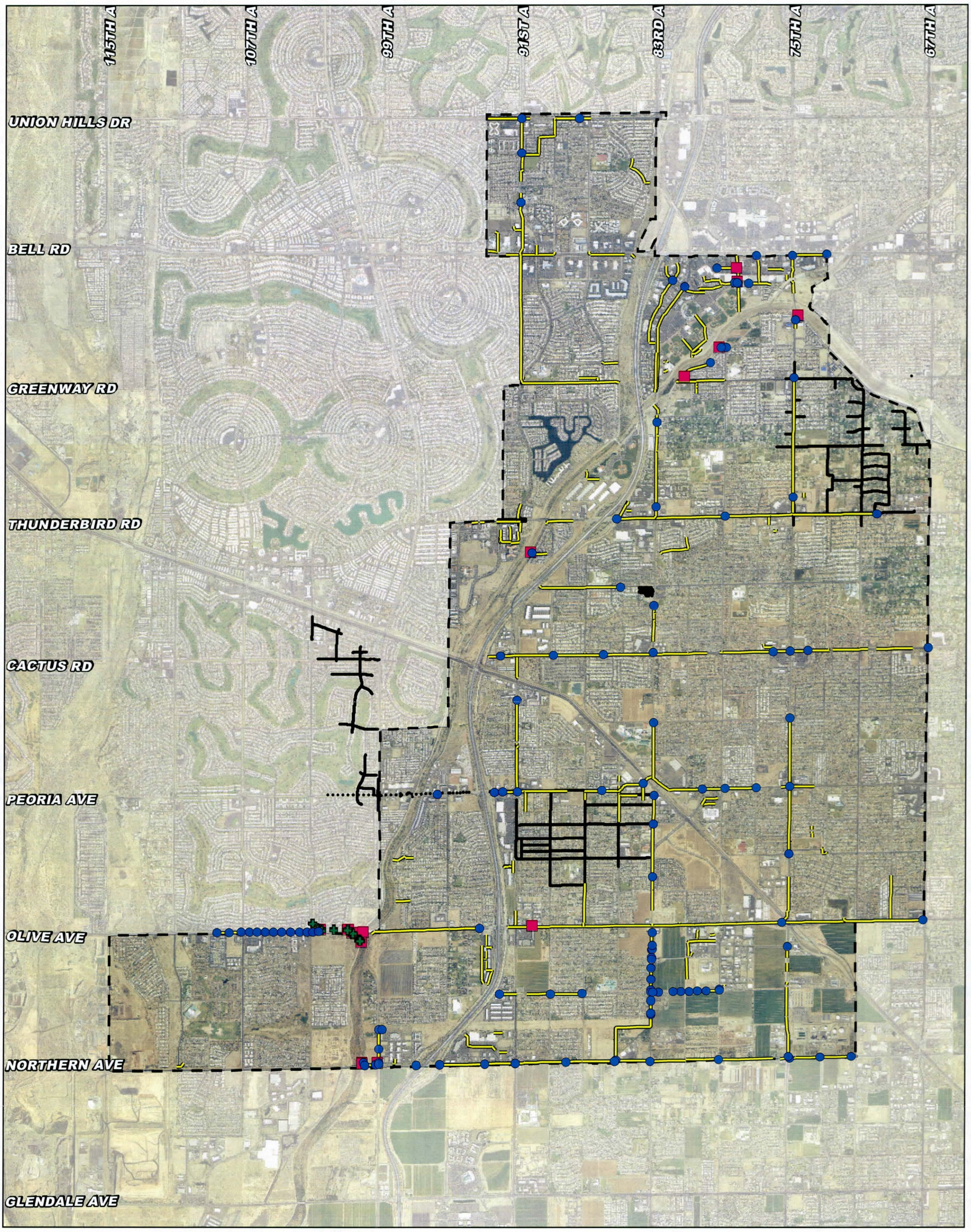
3.1 EXISTING FACILITY INVENTORY

The drainage facility inventory identifies and locates all existing significant or major drainage structures in the study area including storm drains over 24-inches in diameter, regional retention and detention basins, canals, man-made and natural channels and washes, and other significant contributors to regulating drainage such as roadways, canal embankments, railroad embankments, and regional pump stations. The intention of the facility inventory was to ensure accurate, current information of the existing facilities to be utilized for hydraulic modeling purposes.

The storm drain system for the entire project area was evaluated utilizing GIS data, as-built documents, various planning documents, and City staff institutional knowledge. Although the majority of the existing storm drain systems were included in the GIS database provided by the City, discrepancies between as-built documents and the GIS data did exist. These data discrepancies, as well as facilities that were lacking sufficient data, and recently constructed facilities were identified and recommended for further field investigation. Upon approval from the City, Entellus conducted a field survey utilizing survey grade GPS equipment (see **Section 2.3 Survey and GIS Data** and **Appendix B Additional Survey Data**). The surveyed facilities included:

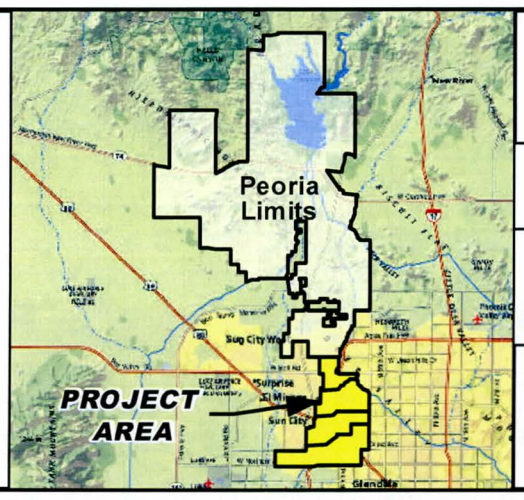
- 116 Storm Drain Manholes
- 17 Storm Drain Junctions
- 87 Topographic Shots of Channel Facilities

The data collected from the survey was compiled into a GIS geodatabase format and adheres to the City's current schema and coordinate system standards. The GIS data has been submitted electronically to the City, and data is included in **Appendix J Report DVD** of this report. The location of these survey points and the additional survey described in **Section 2.3 Survey and GIS Data** are shown on **Figure 3.1 – Facility Inventory Survey**. Details of these survey points including the locations are provided in **Appendix B Additional Survey Data**.



LEGEND

- Surveyed Storm Drain Manhole
- Surveyed Storm Drain Junction
- Surveyed Channel Topography
- Supplemental Topographic Road Survey
- Storm Drain
- Project Boundary



CITY OF PEORIA
PEORIA STORM DRAIN
MASTER PLAN

NORTH

0 0.5 1 Miles

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FIGURE 3.1
FACILITY INVENTORY SURVEY

SECTION 4. EXISTING DRAINAGE ISSUES

4.1 DRAINAGE ISSUE CATEGORIES

The drainage issues identified during the data collection phase were discussed with City staff and a final list of issues was developed and categorized based on the level of analysis required:

- **Red and Orange -** Alternatives formulation and evaluation were not required for these drainage issues because the solutions were straightforward and/or have already been identified. Drainage issues categorized as Orange may require some additional analysis of the identified solution. These issues and potential solutions are documented in **Appendix C.2 Unresolved Drainage Issues**.
- **Green** - General solutions to these drainage issues have been previously identified. This study further developed these solutions to include required facility sizes, costs, and other information. The issues and findings are summarized in **Section 8 Alternatives Formulation and Evaluation** with additional details provided in **Appendix F Alternatives Formulation and Evaluation Supporting Data**.
- **Blue -** Alternative solutions to address these drainage issues were developed and evaluated to determine a recommended solution. The issues, alternatives, and findings are summarized in **Section 8 Alternatives Formulation and Evaluation** with additional details provided in **Appendix F Alternatives Formulation and Evaluation Supporting Data**.

The categorized final drainage issue list and map are included in **Appendix C.1 Drainage Issues Color Coded List and Exhibit**.

4.2 ADDITIONAL DRAINAGE ISSUES

As the drainage issues analysis and alternatives formulation progressed, additional potential drainage issues were identified. These additional drainage issues were discussed with the City to determine the appropriate level of documentation and analysis. The nature of some additional drainage issues necessitated the development and evaluation of alternatives. Other potential drainage issues were simply documented within the context of the original drainage issue.

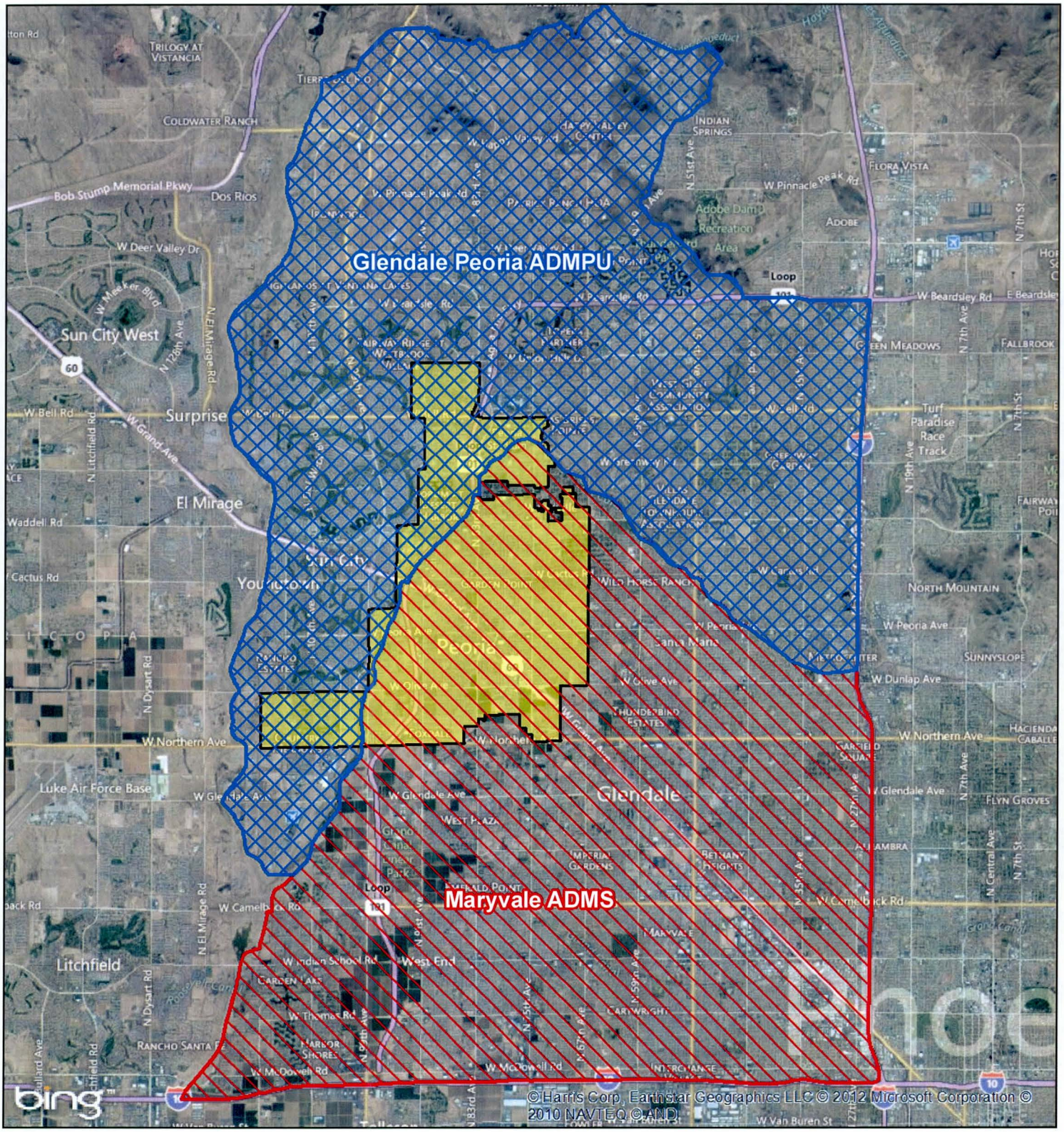
SECTION 5. BASE HYDROLOGY REVIEW AND ANALYSIS

5.1 PREVIOUS HYDROLOGY REVIEW

The main purpose of the hydrology review was to determine the adequacy of previous hydrology models for use in this Storm Drain Master Plan. The following sections describe the process for assessing and reviewing the hydrology and any modifications that were deemed necessary to the models.

5.1.1 Description of Previous Models

There are several hydrology models that have been developed over the years that encompass the project area. Most recently, the *Glendale Area Stormwater Management Plan* (**References 004, 120, 121**) was developed and as part of that project the hydrology models from the *Glendale/Peoria ADMPU* (**Reference 003**) and the *Maryvale ADMS* (**Reference 223**) were updated for both the existing and future conditions. These two models encompass the entire limits of this project, are the most recent hydrology models available and were thus utilized as the basis for the hydrology. The limits of the hydrologic models within the study area can be seen in **Figure 5.1 – Existing Hydrology Model.**



LEGEND

- Glendale Peoria ADMPU Boundary
- Maryvale ADMS Boundary
- Project Boundary

CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 1.5 3 Miles

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FIGURE 5-1
EXISTING HYDROLOGY MODELS

5.1.2 Parameters Reviewed

The two hydrology models described above were evaluated and reviewed to determine their adequacy for the Peoria Storm Drain Master Plan. Various model parameters were reviewed including, split flows (both intersection & storm drain diversions) and modeled retention (in particular regional retention). From the review that was conducted the locations discussed in the following sections were identified as areas in need of further review and analysis.

5.1.2.1 Intersection Split Flows

The methodology presented in the *Glendale Area Stormwater Management Plan* (**References 004, 120, 121**) on how intersection split flows were estimated was reviewed. The methodology accounts for flow crossing subbasin boundaries not only at major intersections, but all along the subbasin boundary. These "multiple street diversions" as they are called were created because flow can split off of the main flow path at various locations, not just at the major intersections. These split flows were reviewed and appeared to be adequate. However, the 75th Avenue and Thunderbird Rd intersection was recently improved. This location was looked at in more detail to determine if flow conditions have changed. A discussion of this follows.

<u>75th Avenue and Thunderbird Road Intersection Improvements:</u>

Design plans were reviewed for the *75th Avenue and Thunderbird Road Intersection Widening* (**Reference 250**). The widening of the intersection could potentially affect the modeled split flow at the intersection.

The proposed project improvements included lane widening, striping and catch basin re-locations but no major storm drain modifications. The proposed street configurations were reviewed to ensure there were no major impacts to the street diversions represented in the HEC-1 model. The improvements increased the roadway widths by approximately 24-feet to the west and 40-feet to the south. Using the same methodology for street flow diversions as presented in the *Glendale Area Stormwater Management Plan*, it was concluded that the split flow percentage west could decrease from 55% to 53.5% and the split flow percentage to the south could increase from 45% to 46.5% therefore making the intersection impacts on the hydrology models negligible and thus no modifications were made to the hydrology models (see **Appendix D.1 75th Avenue & Thunderbird Road Intersection Improvements** for details). See **Section 5.1.3 Hydraulic Capacity of Storm Drains** for the analysis that was performed on the storm drains.

5.1.2.2 Storm Drain Diversions

As part of the hydraulic analysis of this Storm Drain Master Plan, the full flow capacity of storm drains 24-inches and larger within the City of Peoria were estimated utilizing StormCAD. The results of this analysis were then incorporated back into the hydrologic analysis where appropriate. The hydrologic models do not model every storm drain but account for flows that are moving between subbasins. This differs from previous studies that utilized Manning's equation to estimate the capacities of the storm drains. A comparison of the previous storm drain capacity assumptions as modeled in the *Glendale Area Stormwater Management Plan* hydrology models and the newly estimated storm drain capacities can be found in **Appendix D.2 Storm Drain Capacity Comparison**. See **Section 5.1.3 Hydraulic Capacity of Storm Drains** for details of the storm drain hydraulic analysis.

5.1.2.3 Regional Retention Basins

As part of the data collection portion of the project, several as-builts were reviewed of recent improvements that may not be reflected in the *Glendale Area Stormwater Management Plan* or models. The locations that were examined in detail are discussed below.

Hayes Park Retention Basin:

The Hayes Park basin is located in the vicinity of Mountain View and 75th Avenue (see **Appendix D.3 Hayes Park Basin**). This retention basin is located within the limits of the Maryvale hydrology model as part of the HEC-1 subbasin OL75. Hayes Park was not previously directly modeled. The system contributing to Hayes Park includes a 60-inch storm drain along 75th Avenue from north of Peoria Avenue to Hayes Park where it is connected to the Hayes Park basin with a 78-inch storm drain as well as inlets to the basin from Mountain View Dr and 73rd Dr for local runoff. The 75th Avenue storm drain is reduced to a 48-inch storm drain soon after the connection to the retention basin (approximately 35 feet south).

Based on the configuration of the storm drain it is possible that, as head is increased in the 60-inch storm drain along 75th Avenue, flow may begin to enter the retention basin, thus reducing peak discharges downstream. This is also dependent on the head present in the retention basin.

To assess this situation the following steps were taken:

1. Estimated the capacity of the 60-inch and 48-inch storm drains
2. Estimated the volume of the Hayes Park basin
3. Estimated the 100-year, 2-hour retention requirement for the area contributing to the retention basin

Using the program StormCAD, it was estimated that the full-flow capacity of the 60-inch storm drain north of the Hayes Park basin connection is approximately 180 cfs and approximately 85 cfs for the 48-inch storm drain

south of the basin connection. This is in line with the Maryvale hydrology model, which estimated the flow of the 60-inch storm drain as 179 cfs (HEC-1 diversion id D75PE).

A volume estimate was performed for the Hayes Park basin using the provided as-builts (#37-103) and the FCDMC 2-foot contours. This resulted in an approximate volume of 46.4 ac-ft to the top of the basin with no freeboard (see **Appendix D.3 Hayes Park Basin** for volume estimation).

Lastly, the 100-year, 2-hour retention requirement was estimated by using the provided GIS data, aerials, and the FCDMC contours. The local contributing area to the Hayes Park basin was estimated as being approximately 1/4 of the total subbasin area or 160 acres (HEC-1 subbasin id OL75). Assuming a rainfall depth of 2.2-inches for the 100-year 2-hour event and a weighted C-value of 0.70 that would represent the predominantly residential area, the required retention volume for the 100-year, 2-hr storm event would be approximately 20 ac-ft. This leaves a significant amount of volume in the Hayes Park basin unaccounted for, so from this it was determined that it was necessary to model the Hayes Park basin within the hydrologic model.

In order to model Hayes Park basin for both the 100-year 2-hour retention and the storm drain attenuation the following steps were taken:

- Diverted 25% of subbasin OL75 (called DHayes).
- Modified EROL75 to reflect only the storage associated with the remaining 75% of the subbasin OL75.
- Modified storm drain route RP75OL to end at Hayes Park basin.
- Created new concentration point (CHayes) that combines DHayes, which is the 25% of the contributing subbasin, and 75th Avenue storm drain (RP75OL).
- Created Stage / Storage / Discharge record for the Hayes Park basin (SHayes).
- Created new route for the 48-inch storm drain from Hayes Park basin to 75th Avenue and Olive Avenue (RHayes).

Desert Amethyst Basin:

The Desert Amethyst basin is located in the vicinity of 91st Avenue and Villa Rita Drive, approximately 1,300-feet south of Union Hills Drive. This particular basin was modeled in the Glendale/Peoria hydrology model (HEC-1 storage id SRAT91) using proposed design plans by Wood/Patel & Associates, Inc in May of 2000 for a total capacity of approximately 45 ac-ft.

Volume estimations were performed using the provided as-builts (#38-160). The available contours reflected pre-basin conditions and could not be utilized. Based on this analysis, it was determined that the Desert Amethyst

basin has an approximate retention volume of 47 ac-ft (see **Appendix D.4 Desert Amethyst Basin**) without freeboard so no modifications were made to the HEC-1 Model.

Northern Avenue Retention Basin

A review of the contributing area and volume to the retention basin along Northern Avenue near 87th Avenue showed that a large volume was entering the retention basin from the northwest via the street flow route RSNO91. Upon review of this, it was determined that an additional storm drain diversion was needed at the intersection of 91st Avenue & Olive Avenue (see **Section 5.1.3.7 4021 - Olive Ave** for details). It was also determined that the street flow flowing south from that intersection along 91st Avenue towards Northern Avenue would not be able to contribute to the retention basin. The retention basin is configured to accept flows from the northeast along 83rd Avenue and from the east along Northern Avenue, and to allow low flows to bypass the retention basin through a 42-inch storm drain to the west of the retention basin along Northern Avenue. From a modeling standpoint, the only flow contributing to the Northern Avenue retention basin would include flow from the subbasin (NO91) and flow from the east and northeast (CPNO83). To account for this the following modifications were made to the Maryvale HEC-1 models.

- Added storm drain diversion DOL91/DPOL91 and diversion recovery PROL91. This represents the storm drain along Olive Avenue from 91st Avenue to the Loop 101 Freeway (see **Section 5.1.3.7 4021 - Olive Ave** for details).
- Routed storm drain (RPOLLO) to the Loop 101 Freeway and added new combine (CPOLLO).
- Changed name and parameters for street route RWNO91 to RWNO87. This route now ends at the retention basin along Northern Avenue.
- Changed name and parameters for storm drain route RPNO91 to RPNO87. This route now ends at the retention basin along Northern Avenue.
- Modified storage route for retention basin SRNO91. This was modified so the pipe full capacity of the storm drain (25 cfs) completely bypasses the retention basin.
- Added storm drain diversion DNO87, diversion recovery DPNO87/PRNO87 and route RPNO91 for the storm drain from the Northern Avenue retention basin to 91st Avenue.
- Added street flow route RWNO91 from the retention basin to 91st Avenue along Northern Avenue.
- Added new concentration point CPNO91, which combines RPNO91, RWNO91 & RSNO91. This represents the flow getting to the intersection of Northern Avenue & 91st Avenue via a storm drain

along Northern Ave, street flow along Northern Avenue & street flow along 91st Avenue, respectively.

- Changed concentration point CNO91 to only combine 2, and added concentration point CSNO91, which represents flow getting to the Northern Avenue retention basin (SRNO91).

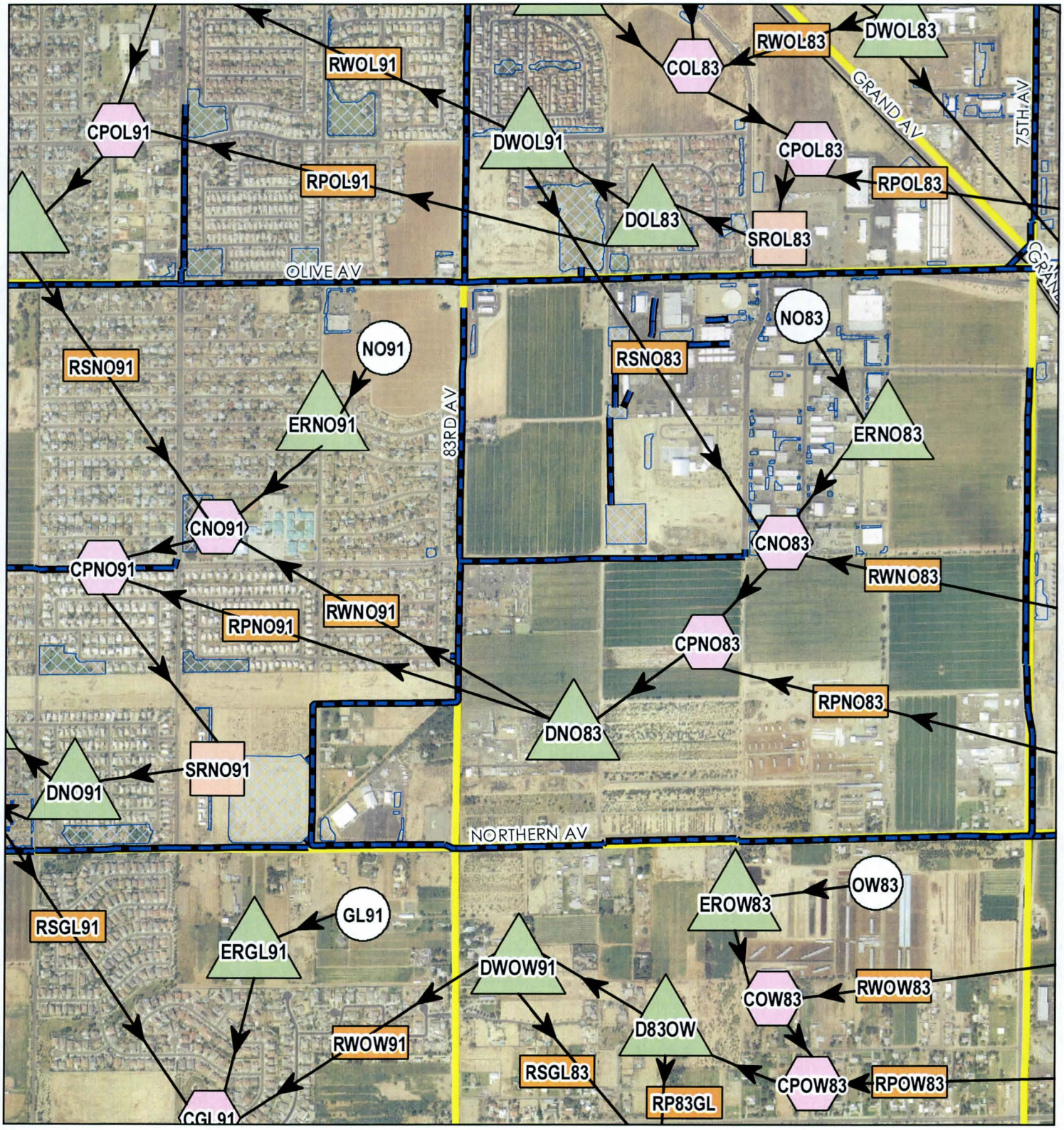
5.1.2.4 Existing Storm Drains

As part of the data collection portion of the project, plans and as-builts were reviewed of recent improvements that may not be reflected in previous studies or models.

83rd Avenue Storm Drain Extension:

Design plans were reviewed for the storm drain extension on 83rd Avenue from Las Palmaritas Drive to approximately 500 feet north of Alice Avenue and on Butler Drive from 83rd Avenue to 79th Avenue. The 83rd Avenue improvement consists of approximately 3,150 feet of storm drain ranging from 24- to 42-inches (see **Figure 5.2 – 83rd Avenue Strom Drain Extension**). The Butler Drive improvements consist of approximately 2,650 feet of storm drain ranging from 18- to 42-inches.

These proposed storm drain improvements do not affect the over-all hydrology modeling in the area as the 72-inch storm drain along Northern Avenue (HEC-1 diversion id PRNO83) is utilized to route storm drain flow to the regional detention basin SRNO91. The proposed project will not change the existing flow path and most of the improvements occur within the subbasin and therefore have a negligible effect on the global hydrology model. No change was made to the HEC-1 hydrology from these improvements.



LEGEND

- PSDMP Subbasin Boundary
- Maryvale Subbasin Boundary
- Existing Retention
- Existing Storm Drain
- Concentration Point
- Diversion
- Route
- Storage
- Subbasin
- Element Connection

CITY OF PEORIA
PEORIA STORM DRAIN
MASTER PLAN

NORTH

0 750 1,500 Feet

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FIGURE 5.2
83RD AVE STORM
DRAIN EXTENSION

5.1.2.5 Schematic Modifications

As a part of the HEC-1 model evaluation, the schematic was reviewed to ensure consistency. It was found that a section of the *Glendale Area Stormwater Management Plan* hydrology within the Maryvale schematic did not fully reflect the HEC-1 model. To ensure consistency, modifications were made to the hydrology schematic within subbasins OL75, OL83, GR75, NO75 and NO83. See the Maryvale Schematic Modification Exhibits in **Appendix D.5 Maryvale Schematic Modifications**.

In particular, the following modifications were made:

- Concentration Point CPOLGR does not exist in the HEC-1 models.
- Diversion DPOLGR does not exist in the HEC-1 models.
- Storage Route SRGR75 is combined with CIGR75, not CPOLGR.
- Concentration Point CIGR75 only combines 3 records: SRGR75, DR75NO (via DWOL83), and DI75NO (via D75GR).
- Route RPOL83 routes Diversion DPOL75 (via DOL75), not DPOLGR.

Additionally, modifications were made to the HEC-1 models and the schematic due to the addition of another storm drain route (see **Section 5.1.3.7 4021 - Olive Ave** for details) and modifying the modeling of the Northern Avenue Retention basin near 87th Avenue (see **Section 5.1.2.3 Regional Retention Basins** for details). See the Maryvale Schematic Modification Exhibits in **Appendix D.5 Maryvale Schematic Modifications**.

5.1.3 Hydraulic Capacity of Storm Drains

The existing HEC-1 models include several of the major storm drains in the project area. The modeled storm drains are typically limited to those that have regional effects on the flow characteristics of the watershed, in particular by transporting flow across subbasin boundaries. As part of the hydrologic review, the top of pipe capacity of these modeled storm drains was estimated utilizing StormCAD. The modeling results are discussed in the following sections and profiles and output tables of the hydraulic modeling can be found in **Appendix D.7 Storm Drain Profiles**. Modifications were made to the HEC-1 models when significant differences in the pipe flow capacity were determined.

5.1.3.1 1029-1 - 91st Avenue / Union Hills Drive & 1030-1 - 89th Avenue / Union Hills Drive

These 2 storm drains contribute to the Desert Amethyst Basin (HEC-1 ID SRAT91) along 91st Avenue just south of Union Hills Drive in the Glendale/Peoria watershed. The original HEC-1 model brings flow to the basin by diversion DUH91 which has a total capacity of 583 cfs. The model states that this capacity is due to 454 cfs from a 78-inch storm drain along 89th Avenue and Union Hills Drive and 129 cfs from a 54-inch storm drain along 91st Avenue.

The 91st Avenue / Union Hills Drive storm drain just south of the intersection has approximately a 100 foot section of 54-inch storm drain after which there is a large trench drain where it transitions to a 78-inch storm drain. The capacity of the storm drain increases significantly at this point from approximately 170 cfs for the 54-inch to 350 cfs for the 78-inch. For this analysis and for the purposes of this hydrologic modeling of the split flow at 91st Avenue and Union Hills Drive the capacity of the 78-inch storm drain, or 350 cfs was utilized.

The 89th Avenue / Union Hills Drive storm drain transitions from a 60-inch storm drain to a 78-inch storm drain just south of the intersection of 89th Avenue & Union Hills Drive. In a similar fashion as above, the capacity of the storm drain increases significantly at this point increasing from approximately 235 cfs for the 60-inch to 350 cfs for the 78-inch and there is a large trench drain at this location. For this analysis and for the purposes of this hydrologic modeling of the split flow at 89th Avenue and Union Hills Drive the capacity of the 78-inch storm drain, or 350 cfs was utilized.

The combined diversion to the Desert Amethyst Basin will be the combined flow of these 2 storm drains, 350 cfs & 350 cfs, for a combined flow of 700 cfs. This varies significantly from what was previously modeled, so modifications have been made to the Glendale/Peoria watershed HEC-1 models to reflect this change. The results of this modification were minimal at the Desert Amethyst Basin with the peak discharge remaining virtually unchanged (332cfs vs. 333cfs for the 100-year 24-hour event). A slight decrease in peak flow (1014cfs vs. 975cfs) was seen downstream of the retention basin (HEC-1 ID CPBL91) due to more flow being routed through the retention basin, but the changes resulted in minimal differences in the downstream modeling results.

5.1.3.2 1016 - Bell Road

This storm drain in the Glendale/Peoria watershed is a 72-inch storm drain from 87th Avenue to the New River along Bell Road. The original HEC-1 models state that this diversion, DPBLNR, has a capacity of 159 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 160 cfs, so no modifications were made to the HEC-1 models.

5.1.3.3 2027 - Thunderbird Road

There are several HEC-1 diversions for the storm drain along Thunderbird Road in the Maryvale watershed.

HEC-1 diversion DTB75 accounts for the diversion at Thunderbird Road and 75th Avenue. At this location there is a 66-inch storm drain along Thunderbird Road and the HEC-1 model states that the capacity of the storm drain is 161 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 165 cfs, so no modifications were made to the HEC-1 models.

HEC-1 diversion DTB83 accounts for the diversion at Thunderbird Road and 83rd Avenue. At this location there is a 72-inch storm drain along Thunderbird Road and the HEC-1 model states that the capacity of the storm drain is 247 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 255 cfs, so no modifications were made to the HEC-1 models.

5.1.3.4 2030 - Greenway Road & 2031 - Greenway Road

This storm drain in the Maryvale watershed, HEC-1 ID DGW83, is stated as being a 42-inch storm drain at the intersection of 83rd Avenue and Greenway Road with a capacity of 45 cfs. Upon reviewing the storm drain network, it appears that the majority of flow to this storm drain would actually come from the area south of the subbasin boundary and not from the flow that would be contributing to the split flow. However, there is a parallel 54-inch storm drain along Greenway Road that would convey flow from 79th Avenue towards Skunk Creek. The capacity of this storm drain was estimated as being approximately 55 cfs, which is very similar to the 45 cfs estimated in the HEC-1 models, so no modifications were made to the HEC-1 models.

5.1.3.5 3010 - Cactus Road

There are several HEC-1 diversions for the storm drain along Cactus Road in the Maryvale watershed.

HEC-1 diversion DCT67 accounts for the diversion at Cactus Road and 67th Avenue. At this location there is a 78-inch storm drain along Cactus Road and the HEC-1 model states that the capacity of the storm drain is 268 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 270 cfs, so no modifications were made to the HEC-1 models here.

HEC-1 diversion DCT75 accounts for the diversion at Cactus Road and 75th Avenue. At this location there is a 108-inch storm drain along Cactus Road and the HEC-1 model states that the capacity of the storm drain is 651 cfs. The review of the hydraulics showed that the storm drain increases to a 114-inch storm drain along this stretch of Cactus Road thus allowing for a higher

capacity within this section of storm drain. The pipe full capacity of this storm drain is approximately 725 cfs and the model was updated to reflect this increase in capacity.

HEC-1 diversion DCT83 accounts for the diversion at Cactus Road and 83rd Avenue. At this location there is a 120-inch storm drain along Cactus Road and the HEC-1 model states that the capacity of the storm drain is 663 cfs. The review of the hydraulics of this storm drain show that there are 2 slope changes in the storm drain. At 83rd Avenue the slope is approximately 0.0016 ft/ft followed by an increase in slope to 0.0028 ft/ft followed by a decrease in slope to 0.0013 ft/ft to the outlet. Utilizing Manning's equation for the first section of storm drain would yield a storm drain capacity of approximately 660 cfs; however by modeling the entire reach it is apparent that there is significantly more capacity in the storm drain. The hydraulic analysis showed that the pipe full capacity for this entire section of storm drain is approximately 750 cfs and the HEC-1 models were updated to reflect this increase in capacity.

5.1.3.6 3012 - Peoria Avenue

There are several HEC-1 diversions for the storm drain along Peoria Avenue in the Maryvale watershed.

HEC-1 diversion DPE83 accounts for the diversion at Peoria Avenue and 83rd Avenue. At this location there is a 48-inch storm drain along Peoria Avenue and the HEC-1 model states that the capacity of the storm drain is 112 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 115 cfs, so no modifications were made to the HEC-1 models here.

HEC-1 diversion DPE91 accounts for the diversion at Peoria Avenue and 91st Avenue. At this location there is a 72-inch storm drain along Peoria Avenue and the HEC-1 model states that the capacity of the storm drain is 147 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 150 cfs, so no modifications were made to the HEC-1 models here.

HEC-1 diversion DPELO accounts for the diversion at Peoria Avenue and Loop 101 Freeway. At this location there is a 72-inch storm drain along Peoria Avenue and the HEC-1 model states that the capacity of the storm drain is 255 cfs. It appears that the Peoria Avenue storm drain was modified upon the construction of the Loop 101 Freeway to empty into the ADOT channel along the east side of the Loop 101 Freeway. Because of this, the HEC-1 diversion DPELO was removed from the HEC-1 models.

5.1.3.7 4021 - Olive Avenue

There are several HEC-1 diversions for the storm drain along Olive Avenue in the Maryvale watershed.

HEC-1 diversion DOL67 accounts for the diversion at Olive Avenue and 67th Avenue. At this location there is a 72-inch storm drain along Olive Avenue and the HEC-1 model states that the capacity of the storm drain is 662 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 660 cfs, so no modifications were made to the HEC-1 models here.

HEC-1 diversion DOL71 accounts for the diversion at Olive Avenue and 71st Avenue. At this location there is a 78-inch storm drain along Olive Avenue and the HEC-1 model states that the capacity of the storm drain is 386 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 300 cfs, so modifications were made to the HEC-1 models at this location. The local capacity of the storm drain is higher for this and subsequent portions of storm drain, however, the capacity of the downstream-most portion of storm drain is the governing factor along Olive Avenue.

HEC-1 diversion DOL75 accounts for the diversion at Olive Avenue and 75th Avenue. At this location there is a 90-inch storm drain along Olive Avenue and the HEC-1 model states that the capacity of the storm drain is 239 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 300 cfs, so modifications were made to the HEC-1 models at this location.

HEC-1 diversion DOL83 accounts for the diversion at Olive Avenue and 83rd Avenue. At this location there is a 90-inch storm drain along Olive Avenue and the HEC-1 model states that the capacity of the storm drain is 243 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 300 cfs, so modifications were made to the HEC-1 models at this location.

The Olive Avenue storm drain empties into the ADOT channel along the Loop 101 Freeway just west of 91st Avenue. However, the HEC-1 model does not model the last portion of the 102-inch storm drain from 91st Avenue to the ADOT channel. The consequence of this is that the entire flow is utilized to estimate the intersection split flow at 91st Avenue & Olive Avenue. An additional storm drain diversion was added to the model to account for the downstream-most leg of the Olive Avenue storm drain. The hydraulic capacity analysis estimated the pipe full capacity of this 102-inch storm drain as 400 cfs. This diversion (DOL91/DPOL91) was added to the HEC-1 models and routed (RPOLLO) to the ADOT channel (CPOLLO). Several modifications were made to the HEC-1 schematic to address this addition. Please see **Section 5.1.2.5 Schematic Modifications** for details on the modifications to the HEC-1 schematic.

5.1.3.8 4021 - 75th Avenue

This storm drain in the Maryvale watershed is a 60-inch storm drain at 75th Avenue and Peoria Avenue. The original HEC-1 models state that this

diversion, D75PE has a capacity of 179 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 180 cfs, so no modifications were made to the HEC-1 models for this diversion.

5.1.3.9 4039 - Northern Avenue

There are several HEC-1 diversions for the storm drain along Northern Avenue in the Maryvale watershed.

HEC-1 diversion DNO75 accounts for the diversion at Northern Avenue and 75th Avenue. At this location there is a 60-inch storm drain along Northern Avenue and the HEC-1 model states that the capacity of the storm drain is 161 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 160 cfs, so no modifications were made to the HEC-1 models.

HEC-1 diversion DNO83 accounts for the diversion at Northern Avenue and 83rd Avenue. At this location there is a 72-inch storm drain along Northern Avenue and the HEC-1 model states that the capacity of the storm drain is 233 cfs. A significant grade break occurs in this section of storm drain (from approximately 0.78% to 0.04%). Because of this, the hydraulic grade line for this section of storm drain as estimated in the HEC-1 models is above the top of pipe, but still within allowable design criteria, so no modifications were made to the HEC-1 models.

HEC-1 diversion DNO91 accounts for the diversion at Northern Avenue and 91st Avenue. At this location there is a 60-inch storm drain along Northern Avenue and the HEC-1 model states that the capacity of the storm drain is 69 cfs. The review of the hydraulics showed that the pipe full capacity of this storm drain is approximately 70 cfs, so no modifications were made to the HEC-1 models here.

5.2 ESTABLISH BASE HYDROLOGY

From the review of the previous hydrology models and the hydraulic modeling of the storm drains, it was determined that modifications to the existing hydrologic models were necessary. The following sections detail those modifications.

5.2.1 Storm Drain Diversion Modifications

Per the hydraulic analysis, modifications were made for the modeling of the following storm drains in the hydrologic models.

Glendale / Peoria Watershed

91st Avenue / Union Hills Drive & 89th Avenue & Union Hills Drive (HEC-1 ID DUH91) - The capacity of this storm drain was determined to be larger than initially modeled. The HEC-1 diversion for this storm drain was increased from 583 cfs to 700 cfs.

Maryvale Watershed

Cactus Road - Two of the HEC-1 storm drain diversions along Cactus Road were determined to be larger than previously modeled. The HEC-1 diversion for Cactus Road at 75th Avenue (HEC-1 ID DCT75) was increased from 651 cfs to 725 cfs and the diversion for Cactus Road at 83rd Avenue (HEC-1 ID DCT83) was increased from 663 cfs to 750 cfs.

Olive Avenue - Three of the HEC-1 storm drain diversions along Olive Avenue were determined to be different than previously modeled. The HEC-1 diversion for Olive Avenue at 71st Avenue (HEC-1 ID DOL71) was decreased from 386 cfs to 300 cfs. The diversion for Olive Avenue at 75th Avenue (HEC-1 ID DOL75) was increased from 239 cfs to 300 cfs and the diversion for Olive Avenue at 83rd Avenue (HEC-1 ID DOL83) was increased from 243 cfs to 300 cfs. Additionally a section of storm drain along Olive Avenue from 91st Avenue to the Loop 101 Freeway that was not previously modeled was added. This storm drain, with a pipe full capacity of 400 cfs, was added to the HEC-1 models as HEC-1 ID DOL91.

Peoria Avenue - As part of the construction of the Loop 101 Freeway the storm drain along Peoria Avenue, which once terminated at the New River, was truncated at the ADOT channel along the eastern edge of the Loop 101 Freeway. The storm drain diversion DPELO was previously utilized to divert flow into a storm drain that once crossed where the highway is now located. This diversion was removed and the flow at this location is combined with the ADOT channel.

5.2.2 Retention Modeling Modifications

From the analyses that have been performed there were 2 instances where modifications were made to the retention modeling in the hydrology models.

Hayes Park Basin - Several modifications were made to add the storage associated with the Hayes Park Basin to the hydrologic models. These modifications were detailed in previous sections but include diverting contributing area flow to the Hayes Park Basin, estimating the Stage / Storage / Discharge for the Hayes Park Basin and routing the discharge from the basin downstream.

Northern Avenue Retention Basin - Modifications were made to the Northern Avenue retention basin to accomplish the following items:

- Limit inflow to the retention basin to the flows from the north and the east (these are the flows that could potentially reach the retention basin).
- Allow the Northern storm drain base flow to bypass the retention basin. These modifications were described in detail in the preceding sections.

5.3 MULTI-FREQUENCY ANALYSIS

Once all the modifications to the hydrology models were made, DDMSW was utilized to create models of various frequencies. The models created include 10, 25, 50 & 100-year models for the 2, 6 and 24-hour events. The storm drain design for this project was based

on the controlling 10-year event; however other storm frequency models were created to look at drainage issues and solutions other than the 10-year event. For instance, the 100-year, 2-hour model was utilized to determine the retention volume for various drainage issue solutions.

5.3.1 Precipitation

As part of the multi-frequency analysis, the precipitation for various storms was estimated. The precipitation values for the various frequency events were taken from the provided DDMSW files of the *Glendale/Peoria ADMPU* and the *Maryvale ADMS* models. The precipitation values utilized are shown **Table 5.1 – Precipitation Values** below:

Recurrence Interval	Glendale / Peoria Model			Maryvale ADMS Model		
	2-hour	6-hour	24-hour	2-hour	6-hour	24-hour
10-year	1.559	1.762	2.327	1.479	1.725	2.222
25-year	1.898	2.121	2.816	1.803	2.076	2.691
50-year	2.157	2.401	3.202	2.050	2.351	3.063
100-year	2.425	2.692	3.606	2.307	2.638	3.450

Table 5.1 – Precipitation Values

5.3.2 Modeling Results

A summary table of the modeling results for the 24 HEC-1 models can be found in **Appendix D.6 HEC-1 Summary Table**. The HEC-1 input and output files as well as the StormCAD files are included electronically in the report DVD in **Appendix J**.

SECTION 6. HYDRAULIC REVIEW AND STORM DRAIN ANALYSIS

6.1 HYDRAULIC MODELING

Hydraulic modeling was performed generally for all storm drains 24-inches and larger as well as selected channels and box culverts within the project area. *StormCAD V8i Edition*, by Bentley Systems, Inc. was utilized for the storm drain modeling. The purpose of the hydraulic modeling was to determine the capacity of the storm drain system at the top of pipe condition (flow full capacity where the hydraulic grade line is approximately equal to the top of the pipe) as well as the storm drain systems maximum capacity (where the hydraulic grade line does not exceed one foot below the existing ground elevation). The following sections describe the data and process for these analyses.

6.2 HYDRAULIC MODELING DATA

GIS storm drain and modeling data was provided by the City and the FCDMC in Geodatabase format for the entire study area. This included storm drain mains, culverts, channels, manholes, catch basins, headwalls, connections, junctions and others. To facilitate the hydraulic modeling, the project area was split into 4 zones and the storm drains were separated into contributing networks. The storm drain networks were assigned names based on their corresponding zone (See **Index Map Overview** in **Appendix E Hydraulics Supporting Data**).

The storm drain data was reviewed and a significant portion of the GIS data could not be directly imported into StormCAD for modeling purposes. See **Section 2.7 Data Deficiencies** and **Appendix A.3 Data Collection Deficiencies** for details on the data deficiencies.

Missing or insufficient GIS data was supplemented via acquired survey, as-builts or matching neighboring values. In instances where missing or inadequate data was found in the attribute table and invert elevations were not annotated on the as-built file, or survey was not acquired, the data points were interpolated between the two nearest known data points. These assumptions were documented in the GIS attribute table.

As a result of the inadequate data referenced above, assumptions and engineering judgments had to be implemented in order to utilize the data for modeling purposes. The original GIS data was not changed but additional attributes were added to the GIS attribute tables. See **Table 6.1 – GIS Supplemented Data Description** for a list and description of the GIS data used for the StormCAD modeling.

GIS Identifier	Purpose		Description
Network_ID	Documentation	General	Network Identifier
Reach_ID	Documentation	General	Network Reach Identifier
Zone	Documentation	General	Project Zone
SC_SetInUp	StormCAD	Conduit	Allowing Drops. Not Forcing SD Upstream Elevation to Manhole Elevation
SC_SetInDn	StormCAD	Conduit	Allowing Drops. Not Forcing SD Downstream Elevation to Manhole Elevation
SC_Up_Inv	Documentation	Conduit	Supplemented SD Upstream Invert Elevation
Source_Up	Documentation	Conduit	Supplemented SD Upstream Invert Source
SC_Dn_Inv	Documentation	Conduit	Supplemented SD Downstream Invert Elevation
Source_Dn	Documentation	Conduit	Supplemented SD Downstream Invert Source
Datun_Adju	Documentation	Conduit	Datum Adjustment Magnitude
SC_Comment	Documentation	Conduit	General Comments
AdjElvUp	StormCAD	Conduit	Datum Adjustment Applied to the Supplemented SD Upstream Invert Elevation
AdjElvDn	StormCAD	Conduit	Datum Adjustment Applied to the Supplemented SD Downstream Invert Elevation
SC_No_Barr	StormCAD	Conduit	Number of Barrels
SC_Shape	StormCAD	Conduit	Conduit Shape
SC_Span	StormCAD	Conduit	Rectangular Storm Drain (Culvert) Width
SC_Rise	StormCAD	Conduit	Rectangular Storm Drain (Culvert) Height Or Channel Depth
SC_Bott_W	StormCAD	Conduit	Channel Bottom Width
SC_R_SS	StormCAD	Conduit	Channel Right Side Slope
SC_L_SS	StormCAD	Conduit	Channel Left Side Slope
SC_Invert	Documentation	Nodes	Supplemented Node Invert Elevation
Data_Source	Documentation	Nodes	Supplemented Node Invert Source
Datum_Adju	Documentation	Nodes	Datum Adjustment Magnitude
Adj_Inver	StormCAD	Nodes	Datum Adjustment Applied To The Supplemented Node Invert Elevation
SC_Rim_Elv	StormCAD	Nodes	Node Ground Elevation
SC_GrndSou	Documentation	Nodes	Node Ground Elevation Source
Q_Full_Cap	StormCAD	Nodes	Flowing Full Capacity For Inflow Nodes
Q_Max_Cap	StormCAD	Nodes	Maximum Capacity For Inflow Nodes
Q_MaxIncre	Documentation	Nodes	Percentage Greater From Max Capacity To Full Capacity

Table 6.1 – GIS Supplemented Data Description

Ground elevation information was obtained from topographic mapping provided by the FCDMC (see **Section 2.1 Topographic and Aerial Mapping**). Due to mapping datum differences, an elevation conversion factor of 1.83 feet was used to convert elevations from the National Geodetic Vertical Datum of 1929 (NGVD29) to North American Vertical Datum of 1988 (NAVD88) where needed to provide a uniform dataset.

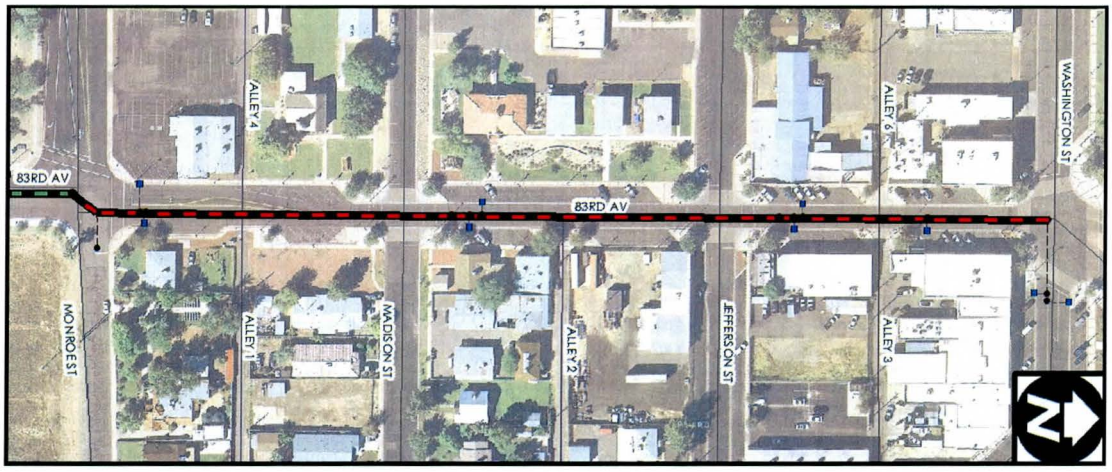
This conversion factor was identified by averaging datum elevation differences from known benchmarks of a recorded Maricopa County Geodetic Densification and Cadastral Survey. The elevation differences at the benchmarks in the project area were calculated using the National Geodetic Survey online conversion tool VERTCON. This tool computes the modeled difference in orthometric height between NAVD88 and NGVD29 for a given location specified by latitude and longitude.

Once the modeling data was analyzed and annotated in the attribute table using the best available information, each storm drain network reach was reviewed on a macro level to determine if there were any conflicting datums within a single storm drain network. This was done by comparing the as-built annotated elevations to the acquired survey shots. As previously mentioned, many of the projects throughout the study area were done using different vertical datums including NAVD88 and NGVD29, and in some cases, local datums. To account for unexplained variations between the annotated as-built elevations and the acquired survey data, if the variation was less than three quarters of a foot (0.75'), the as-built datum was assumed to be equivalent to NAVD88, otherwise, the entire infrastructure corresponding to that particular as-built set was moved up by a magnitude of 1.83 feet, the difference between NGVD29 and NAVD88, as previously described. Specifics regarding the elevation adjustments that were made can be found in the GIS data provided on the report DVD in **Appendix J Report DVD**.

The exceptions to the 1.83 foot vertical adjustments are as follows:

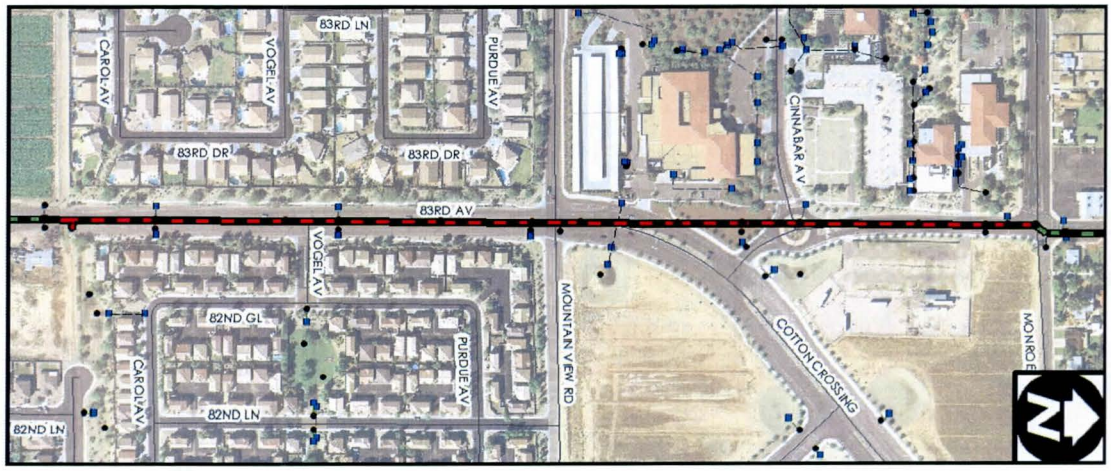
- 83rd Avenue from approximately Washington Street to Monroe Street

  Elevations for as-built number 52-158 were lower than the as-builts to the south by 0.74'. Elevations were increased to match the as-builts to the south.



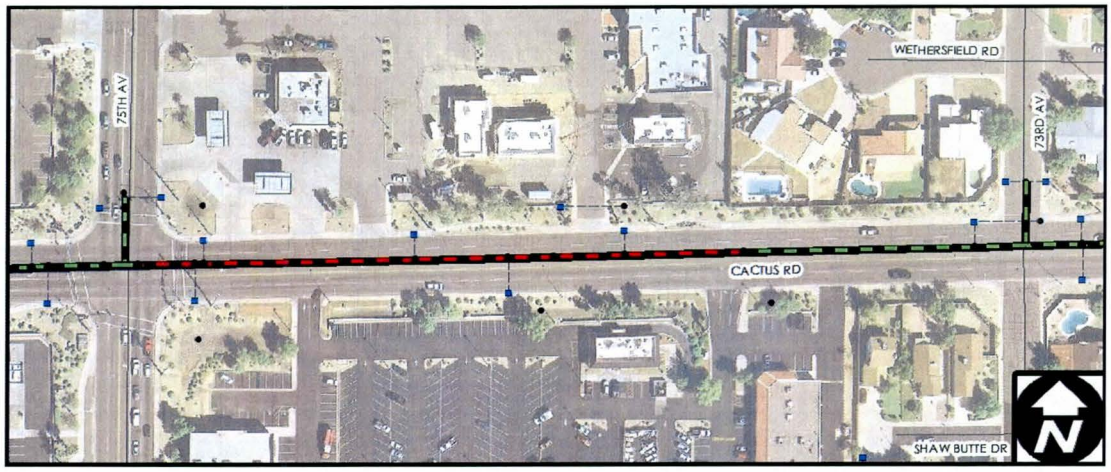
- 83rd Avenue from approximately Monroe Street to Hatcher Road:

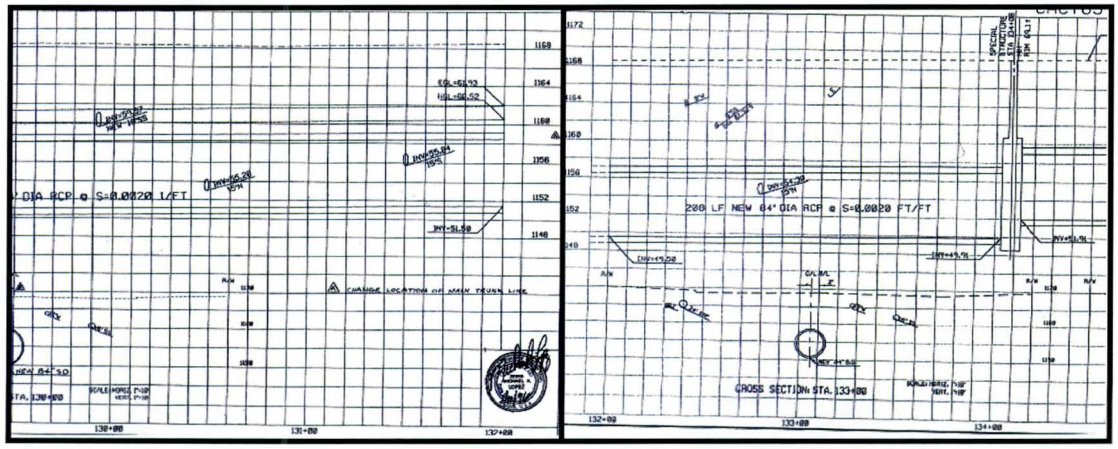
  Elevations for as-built 37-105 were higher than the as-builts to the north by 1.61'. Elevations were decreased to match the as-builts to the north.



- Cactus Road from approximately 75th Avenue to 74th Avenue

  Downstream as-builts 37-109 (Phase II of the Cactus Road improvements) are 2 ft higher than the upstream as-built 38-134 (Phase III) for the same station. As a result they were adjusted to match.





6.3 EXISTING SYSTEM HYDRAULIC CAPACITY

The hydraulic capacities of storm drainage systems within the project are were estimated using information generated by the data collection and facility inventory tasks.

6.3.1 Hydraulic Modeling Methodology

Hydraulic modeling was done using the computer program *StormCAD V8i.* Once the above modifications were made to the data it was imported by zone into StormCAD. An n-value of 0.013 was used for all storm drains and an n-value of 0.016 was used for all channels modeled. The downstream boundary condition for the storm drain system outfalls was set as the crown of pipe for most storm drains to account for potential backwater conditions.

6.3.2 Storm Drain Inflow and Outflow Nodes

Modeling inflow nodes were identified at intersections, pipe size change locations, laterals, significant grade changes, and any location where there may be a significant flow change in the hydraulic system. Outfall nodes were identified at the most downstream location of each network and limited to one per network. Once the inflow and outflow nodes were identified, the modeling data was then formatted into six (6) separate files so the information could be imported into StormCAD (see **Table 6.2 – StormCAD Files**). The GIS files used for the hydraulic modeling including the updated and corrected information, are contained on the report DVD in **Appendix J Report DVD**.

GIS File	StormCAD
SD Channels	Conduit
SD Culverts	Conduit
SD Mains	Conduit
SD Nodes In	Inflow Nodes
SD Nodes Out	Network Outfall
SD Nodes	Manhole or Transition Nodes

Table 6.2 – StormCAD Files

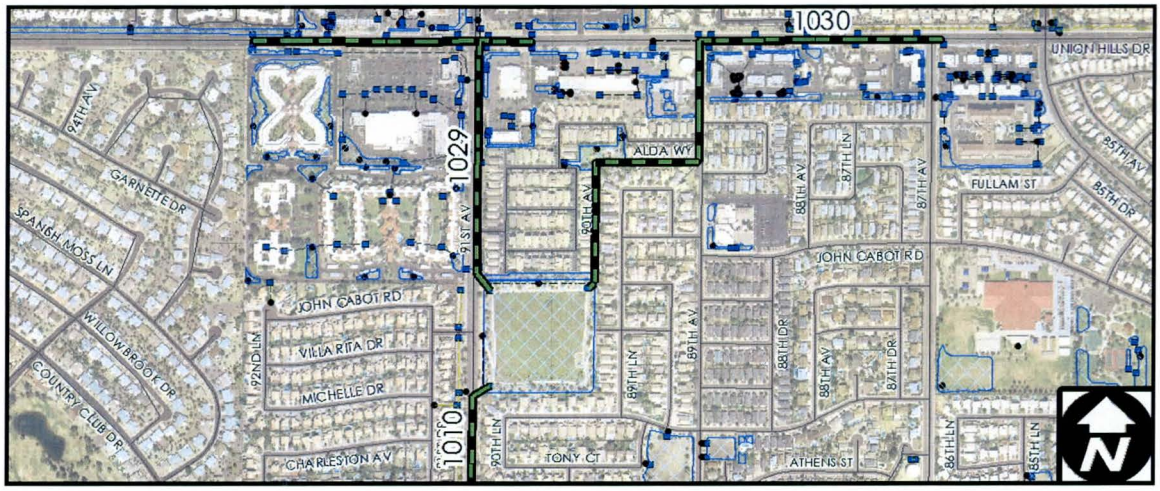
6.3.3 Retention Basins

No retention basins were modeled in the hydraulic capacity portion of the project as noted in **Section 5 Base Hydrology Review and Analysis**; however, onsite retention basins were considered for developments after 1990. In the instance of off-line or hydraulically connected retention basins, the basin was either treated as an outfall location (typically when the storm drain configuration only allows for a very small bypass flow) or a reduction in flow along the storm drain. When the off-line retention basin was treated as a flow reduction location the reduced downstream flow value was estimated as being the downstream storm drain capacity. In each of these instances the storm drain size is reduced downstream of

the off-line retention basin to force flow into the retention basin. Some of the major retention basins in the project area include the following:

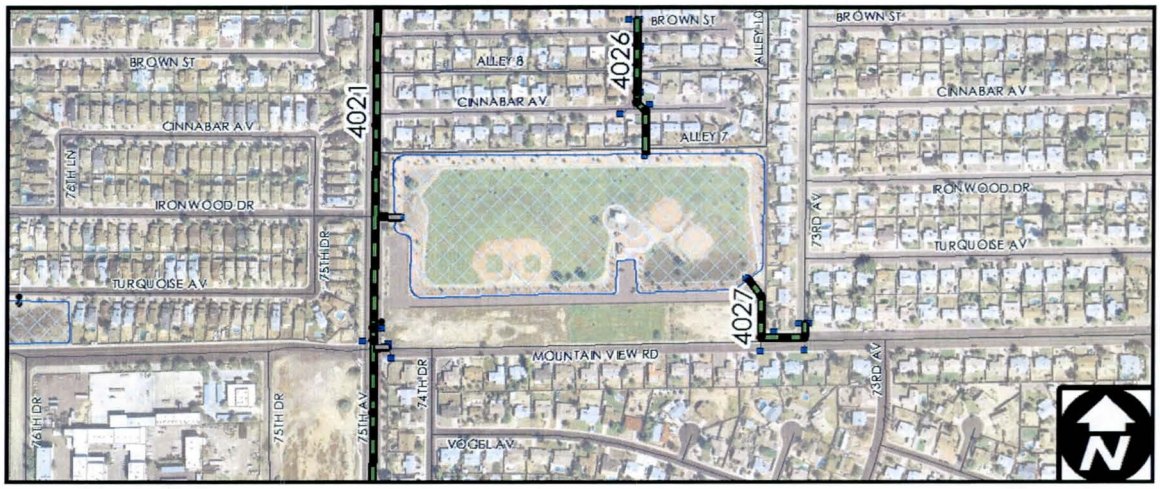
The Desert Amethyst Basin

The Desert Amethyst Basin is located in the vicinity of 91st Avenue and Villa Rita Drive, approximately 1,300 ft south of Union Hills Drive. As previously mentioned outfall nodes were identified at the most downstream location of each network and limited to one per network. After reviewing the basin configuration, for modeling purposes, the 48-inch equalizer pipe along the north and west portion of the basin were removed. The flow contributing to this retention basin was modeled as 2 outfalls into the basin: networks 1029 and 1030. Additionally, the retention basin bleeds off into the upstream-most segment of network 1010.



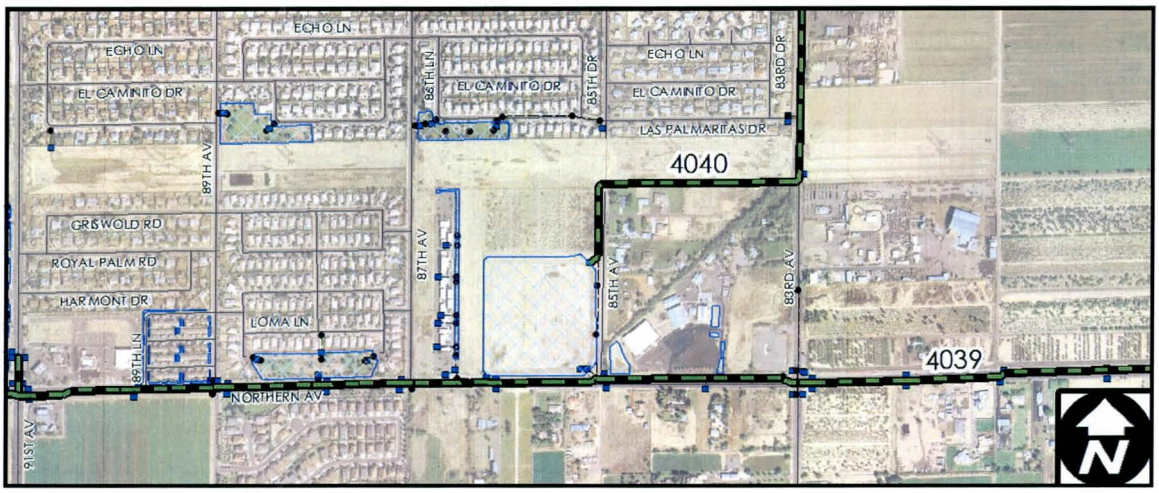
The Hayes Park Basin

The Hayes Park basin is located in the vicinity of Mountain View Road and 75th Avenue. The system contributing to Hayes Park includes a 60-inch storm drain along 75th Avenue (network 4021) from north of Peoria Avenue to Hayes Park. After Hayes Park this storm drain is reduced to a 48-inch storm drain (approximately 35 feet south of the basin). This basin is modeled as a reduction in flow and the reach along 75th Avenue was not disconnected.



Regional Basin in the vicinity of Northern Avenue and 85th Avenue

The storm drain to the north of the basin (network 4040) was treated as an independent network and the equalizer pipe along the east side of the basin was removed in the model. The storm drain along Northern Avenue (4039) was modeled as a reduction in flow and the reach along Northern Avenue was not disconnected at the retention basin.



6.3.4 Storm Drain - Flow Full Capacity

To begin the hydraulic modeling the modified GIS data was imported into StormCAD V8i. Several iterations were performed in StormCAD to obtain a network flow full capacity. The flow full capacity iterations began by first looking at the flow full capacity of each of the individual storm drain segments. Because the flow full capacity of each storm drain segment is dependent on the slope of each individual pipe (manhole to manhole), a generalized capacity was established from inflow node to inflow node. The established flows were then modeled in StormCAD and each network reach was reviewed to confirm the flow full capacity. This process was followed for all storm drains in the project area beginning with

each of the network's main trunks followed by the network laterals. See **Appendix E Hydraulics Supporting Data** for hydraulic profiles and tables.

6.3.5 Storm Drain – Maximum Capacity

Once the flow full capacity was established for the entire project area, the storm drain systems were analyzed to estimate the maximum capacity. The maximum capacity was established by increasing the storm drain flows while maintaining the hydraulic grade line (HGL) approximately one foot below the ground elevation. Because the HGL of the upstream portions of the storm drain is heavily influenced by the downstream HGL, the first iteration to increase the storm drain flow to the maximum capacity started by increasing the capacity of a storm drain reach by a global amount (10%-50%) above the flow full capacity. Once the HGL was established for the main trunk of the storm drain, all connecting storm drains and laterals were reviewed to determine if the increase of flow downstream made the connecting reach inadequate or if there was an opportunity to further increase the flow in those reaches. See **Appendix E Hydraulics Supporting Data** for hydraulic profiles and tables.

6.4 STORM DRAIN NETWORKS

Descriptions of all the storm drain networks are not included in this report. Some of the networks that required particular attention to address their unique situations are addressed in the following sections.

6.4.1 Zone 1 – Network 1010

Network 1010 consists of a major 78 to 96-inch storm drain along 91st Avenue beginning at the Desert Amethyst Park Basin. As it flows south, this storm drain collects flow along 91st Avenue for approximately 3,330 ft where it crosses Bell Road through a 2-6'x6' box culvert. Flow is conveyed south for approximately 1 ½ miles in a concrete lined channel and ultimately outfalls into the New River. There are several lateral storm drains contributing to this network, particularly on Bell Road at the transition from the storm drain to channel. This network is modeled using a downstream hydraulic grade line constraint of crown of pipe to accommodate possible flows in the New River.

6.4.2 Zone 1 – Network 1015

This network consists of approximately 1,400 ft of 27-inch storm drain starting at the intersection of John Cabot Road and 84th Avenue outfalling into the New River. This network drains the Bell Park subdivision and has no additional inlets other than at the intersection of John Cabot Road and 84th Avenue. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.3 Zone 1 – Network 1016

This network is approximately 1,900 ft of 72-inch storm drain flowing east along Bell Road from 87th Avenue to the New River. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.4 Zone 1 – Network 1019

This network consists of approximately 625 ft of 60-inch storm drain acting as an outfall for the Arrowhead Shores Park and collecting flows from the Arrowhead Shores subdivision. The storm drain conveys flows from the intersection of Tumblewood Drive and 87th Avenue to the New River. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.5 Zone 1 – Network 1020

This network consist of a 24-inch storm drain along Arrowhead Fountains Center Drive from south of Bell Road to Paradise Lane. Additionally, the network includes a 30 to 36-inch storm drain from Paradise Lane to Mariners Way where it then flows south along 83rd Avenue via a 48-inch storm drain and outfalls into the Skunk Creek. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in Skunk Creek.

6.4.6 Zone 1 – Network 1021

This network consists of a 30 to 54-inch storm drain along 83rd Avenue from the intersection of Paradise Lane and outfalls at Skunk Creek. There is also a lateral along Paradise Lane (1021-2), east of 83rd Avenue for approximately 870 ft. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in Skunk Creek.

6.4.7 Zone 1 – Network 1022

The main trunk of this network consists of approximately 1,400 ft of 84-inch and 820 ft of 96-inch storm drain running north to south along an alley between 77th and 78th Avenue and through the east fields of the Peoria Sport Complex from Bell Road to Skunk Creek. This storm drain system extends into Glendale and drains the areas in Glendale including the Arrowhead Towne Center and much of the area between 75th Avenue and the Loop 101 Freeway south of Union Hills.

There are several laterals to this network within Peoria. The first (1022-6) is a 30-inch which is then reduced to a 24" pipe approximately 450-feet south of bell road. There are no available as-builts or survey information for this reach so the modeling data consists of two survey points acquired as a part of the facility inventory process.

The second (1022-4 & 1022-5) is a large collection system approximately 1,000 ft south of Bell Road that collects flow from the Enclave at Paradise Lane Apartments and the North Valley Power Center. This reach consists of several conflicting as-builts and reaches with little to no information so engineering judgment and several survey points were utilized to establish the modeling data. This particular reach is the major limiting factor for this network since it is flowing against surface grade and has limited cover.

The last reach for this network consists of approximately 1,250 ft of 24-inch storm drain along Paradise Lane (1022-2) and an additional 850 ft of 24-inch pipe along 77th Avenue (1022-3). Collectively this overall network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in Skunk Creek.

6.4.8 Zone 1 – Network 1024

Network 1024 consists of approximately 1,000 ft of 78-inch storm drain along 75th Avenue from just north of Bell Road to Skunk Creek. There is a lateral connection along Bell Road (1024-2) consisting of approximately 1,420 ft of 24-inch storm drain, east of 75th Avenue. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in Skunk Creek.

6.4.9 Zone 1 – Network 1029

This network consists of two 30-inch laterals along Union Hills Drive draining towards 91st Avenue where it then travels south for approximately ¼ of a mile and ultimately outfalls in the Desert Amethyst Park Basin. Although this network is connected to network 1010 with a 48-inch equalizer pipe, this network was assumed to outfall into the Desert Amethyst Park Basin with a 78-inch storm drain, therefore this storm drain, for modeling purposes is not affected by the downstream hydraulic grade line from network 1010. This network was also modeled using a free outfall with the assumption that network 1010 will drain the Desert Amethyst Park Basin before there is any major backwater effects to the upstream system.

6.4.10 Zone 1 – Network 1030

This network consists of a 42 to 60-inch storm drain along Union Hills Drive from 87th to 89th Avenue where it travels southwest along a 78-inch pipe and outfalls into the Desert Amethyst Park Basin. Like network 1029, this network is connected to networks 1010 and 1029 with a 48-inch equalizer pipe but outfalls to the Desert Amethyst Park Basin with a 78-inch storm drain, therefore this storm drain, for modeling purposes is not affected by the downstream hydraulic grade line from downstream networks (1010 & 1029).

6.4.11 Zone 2 – Network 2010

Network 2010 consists of a gradually increasing 30 to 72-inch storm drain along Thunderbird Road from approximately 94th Avenue to 91st Avenue where it flows south and empties into an earth lined channel ultimately outfalling to the New River. There are approximately 700 ft of 36-inch lateral storm drain along 91st Avenue (2010-2) collecting street flow and flows from the West Shore subdivision. The lateral along 91st Avenue is the limiting reach of this network. This is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.12 Zone 2 – Network 2022

This network consists of approximately 1,150 ft of 48-inch and 1,950 ft of 60-inch storm drain along Sweetwater Avenue between 85th Avenue and the Loop 101 Freeway. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the ADOT channel along the Loop 101 Freeway.

6.4.13 Zone 2 – Network 2027

Thunderbird is one of the larger networks in the project area. It consists of a 36-inch storm drain from 70th to 71st Avenue, a 54-inch storm drain from 71st to 75th Avenue, a 66-inch storm drain from 75th to 83rd Avenue, and a 72 inch storm drain from 83rd Avenue to the Loop 101 Freeway. This reach had no storm drain profiles in the as-built files; therefore the data used for this reach was provided by the City and interpolated between the known points. Some data was also verified by the acquired survey.

The first lateral for this network is along 83rd Avenue from Country Gables Drive to Thunderbird Road (2027-2) and consists of 700 ft of 36-inch, 2,760 ft of 54-inch pipe, and 500 ft of 66-inch storm drain. The north most 36-inch segment is one of the limiting segments of the entire network. Raising the hydraulic grade line along Thunderbird Road can make this particular segment inadequate.

The second lateral for this network consists of a 30-inch storm drain around the 76th Drive Alignment (2027-3) that drains the Primrose School of Arrowhead basin. The last major lateral is along 75th Avenue from Greenway Road to Thunderbird Road (2027-4). This consists of approximately 1,575 ft of 24-inch storm drain, 1,780 ft of 36-inch storm drain and approximately 2,000 ft of 48 to 54-inch storm drain.

6.4.14 Zone 2 – Network 2030

This network consists of approximately 620 ft of 48-inch storm drain and 1,300 ft of 54-inch storm drain along Greenway Road from 79th Avenue to Skunk Creek. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in Skunk Creek.

6.4.15 Zone 3 – Network 3010

Network 3010 is one of the major systems within the project area. Its main reach is along the Cactus Road alignment from just east of 67th Avenue in Glendale to the Loop 101 Freeway. This reach consists of approximately 2,700 ft of 78-inch storm drain, 2,600 feet of 84-inch, 2,650 ft of 108-inch, 2,675 feet of 114-inch, and 6,400 feet of 120-inch storm drain. There are several stub outs in this network ranging from as small as 24-inch to several ranging from 42 to 66-inch. This network also extends into Glendale along 67th Avenue north to approximately ½ mile north of Thunderbird Road. This portion of the storm drain within Glendale also extends east along Sweetwater from 67th Avenue to 63rd Avenue. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the ADOT channel along the Loop 101 Freeway.

The first lateral connection, an 84-inch storm drain, follows 91st Avenue south to Grand Avenue (3010-2). This reach of storm drain is against surface grade and is one of the limiting segments of the overall network. It is believed that this storm drain is intentionally plugged at or near the railroad tracks along Grand Avenue. A channel along the north side of the railroad tracks collects flow from approximately 89th Avenue and ends at 91st Avenue, near the end of the 84-inch storm drain. There is potential to connect the channel to the 84-inch storm drain; however the surface grade is very flat in this area and a channel connection or storm drain extension (as proposed in the Original Master Plan) would be very difficult.

There is second collection segment flowing from north to south along 83rd Avenue (3010-3). This storm drain ranges from a 36 to 54-inch pipe between Windrose Drive and Cactus Road.

6.4.16 Zone 3 – Network 3012

This is a major network along Peoria Avenue consisting of a 30 to 42-inch storm drain from 77th Avenue to 83rd Avenue, turns north and parallels and then crosses Grand Avenue and the railroad tracks as a 48-inch pipe, merges back to Peoria Avenue as a 48 to 72-inch, and outfalls into the ADOT channel along the Loop 101 Freeway. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the ADOT channel.

The first lateral for this network is along 90th Avenue (3012-3). It consists of approximately 780 ft of 24-inch storm drain flowing from south to north. This is one of the limiting segments of the entire network because it flows against surface grade and limits the elevation of the hydraulic grade line for the entire system. A similar situation occurs for the 350 ft, 24-inch lateral south of Peoria Avenue along 87th Avenue (3012-4).

There are several other laterals including approximately 600 ft of 36-inch storm drain along 85th Avenue north of Peoria Avenue (3012-5) and 1,200 ft of 36-inch south of Peoria Avenue (3012-6), 700 ft of 24-inch storm drain along 83rd Drive just south of Peoria Avenue (3012-8) and 2,200 ft of 30 to 36-inch storm drain along 83rd Avenue, north of Peoria (3012-2).

6.4.17 Zone 3 – Network 3013

This network is comprised of a 24 to 54-inch storm drain along 91st Avenue from Cortez Street (roughly 750 ft south of Grand Avenue) to Peoria Avenue. This network then turns west on Peoria Avenue as a 72-inch storm drain where it runs parallel to network 3012 and ultimately outfalls into the ADOT channel along the Loop 101 Freeway. This network is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the ADOT channel.

6.4.18 Zone 4 – Network 4010

Network 4010 consists of a single 24 to 36-inch storm drain located on Olive Avenue from approximately 109th Avenue to just east of 103rd Avenue. The storm drain outfalls to a concrete lined channel, then crosses Olive Avenue via a single, 10'x8' box culvert, and ultimately outfalls into the New River. This network is modeled using a free outfall because there is a berm and intermediate channel between the network and the New River.

6.4.19 Zone 4 – Network 4014

This network is located on Olive Avenue flowing from east to west consists of a 36-inch storm drain from 93rd Avenue 95th Avenue, 48-inch from 95th Avenue to 97th Avenue and a 54-inch to the New River. This is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.20 Zone 4 – Network 4016

This network consists of approximately 1,400 ft of 48-inch storm drain along 99th Avenue and 800 ft from 99th Avenue to the New River. This is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.21 Zone 4 – Network 4021

This is one of the larger networks in the project area with the major reach along Olive Avenue from 67th Avenue to the Loop 101 Freeway. A significant portion of the storm drain is located within the City of Glendale. This includes a storm drain along Olive from 67th Avenue to just east of 47th Avenue as well major laterals along 67th Avenue north to almost Cactus Road, 63rd Avenue north to Brown Street, and 59th Avenue north to just south of the Arizona Canal. No hydraulic modeling was performed for the storm drain reaches within the City of Glendale. The modeling assumption for all storm drains with upstream segments in Glendale was that the reaches within Glendale did not adversely affect the storm drain within

Peoria, and the top of pipe capacity for the upstream segment in Peoria was set to approximately be the full flow capacity of the pipe.

The upstream portion of the Olive Avenue reach within the City of Peoria consists of approximately 170 ft of 96-inch and 2,975 ft of 102-inch storm drain from 67th Avenue to just west of 71st Avenue. At this point, the storm drain is connected to an off-line regional retention basin at Sunnyslope Park. Although this off-line retention acts as an intermediate outfall, as previously mentioned, all networks are modeled with one outfall per network and a flow reduction was applied in this location. After the Sunnyslope Park retention basin, the pipe is reduced from a 102-inch to a 78-inch storm drain from just west of 71st Avenue to 75th Avenue. The storm drain increases to a 90-inch to 96-inch pipe from 75th Avenue to just west of 81st Avenue where it encounters a second off-line retention basin at the Roundtree Ranch Park. This off-line basin was also modeled as a flow reduction and not an ultimate outfall. The storm drain was once again reduced to an 84-inch storm drain following the Roundtree Ranch Park to 83rd Avenue. The storm drain continues as a 90 to 96-inch from 83rd to 87th Avenue, 96-inch from 87th to just east of 91st Avenue where it enters a single 10'x6' box culvert and ultimately outfalls into the ADOT channel along the Loop 101 Freeway.

The first lateral is located along 69th Avenue consisting of a 24 to 36-inch storm drain from Vogel Avenue to Olive Avenue (4021-8).

The second major lateral is located along 75th Avenue from Cholla Street to Olive Avenue (4021-2). The 75th Avenue lateral consists of a single 48-inch storm drain from Cholla Street to Peoria Avenue and a 60-inch from Peoria Avenue to approximately Ironwood Drive where it connects to a third off-line basin at Hayes Park. Just like the other off-line basins in this network, the junction was treated as a flow reduction. The 75th Avenue storm drain is reduced to a 48-inch pipe soon after the connection to the retention basin (approximately 35 ft south). Based on the configuration of the storm drain it is possible that, as head is increased in the 60-inch storm drain along 75th Avenue flow may begin to enter the retention basin, thus reducing peak discharges downstream. This is also dependent on the head present in the retention basin. The lateral continues as a single 48-inch storm drain from Mountain View Road to Grand Avenue where it increases to a 54-inch storm drain, crosses Grand Avenue and connects with the main reach along Olive Avenue.

The third major lateral for this network is located along 83rd Avenue from Washington Street to Olive Avenue (4021-5) consisting of approximately 700 ft of 24-inch storm drain, 1,330 ft of 30-inch, and 2,660 ft of 48-inch storm drain. This particular reach is comprised of 3 different as-builts with 3 different vertical datums. Using acquired survey as part of the facility inventory portion of the project and engineering judgment, the as-built data was adjusted for modeling purposes.

The fourth and fifth laterals are located along 87th Avenue (4021-4) consisting of approximately 1,675 ft of 48-inch storm drain from Carol to Olive Avenue and approximately 650 ft of 54-inch storm drain along 91st Avenue (4021-3).

6.4.22 Zone 4 – Network 4028

This network is located on Butler Drive flowing from east to west and consists of a 36-inch storm drain from 87th Avenue to 89th Avenue, a 42-inch from 89th Avenue to 91st Avenue and a 48-inch storm drain to the New River. This is modeled using a downstream hydraulic grade line constraint at crown of pipe to accommodate possible flows in the New River.

6.4.23 Zone 4 – Network 4039

Network 4039 is one of the largest and the southernmost network of the project area. The GIS data for this network consists of overlapping and conflicting as-builts both in US and metric units. A large portion of this network was surveyed to obtain consistent modeling data. This network consists of a 36 to 42-inch storm drain in Northern Avenue from approximately 71st Avenue to 75th Avenue, 1,200 ft of 60-inch and 5,500 ft of 72-inch storm drain from 75th Avenue to 85th Avenue. At this point, the storm drain is connected to an off-line regional retention basin. Although this off-line retention acts as an intermediate outfall, as previously mentioned, all networks are modeled with one outfall per network and a flow reduction was applied in this location. After the regional retention basin, the pipe is reduces to a single 42-inch storm drain for approximately 3,600 ft and is increased to a single 60-inch pipe for approximately 3,100 ft and ultimately outfalls into the ADOT channel along the Loop 101 Freeway.

This network has one major lateral along 75th Avenue from Golden Lane to Northern Avenue consisting of a single a 24 to 36-inch storm drain (4039-3).

This network is also hydraulically connected to network 4040 (See the **Index Map Overview** in **Appendix E Hydraulics Supporting Data**) but the connection was removed in the StormCAD model because the primary outfall of this network 4039 (ADOT channel along the Loop 101 Freeway) is not the primary outfall of network 4040 (regional retention basin near 85th Avenue and Northern).

6.5 STREET FLOW ROUTING EVALUATION

As a part of the hydraulic analysis, the major street routes were reviewed to determine if it met the City's standards. Section 4.2 of the *City of Peoria Infrastructure Development Guidelines, January 2012* states that collector streets shall be designed to carry 10-year flows between the property lines, and the 100-year flows between the right-of-way. Major and minor arterials street are to carry a 10-year flow between the curbs and maintain a 12 ft dry lane in each direction. A typical roadway cross-section was modeled to estimate the street flow capacity.

The typical cross-section consists of:

- Roadway cross slope of 2%
- Ponding depth of 6-inches
- n-value of 0.013

FlowMaster V8i was utilized using Manning's equation to estimate the roadway capacity. A rating curb was developed using longitudinal slope vs. conveyed flow.

$$Q = \left(\frac{1.49}{n}\right) * A * R^{\left(\frac{2}{3}\right)} * So^{\left(\frac{1}{2}\right)}$$

For this analysis, the HEC-1 model's street route ID's where identified within the project area and their corresponding street slope and governing 10-year flows were extracted. Using the modeled routing street slopes, a street capacity was estimated ranging from 10 cfs for a modeled street slope of 0.0003ft/ft to 35 cfs for a slope of 0.004ft/ft. The approximated street capacity was then compared to the governing 10-year routing flows to find any street capacity deficient reaches (See **Table 7.1 – Master Planned Facilities - Existing Evaluation Summary**). Once the street routing deficiencies were identified, the storm drains along those particular reaches were reviewed to determine if there was any additional capacity from the storm drains full flow capacity to the maximum storm drain capacity.

SECTION 7. REVIEW OF ORIGINAL STORM DRAIN MASTER PLAN

The purpose of this task of the Peoria Storm Drain Master Plan was to assess the previous Master Plan and how it has been implemented. In particular the following items were looked at:

- Master Planned Facilities - Existing Evaluation: does the constructed infrastructure adequately meet the master plan design standards.
- Master Planned Facilities - Existing vs. Planned: was the infrastructure built as originally proposed.
- Master Planned Facilities - Proposed Evaluation: are the proposed facilities (not built) still required and/or should modifications be made to the proposed infrastructure.

7.1 ORIGINAL MASTER PLAN DOCUMENTS

Several documents make up the original Master Plan. A list of the available documents from the original Storm Water and Area Drainage Master Plans are as follows (in chronological order):

- ***Storm Water Master Plan Hydrology Report*, April 1985 (Reference 042)** by James M. Montgomery, Consulting Engineers, Inc.
- ***Glendale-Peoria Area Drainage Master Plan (FINAL DRAFT)*, April 1986 (Reference 003)** by Camp Dresser & McKee Inc. and James M. Montgomery, Consulting Engineers, Inc.
- ***Glendale-Peoria Area Drainage Master Plan*, May 1987 (Reference 124)** by Camp Dresser & McKee Inc. and James M. Montgomery, Consulting Engineers, Inc.
- ***Addendum To Glendale-Peoria Area Drainage Master Plan*, May 1987 (Reference 125)** by Camp Dresser & McKee Inc. and James M. Montgomery, Consulting Engineers, Inc.
- ***Master Plan of Storm Drainage, Executive Summary*, April 1988 (Reference 001)** by James M. Montgomery, Consulting Engineers, Inc.
- ***Master Plan of Storm Drainage*, April 1988 (Reference 002)** by James M. Montgomery, Consulting Engineers, Inc.

The final two documents, *Master Plan of Storm Drainage* from April of 1988 (**References 001 & 002**) were utilized in the following sections of this report and are referred to jointly as the "Master Plan".

7.2 MASTER PLANNED FACILITIES - EXISTING EVALUATION

The Master Plan design criterion was that the 10-year flood event be contained within the storm drain and the street section. As part of the Facilities Inventory (see **Section 3 Facility Inventory**) and the Hydraulic Review and Analysis (see **Section 6 Hydraulic Review And Storm Drain**), the capacities of the existing storm drains were estimated for both the top of pipe and maximum flow capacity scenarios, and as part of the Base Hydrology Review (see **Section 5 Base Hydrology Review and Analysis**), which incorporated the storm drain capacities, the flows along the major corridors were

established for various storm frequencies including the 10-year event. Using a typical street section, a rating curve based on longitudinal slope was created to approximate the street flow capacity (see **Section 6.5 Street Flow Routing Evaluation**). With the storm drain capacities, street capacities and 10-year flow it could easily be established if the combined existing infrastructure and street section was able to convey the 10-year event.

The top of pipe hydraulic analysis was utilized in the HEC-1 hydrology models to model the storm drains; however, the storm drains, at times have additional capacity beyond the top of pipe capacity. To address this additional storm drain available capacity from what was modeled in HEC-1, the following analysis was performed to determine if there were storm drain and roadway segments that lacked adequate capacity, or was the storm drain able to accommodate the flow with the additional available capacity beyond the top of pipe capacity. **Table 7.1 – Master Planned Facilities - Existing Evaluation Summary** summarizes this analysis. The following is a description of the columns in the table and what they represent:

- **Location:** Major street segments with storm drain infrastructure.
- **HEC-1 Route ID**: The HEC-1 street route ID utilized in the models.
- **Len**: The length of the street route.
- **Slope**: The longitudinal slope of the street route.
- **Street Capacity (10-year)**: The estimated street flow capacity based on slope.
- **Storm Drain Q_{full}**: Top of pipe storm drain capacity (modeled in HEC-1).
- **Storm Drain Q_{max}**: Maximum storm drain capacity. This is often larger than the top of pipe analysis. This was not modeled in HEC-1 but represents real potential flow carrying capacity.
- **HEC-1 10-Year Flow**: The controlling 10-year HEC-1 flow (highest of the 6- and 24- hour models) for the street flow. The storm drain flow is not included in this value.
- **10-Year Flow Above Street Capacity**: This represents the difference between the HEC-1 route flow and the street capacity. If no value is shown in the table the street has sufficient capacity.
- **SD Additional Capacity (Q_{full} vs Q_{max})**: This represents additional available storm drain capacity above the top of pipe capacity that was utilized in HEC-1.
- **System Deficiency/Surplus**: This is the difference between the "10-Year Flow Above Street Capacity" and "SD Additional Capacity" flows. A negative number indicates that the system (street and storm drain flow) has a deficiency after accounting for the storm drains additional capacity.

Location	HEC-1 Route ID	Len.	Slope	Street Capacity (10-year)	Storm Drain Q_{full}	Storm Drain Q_{max}	HEC-1 10-year Flow	10-Year Flow Above Street Capacity	SD Additional Capacity (Q_{full} vs Q_{max})	System Deficiency/ Surplus
		[ft]	[ft/ft]	[cfs]	[cfs]	[cfs]	[cfs]	[cfs]	[cfs]	[cfs]
Thunderbird: 67th to 75th	RWTB75	5280	0.0027	29	70 to 130	70 to 130	81	52	0	-52
Thunderbird: 75th to 83rd	RWTB83	5280	0.0034	33	165	165	130	97	0	-97
Thunderbird: 83rd to L101	RWTBLO	2002	0.0030	31	255	275	71	40	20	-20
83rd Ave: S. to Thunderbird	RSTB83	5280	0.0023	27	25 to 175	25 to 250	6		75	
83rd Ave: Thunderbird to Cactus	RSCT83	5280	0.0030	31	50	55	149	118	5	-113
Cactus: 67th to 75th	RWCT75	5280	0.0030	31	270 to 300	285 to 330	13		30	
Cactus: 75th to 83rd	RWCT83	5280	0.0026	29	725 to 750	800 to 825	0		75	
Cactus: 83rd to L101	RWCTLO	6650	0.0048	39	750	825	26		75	
83rd Ave: Cactus to Peoria	RSPE83	5280	0.0023	27	15 to 50	15 to 50	17		0	
91st Ave: Grand to Peoria	RSPELO	2704	0.0018	24	750	825	47	23	75	52
Peoria: 75th to 83rd	RWPE83	5280	0.0023	27	25 to 45	25 to 45	37	10	0	-10
Peoria: 83rd to 91st	RWPE91	5280	0.0037	34	115 to 150	115 to 150	40	6	0	-6
Peoria: 91st to L101	RWPELO	1289	0.0017	23	150	180	29	6	30	24
75th Ave: Cactus to Peoria	RSPE75	5280	0.0027	29	80	80	0		0	
Peoria: 67th to 75th	RWPE75	5280	0.0035	33	102	102	0		0	
75th Ave: Peoria to Grand/Olive	RSOL75	5280	0.0027	29	180 to 185	180 to 185	42	13	0	-13
91st Ave: Peoria to Olive	RSOL91	5280	0.0019	24	50	175	20		125	
Olive: 67th to 75th	RWOL75	5280	0.0031	31	660	750	43	12	90	78
83rd: Peoria to Olive	RSOL83	5280	0.0031	31	14 to 85	14 to 85	16		0	
Olive: 75th to 83rd	RWOL83	5280	0.0027	29	300	360	0		60	
Olive: 83rd to 91st	RWOL91	5280	0.0025	28	300	360 to 450	13		150	
Olive: 91st to L101	RWOLLO	600	0.0039	35	400	600	16		200	
83rd: Olive to Northern	RSNO83	5280	0.0040	35	15 to 145	15 to 175	9		30	
91st Ave: Olive to Northern	RSNO75	5280	0.0019	24	15 to 40	15 to 40	10		0	
Northern: 67th to 75th	RWNO75	5280	0.0030	31	50	50 to 65	32	1	15	14
Northern: 75th to 83rd	RWNO83	5280	0.0048	39	160 to 230	200 to 250	29		40	
Northern: 83rd to 87th	RWNO87	1400	0.0014	21	230	275	238	217	45	172
Northern: 87th to 91st	RWNO91	5280	0.0014	21	25	40	30	9	15	6
Northern: 91st to L101	RWNOLO	3480	0.0026	29	70	105	0		35	
91st Ave: Olive to Northern	RSNO91	5280	0.0029	30	0	0	14		0	

Table 7.1 – Master Planned Facilities - Existing Evaluation Summary

From this analysis and **Table 7.1 – Master Planned Facilities - Existing Evaluation Summary**, it can be seen that there are three locations (see System Deficiency/Surplus column in **Table 7.1**) where real deficiencies may occur in the storm drain system (deficiencies less than 20 cfs were assumed to be within the limits of the modeling error and were not addressed):

- Thunderbird Road storm drain east of 83rd Avenue
- 83rd Avenue storm drain north of Cactus Road
- Northern Avenue from 83rd Avenue to the retention basin near 87th Avenue.

Each of the above three locations is reviewed in more detail in the following sections.

7.2.1 Thunderbird Road Storm Drain - East of 83rd Avenue

This location is part of Drainage Issue #4 and the proposed alternative for this drainage issue is discussed in detail in **Section 8 Alternatives Formulation and Evaluation**. The area encompasses the upstream portion of the Thunderbird Road storm drain (between 75th Avenue & 67th Avenue). The Thunderbird Road storm drain system (Network ID 2027) as a whole is limited by the HGL of the upstream reaches of Thunderbird Road (east of 71st Avenue) where there is a 36-inch pipe section, and the upstream most portion of the 75th Avenue storm drain (approximately north of Acoma Road) where the storm drain is 24 to 36-inches and there is very little cover.

This limiting factor is quite prevalent when looking at the hydraulic profiles of the storm drains. The entire storm drain system is hydraulically connected and the prevailing hydraulic conditions are such that an increase of the HGL in the main branch downstream could create a backwater effect and increase the HGL of the upstream storm drain reaches to be above the design criteria and potentially even above the ground surface. It appears that the downstream portions of the storm drain would be able to convey additional flow (the HGL is well below the ground surface elevation) if the upstream portions of the storm drain had additional capacity added to them.

7.2.2 83rd Avenue Storm Drain - North of Cactus Road

This location is part of Drainage Issue #9 and the proposed alternative for this drainage issue is discussed in detail in **Section 8 Alternatives Formulation and Evaluation**. The drainage issue is roadway flooding along 83rd Avenue and encompasses this portion of the 83rd Avenue storm drain. This portion of storm drain ranges in size from 36 to 48-inches with a capacity of about 50 cfs and an estimated 10-year flow of 150 cfs. This flow, in the HEC-1, comes as bypass flow from the 83rd Avenue and Thunderbird Road intersection.

7.2.3 Northern Avenue Upstream of Retention Basin

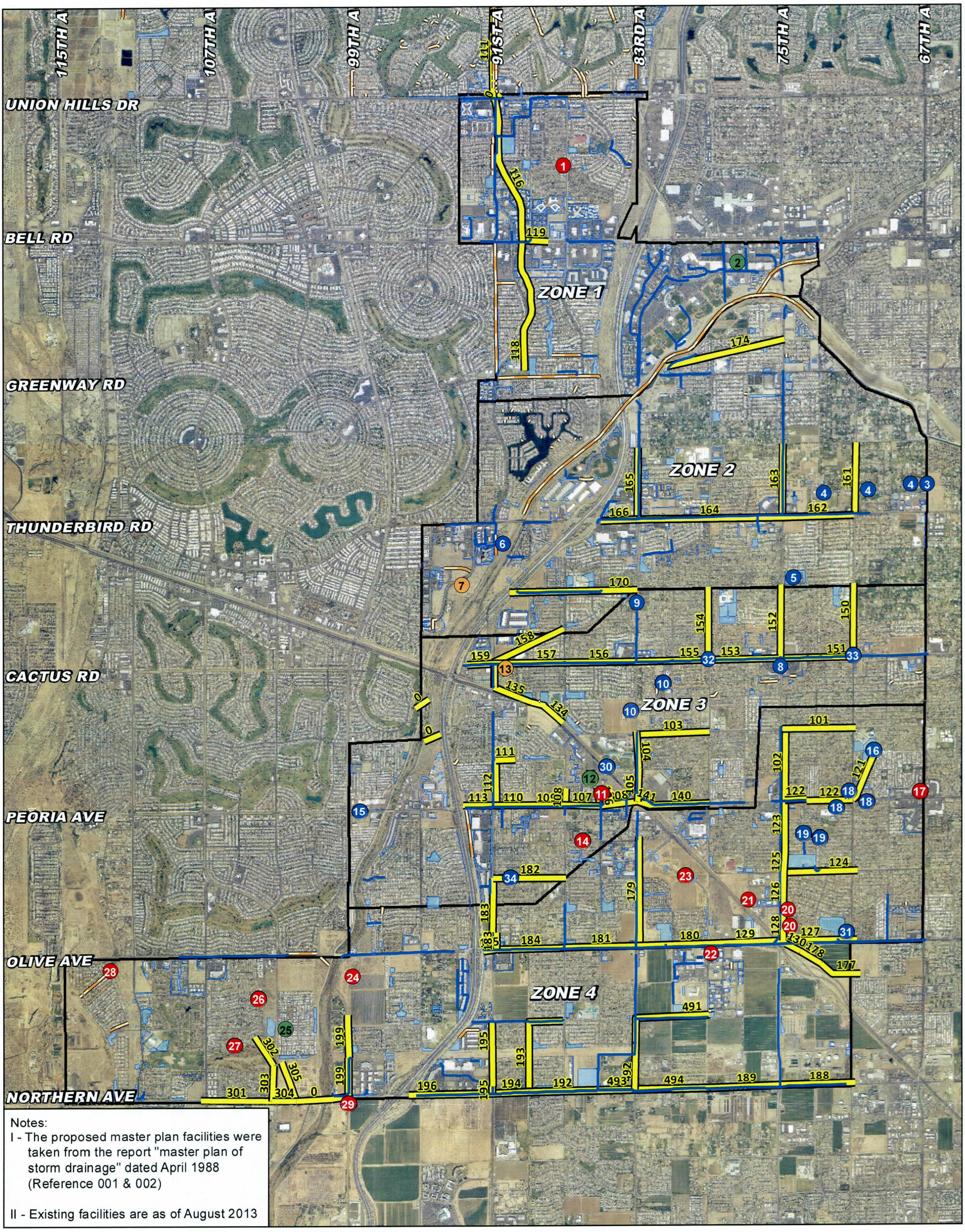
The hydrology models show approximately 470 cfs total flow getting to the intersection of Northern Avenue and 83rd Avenue. The excess flow here as seen in **Table 7.1 – Master Planned Facilities - Existing Evaluation Summary** is approximately 170 cfs, which is the total flow minus the Northern Avenue storm drain and street capacity. The HEC-1 model does not model the newly constructed storm drain along Butler Drive or 83rd Avenue because it falls entirely within a single subbasin; however this storm drain helps convey flow to the Northern Avenue Retention Basin thus preventing this "excess flow" from ever getting to Northern Avenue. The breakdown of capacities for the area is as follows:

- Northern Avenue storm drain capacity ~ 230 to 275 cfs
- Northern Avenue street capacity ~ 21 cfs
- 83rd Avenue storm drain capacity ~ 145 to 175 cfs

The original Master Plan called for a storm drain along Butler Drive and 83rd Avenue to Northern Avenue. By including the 83rd Avenue storm drain capacity, the total potential conveyance for this location is approximately 470 cfs. Therefore, the perceived lack in conveyance at this location was a modeling issue within HEC-1 and was simply due to the fact that the 83rd Avenue storm drain was not modeled in the HEC-1 model. There is no actual lack of conveyance at this location.

7.3 MASTER PLANNED FACILITIES EVALUATION - EXISTING VS. PLANNED

Many of the proposed infrastructure segments from the original Master Plan were not designed and built as originally planned. Despite this, only those locations described in the preceding sections appear to have capacity issues. The following sections describe the locations where infrastructure was designed and built significantly different from the original Master Plan. The original Master Plan storm drain segment ID's will be referenced in the following sections and can be seen in **Figure 7.1 – Proposed Facilities**. These ID's were taken from the *Master Plan of Storm Drainage* dated April 1988 (**Reference 001 & 002**). Additionally the existing storm drain network ID's will be referenced. See **Section 6 Hydraulic Review And Storm Drain Analysis** for details.



Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

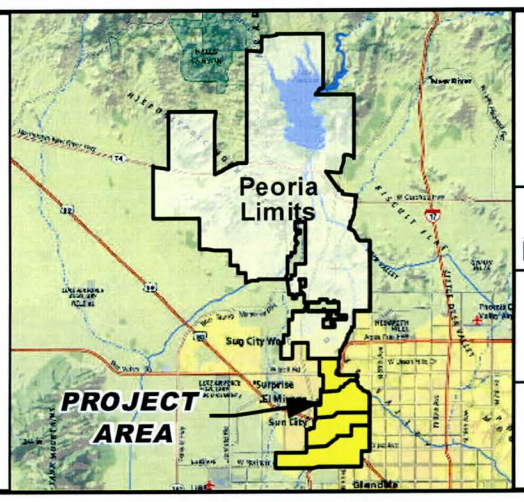
II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin

Drainage Issue/Problem Areas

- Recommended
- Recommended Sizing
- Possible
- Not Recommended



CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 3,500 7,000 Feet

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2255 N. 44th Street Suite 125
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FIGURE 7.1
PROPOSED FACILITIES

7.3.1 Peoria Avenue Storm Drain System - Network ID 3012

There are several segments along Peoria Avenue that were designed and built differently than originally proposed. The analyses presented in this report indicate that there are deficiencies in the area of this existing storm drain network. These inadequacies were addressed as part of **Section 7.5.1 Cholla Street & 83rd Avenue to Peoria Avenue**. The following sections describe the locations along the Peoria Avenue storm drain network where infrastructure was designed and built significantly different from the original Master Plan.

7.3.1.1 Peoria Avenue - ID808

This reach of the Peoria Avenue network is located between 83rd Avenue and 85th Avenue. The previous Master Plan proposed a single 78-inch storm drain with a flow of 270 cfs. Currently, there is an existing 48 to 54-inch storm drain with the flow full capacity of approximately 115 cfs.

7.3.1.2 Peoria Avenue - ID107, 109 & 110

These reaches of the Peoria Avenue network are located between 85th Avenue and 91st Avenue. The previous Master Plan proposed a single 60-inch storm drain with a flow of 255 to 335 cfs. Currently, there is an existing 48 to 54-inch storm drain with the flow full capacity of approximately 115 cfs.

7.3.2 Olive Avenue Storm Drain System - Network ID 4021

There are several segments along and contributing to the Olive Avenue storm drain that were designed and built differently than originally proposed. In particular there are several regional retention sites that reduce the peak flows in the storm drain network. The analyses in this report indicate that there are no deficiencies along this existing storm drain network that needed to be addressed. The following sections describe the locations along the Olive Avenue storm drain network where infrastructure was designed and built significantly different from the original Master Plan.

7.3.2.1 75th Avenue - ID123 & 125

These reaches are located along 75th Avenue between Peoria Avenue and Mountain View Road. The previous Master Plan proposed a single 90 to 96-inch storm drain with a flow of 410 cfs. Currently, there is an existing 60-inch storm drain with the flow full capacity of approximately 180 cfs. There are several drainage issues in the vicinity that will be addressed as part of the alternatives analysis.

7.3.2.2 75th Avenue – ID126 & 128

These reaches are located along 75th Avenue between Mountain View Road and Olive Avenue. The previous Master Plan proposed a single 108 to 102-inch storm drain with a flow of 585 cfs. Currently, there is an existing 48 to 60-inch storm drain with the flow full capacity of approximately 85 cfs. The decrease in size is due to the construction of the Hayes Park retention basin at 75th Avenue and Mountain View Road. The contributing system to Hayes Park includes a 60-inch storm drain along 75th Avenue from north of Peoria Avenue to Hayes Park (Mountain View Road) where it is connected to the Hayes Park basin with a 78-inch storm drain. The 75th Avenue storm drain is reduced to a 48-inch storm drain soon after the connection to the retention basin (approximately 35 ft south). Based on the configuration of the storm drain it is possible that, as head is increased in the 60-inch storm drain along 75th Avenue, flow may begin to enter the retention basin, thus reducing peak discharges downstream.

7.3.2.3 Olive Avenue – ID127

This reach is located along Olive Avenue between 71st Avenue and 75th Avenue. The previous Master Plan proposed a single 66-inch storm drain with a flow of 160 cfs. Currently, there is an existing reach of 102-inch storm drain upstream of this location from 67th Avenue to 71st Avenue. This upstream reach has a flow full capacity of approximately 660 cfs. The 102-inch storm drain is connected to the Sunnyslope Park regional basin at approximately Olive Avenue and 71st Avenue where the storm drain is reduced to a 78-inch storm drain soon after the connection to the retention basin. The existing 78-inch storm drain has a flow full capacity of approximately 300 cfs.

7.3.2.4 Olive Avenue – ID129 & 180

These reaches are located along Olive Avenue between 75th Avenue to 83rd Avenue. The previous Master Plan proposed a single 132 to 138-inch storm drain with a flow of 900 to 940 cfs. Currently, there is an existing 90 to 96-inch storm drain from 75th Avenue to approximately 81st Avenue with an approximate flow full capacity of 300 cfs. At this location, the existing storm drain is connected to the Roundtree Ranch Park regional retention basin. The Olive Avenue storm drain is reduced to an 84-inch storm drain soon after the connection to the retention basin.

7.3.2.5 83rd Avenue – ID179

This reach along 83rd Avenue is located between Monroe Street to Olive Avenue. The previous Master Plan proposed a single 84-inch storm drain with a flow of 315 cfs. Currently, there is an existing 24 to 48-inch storm drain with the flow full capacity of approximately 14 to 85 cfs. Grand

Avenue is located just north of the upstream portion of this reach, thus limiting the amount of flow to the south.

7.3.3 Northern Avenue Storm Drain System – Network ID 4039

There are several segments along and contributing to the Northern Avenue storm drain that were designed and built differently than originally proposed. In particular regional retention is utilized to reduce the peak flows in the storm drain network. The analyses in this report indicate that there are no deficiencies along this existing storm drain network that needed to be addressed. The following sections describe the locations along the Northern Avenue storm drain network where infrastructure was designed and built significantly different from the original Master Plan.

7.3.3.1 Northern Avenue – ID189 & 494

These reaches are located along Northern Avenue between 75th Avenue and 83rd Avenue. The previous Master Plan proposed a single 78-inch storm drain with a flow of 275 to 336 cfs. Currently, there is an existing 60 to 72-inch storm drain with the flow full capacity of approximately 160 to 230 cfs.

7.3.3.2 Northern Avenue – ID493, 192 & 194

These reaches are located along Northern Avenue between 83rd Avenue to 91st Avenue. The previous Master Plan proposed a single 108 to 138-inch storm drain with a flow of 623 to 648 cfs. Currently, there is an existing 72-inch storm drain from 83rd Avenue to 85th Avenue with an approximate flow full capacity of 230 cfs. At this location, the existing storm drain is connected to a regional retention basin. The Northern Avenue storm drain is reduced to a 42-inch storm drain soon after the connection to the retention basin.

7.3.3.3 Northern Avenue – ID196

This reach of Northern Avenue network is located between 91st Avenue to the Loop 101 Freeway. The previous Master Plan proposed a single 114-inch storm drain with a flow of 677 cfs. Currently, there is an existing 60-inch storm drain with the flow full capacity of approximately 70 to 105 cfs. The Northern Avenue retention basin significantly reduces flows to this segment of storm drain.

7.4 MASTER PLANNED FACILITIES – PROPOSED EVALUATION

A significant portion of the previous Master Plan has been constructed; however, there are several locations where infrastructure had previously been proposed but has not yet been built. An analysis was performed to determine if the remaining proposed infrastructure could be integrated into the existing drainage system. **Table 7.2 – Master Planned Facilities - Proposed Evaluation Summary** summarizes how the proposed

infrastructure would connect to the existing drainage system. In the table, the Pipe ID is the original Master Plan Pipe ID, and the Network ID is the storm drain Network ID as previously established in this report.

The majority of the remaining proposed infrastructure segments are compatible with the existing drainage system. There are some conflicts however. Conflicts between proposed drainage facilities in the original Master Plan and existing infrastructure are highlighted (red) in **Table 7.2 – Master Planned Facilities - Proposed Evaluation Summary** and described in the following sections.

Pipe ID	Network	Proposed Diameter [in]	Connecting Diameter [cfs]	Q Design [cfs]	Q_{full} Downstream SD [cfs]	Location
161	2027	36"	54"	34 cfs	130 cfs	71st Ave - Acoma to Thunderbird Rd
150	3010	66"	84"	150 cfs	300 cfs	71st Ave - Sweetwater to Cactus Rd
152	3010	66"	108"	162 cfs	725 cfs	75th Ave - Sweetwater to Cactus Rd
154	3010	60"	114"	142 cfs	750 cfs	79th Ave - Sweetwater to Cactus Rd
134	3010	84"	84"	230 cfs	230 cfs	Grand Ave - 87th Ave to 91st Ave
103	3012	60"	30"	**138 cfs**	**15 cfs**	Cholla St - 79th Ave to 83rd Ave
108	3012	42"	60"	42 cfs	130 cfs	87th Ave - Sahuaro Dr to Peoria Ave
111	3013	54"	54"	62 cfs	85 cfs	Yucca St - 89th Dr to 91st Ave
101	4021	66"	48"	**149 cfs**	**80 cfs**	Cholla St - 71st Ave to 75th Ave
121	4021	42"	72"	42 cfs	173 cfs	71st Ave – Cholla to Peoria Ave
122	4021	72"	48"	**173 cfs**	**102 cfs**	Peoria Ave – 71st Ave to
124	4021	60"	48"	**158 cfs**	**85 cfs**	Mountain View Rd - 71st Ave to 75th Ave
182	4021	66"	84"	163 cfs	240 cfs	Mountain View Rd - 87th Ave to 91st Ave
183	4021	84"	120"	240 cfs	400 cfs	91st Ave - Mountain View to Olive Ave
193	4039	60"	42"	**123 cfs**	**25 cfs**	89th Ave - Butler to Northern Ave
195	4039	60"	60"	**138 cfs**	**70 cfs**	91st Ave - Butler to Northern Ave

Table 7.2 – Master Planned Facilities - Proposed Evaluation Summary

7.4.1 Cholla Street – ID103 in Network 3012

A 60-inch storm drain was proposed on Cholla Street from 79th Avenue to 83rd Avenue connecting to a proposed 78-inch storm drain along 83rd Avenue. The existing storm drain along 83rd Avenue is a 30-inch storm drain with an approximate flow full capacity of 15 cfs. It transitions to a 36-inch storm drain that combines with the Peoria Avenue storm drain (48-inch at Grand Avenue) and ultimately outfalls into the ADOT channel along the Loop 101 Freeway. This location is directly downstream of Drainage Issue #10; however, the recommended alternative for Drainage Issue #10 (see **Section 8.4.3.3 Drainage Issue No. 10 – Roosevelt Street and 81st Avenue**) does not address the regional capacity issue of the storm drain system and so alternatives to address the regional issue were developed and are presented in **Section 7.5 Additional Master Planned Facilities**.

7.4.2 Cholla Street – ID101 in Network 4021

A planned 66-inch storm drain was proposed along Cholla Street from approximately 71st Avenue to 75th Avenue connecting to a 72-inch line along 75th Avenue. Currently, there is an existing 48-inch pipe along 75th Avenue with the flow full capacity of approximately 80 cfs. The storm drain ultimately combines with the Olive Avenue storm drain and outfalls to the ADOT channel along the Loop 101 Freeway. This location is near Drainage Issues #16, 17, & 18 and a new recommendation for this area is being proposed and can be seen in **Section 8 Alternatives Formulation and Evaluation**.

7.4.3 87th Avenue – ID108 in Network 3012

A planned 42-inch storm drain with the design capacity of 42 cfs was proposed along 87th Avenue from approximately Sahuaro Drive to Peoria Avenue. The previous Master Plan proposed a 42-inch storm drain connecting to the existing storm drain at the intersection of Peoria Avenue and 87th Avenue. Currently, there is an existing 60-inch pipe along Cactus Road with the flow full capacity of approximately 130 cfs.

An analysis was performed to determine if a storm drain would need to be proposed along 87th Avenue from Grand Avenue to Peoria Avenue. If the street capacity is large enough to handle all contributing flow, then no storm drain would need to be proposed along this reach.

The analysis showed that the contributing flows exceed the street capacity along 87th Avenue from Mescal Street to Peoria Avenue. Contributing flows along 87th Avenue were approximated by taking the subbasin flow after the retention and multiplying it with the ratio of local contributing area to the total subbasin area. Street capacity were approximated based on sizes, geometry and prevailing ground slopes. Flow magnitudes and street capacity at key locations are presented in **Table 7.3 – 87th Avenue – ID108 in Network 3012 Hydraulic Analysis**.

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N-Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
87th Ave – Grand Ave to Mescal St	1175	0.0051	0	0.013	0	40	40	0.08 * ERPE91 (1)	6-hour	32
87th Ave – Mescal St to Peoria Ave	1370	0.0038	36	0.013	41	35	76	0.18 * ERPE91 (1)	6-hour	67

[1] Only a portion of the total HEC-1 subbasin area contributes at this location

Table 7.3 – 87th Avenue – ID108 in Network 3012 Hydraulic Analysis

Based on this analyses it was determined that a 36-inch storm drain would need to be proposed along 87th Avenue from Mescal Street to Peoria Avenue. See **Figure 7.2 – Network 3012** for details.

7.4.4 Peoria Avenue – ID122 in Network 4021

A planned 72-inch storm drain was proposed along Peoria Avenue from approximately 71st Avenue to 75th Avenue connecting to a 90-inch line along 75th Avenue. Currently, there is an existing 60-inch pipe along 75th Avenue with the flow full capacity of approximately 180 cfs. The system ultimately combines with the Olive Avenue storm drain and outfalls to the ADOT channel along the Loop 101 Freeway. This location is near Drainage Issues #16, 17, 18, & 19 and a new recommendation for this area is proposed in **Section 8 Alternatives Formulation and Evaluation**.

7.4.5 Mountain View Road – ID124 in Network 4021

A planned 60-inch storm drain was proposed along Mountain View Road from approximately 71st to 75th Avenue connecting to a 108-inch line along 75th Avenue. Currently, there is an existing, relatively short reach of 42 to 60-inch storm drain along Mountain View Road that takes flows from 73rd Avenue and Mountain View Road and outfalls to the Hayes Park basin. This location is near Drainage Issue #19 and a new recommendation for this area is proposed in **Section 8 Alternatives Formulation and Evaluation**.

7.4.6 Alice Avenue – ID130, ID177, ID178 in Network 4021

A planned 60-inch storm drain with the design capacity of 128 cfs was proposed along Alice Avenue from approximately 71st Avenue to Grand Avenue and along Grand Avenue from Alice Avenue to Olive Avenue. The previous Master Plan proposed a 60-inch storm drain connecting to the existing storm drain at the intersection of Olive Avenue and 75th Avenue. Currently, there is an existing 78-inch pipe along Olive Avenue with the flow full capacity of approximately 300 cfs.

An analysis was performed to determine if a storm drain, as proposed in the original Master Plan, would be needed at the above mentioned location. The analysis showed that the contributing drainage area (see **Figure 7.3 – Network 4021**) for the proposed storm drain is comprised of an agricultural field and a vacant parcel north of Alice Avenue. It is expected that storm runoff generated in the irrigated agricultural field would be contained within the field. In addition, if the vacant parcel located at the northeast corner of Alice Avenue and 71st Avenue is developed in the future, it is anticipated that adequate drainage infrastructure would be required. Based on this analyses it was determined that no master plan storm drain would need to be proposed along Alice Avenue from 71st Avenue to Grand Avenue and along Grand Avenue from Alice Avenue to Olive Avenue.. See **Figure 7.3 – Network 4021** for details.

7.4.7 Grand Avenue – ID134 & ID135 in Network 3010

A planned 84-inch storm drain with the design capacity of 230 cfs was proposed along Grand Avenue from approximately 87th Avenue to 91st Avenue. The

previous Master Plan proposed an 84-inch storm drain connecting to the existing storm drain at the intersection of Grand Avenue and 91st Avenue. Currently, there is an existing 84-inch pipe along 91st Avenue from Grand Avenue to Cactus Road. In addition, there is a depressed area along the north side of Grand Avenue that forms a small swale. However, there is no guarantee that this swale would be there in the future therefore it was not considered in this analysis.

An analysis was performed to determine if a storm drain would need to be proposed along Grand Avenue from Varney Road to 91st Avenue. Contributing flow at the above mentioned location was determined from the HEC-1 model. Flow magnitudes and storm drain capacity are presented in **Table 7.4 – Grand Avenue – ID134 & 135 in Network 3010 Hydraulic Analysis** below.

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N-Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
Grand Avenue - Varney to 87th Ave.	3500	0.0016	54	0.013	79	0	79	0.56 * CGR91	24-hr	66
Grand Avenue - 87th to 91st Ave	3500	0.0008	72	0.013	120	0	120	CGR91	24-hr	118

Table 7.4 – Grand Avenue – ID134 & 135 in Network 3010 Hydraulic Analysis

Based on this analyses it was determined that a 54-inch storm drain would need to be proposed along Grand Avenue from Varney Road to 87th Avenue and a 72-inch storm drain from 87th Avenue to 91st Avenue. See **Figure 7.4 – Network 3010 (Grand Avenue)** for details. This has been included in the Conceptual Plans (see **Section 9 Recommended Storm Drainage Master Plan** for details).

7.4.8 Cactus Road – ID158 in Network 3010

A planned 36-inch storm drain with the design capacity of 30 cfs was proposed from 87th Avenue and Columbine Drive to Cactus Road and the Loop 101 Freeway. The previous Master Plan proposed a 36-inch storm drain connecting to the existing storm drain at the intersection of Cactus Rd and 91st Avenue. Currently, there is an existing 120-inch pipe along Cactus Road with the flow full capacity of approximately 750 cfs.

An analysis was performed to determine if a storm drain would need to be proposed along Cactus Road from 83rd Avenue to 91st Avenue and along 87th Avenue from Sweetwater Avenue to Cactus Road. If the existing storm drains and street capacities are large enough to handle all contributing flow, then no storm drain would need to be proposed for this area.

The analysis showed that the existing storm drain and street capacities at the above mentioned locations are adequate to handle the contributing flows. Contributing flows along Cactus Road and 87th Avenue were approximated by taking the subbasin flow after the retention and multiplying it by the ratio of local contributing area to the total subbasin area. Existing storm drain and street capacities were approximated based on sizes, geometry and prevailing ground slopes. Flow

magnitudes, as well as, street and storm drain capacities at key locations are presented in **Table 7.5 – Cactus Road – ID158 in Network 3010 Hydraulic Analysis**.

Based on this analyses it was determined that no master plan storm drain would need to be proposed along Cactus Road from 83rd Avenue to 91st Avenue and along 87th Avenue from Sweetwater Avenue to Cactus Road. See **Figure 7.5 – Network 3010 (Cactus Road)** for details.

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N-Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
Cactus Rd – 83rd Ave to 91st Ave	5310	0.0023	120	0.013	750	27	777	ERCTLO	24-hr	85
87th Ave – Sweetwater Ave to Cactus Rd	2600	0.0031	0	0.013	0	31	31	0.28 * ERCTLO (1)	24-hr	24

[1] Only a portion of the total HEC-1 subbasin area contributes at this location

Table 7.5 – Cactus Road – ID158 in Network 3010 Hydraulic Analysis

7.4.9 Greenway Road – ID174 in Network 2030

A planned storm drain with the full flow capacity of 10 cfs was proposed from 75th Avenue and the Arizona Canal to Skunk Creek and Greenway Road. Currently, there is an existing 48 to 54-inch storm drain along Greenway Road from 79th Avenue to the Skunk Creek. There are no identified drainage issues along 75th Avenue north of Greenway Road or along Greenway Road west of 75th Avenue.

An analysis was performed to determine if a storm drain would need to be proposed along Greenway Road from the Arizona Canal to Skunk Creek and along 75th Avenue from Skunk Creek to Greenway Road. If the existing storm drains and street capacities are large enough to handle all contributing flow, then no storm drain would need to be proposed for this area. The contributing area east of 75th Avenue along Greenway Road is very small and was not analyzed.

The analysis showed that the existing storm drain and street capacities (75th Avenue north of Greenway Road & Greenway Road west of 75th Avenue) are adequate to handle the contributing flows. Contributing flows along Greenway Road and 75th Avenue were approximated by taking the subbasin flow after the retention and multiplying it with the ratio of local contributing area to the total subbasin area. Existing storm drain and street capacities were approximated based on sizes, geometry and prevailing ground slopes. Flow magnitudes as well as street and storm drain capacities at key locations are presented in **Table 7.6 – Greenway Rd – ID174 in Network 2030 Hydraulic Analysis**.

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
75th Ave - Skunk Creek to Greenway Rd	2460	0.0033	0	0.013	0	32	32	0.04 * ERTB75[1]	6-hr	17
Greenway Rd - Arizona Canal to 75th Ave	1300	0.0035	0	0.013	0	33	33	0.08 * ERTB7[1]	6-hr	31
Greenway Rd - 75th Ave to 77th Ave	1340	0.0026	0	0.013	0	29	29	0.43 * GW83[1]	6-hr	27
Greenway Rd - 77th Ave to 79th Ave	1340	0.0075	0	0.013	0	46	46	0.65 * GW83[1]	6-hr	41
Greenway Rd - 79th Ave to 81st Ave	1265	0.0039	54	0.013	55	35	90	GW83	6-hr	63
Greenway Rd - 81st Ave to Skunk Creek	600	0.0007	54	0.013	55	13	68	GW83	6-hr	63

[1] Only a portion of the total HEC-1 subbasin area contributes at this location

Table 7.6 – Greenway Rd – ID174 in Network 2030 Hydraulic Analysis

Based on this analyses it was determined that no master plan storm drain would need to be proposed along Greenway Road from Arizona Canal to Skunk Creek and along 75th Avenue from Skunk Creek to Greenway Road.. See **Figure 7.6 – Network 2030** for details.

7.4.10 89th Avenue – ID193 in Network 4039

A planned 60-inch storm drain was proposed along 89th Avenue from approximately Butler Drive to Northern Avenue. The previous Master Plan proposed a 60-inch storm drain connecting to a 108-inch line along Northern Avenue. Currently, there is an existing 42-inch pipe along Northern Avenue with the flow full capacity of approximately 25 cfs. There is an existing 30 to 48-inch storm drain along Butler Drive from 87th Avenue to the Loop 101 Freeway that minimizes the flow south of Butler Drive. There are no identified drainage issues in the area.

An analysis was performed to determine if a storm drain would need to be proposed along this corridor. If the Butler Avenue storm drain and street capacity are large enough to handle all contributing flow, and the local flow along 89th Avenue does not exceed the street capacity, then no storm drain would need to be proposed along this reach.

The analysis showed that the upstream contributing area to 89th Avenue & Butler Drive was approximately 80 acres, or 1/8th of the subbasin NO91. The flow to this location was estimated by taking the subbasin flow after retention from the contributing area. For this location and the controlling 10-year event, the flow at 89th Avenue & Butler Drive was estimated as being ≈18 cfs (142 cfs ÷ 8 = 18 cfs). The capacity of the Butler Drive storm drain at this location is between 20 and 30 cfs, more than sufficient to handle the flow.

For the roadway stretch along 89th Avenue south of Butler Drive, another 1/8th of the subbasin NO91 would potentially contribute, or an additional 18 cfs. Based on an approximate slope of 0.0025 ft/ft the roadway could convey approximately 28 cfs, more than the 18 cfs that would contribute. Based on these analyses it was determined that no master plan storm drain would need to be proposed along 89th Avenue between Butler Drive and Northern Avenue. See **Figure 7.7 – Network 4039** for details.

7.4.11 91st Avenue – ID195 in Network 4039

A planned 60-inch storm drain was proposed along 91st Avenue from approximately Butler Drive to Northern Avenue. The previous Master Plan proposed a 60-inch storm drain connecting to a 114-inch line along Northern Avenue. Currently, there is an existing 60-inch pipe along Northern Avenue with the flow full capacity of approximately 70 cfs. There is an existing 30 to 48-inch storm drain along Butler Drive from 87th Avenue to the Loop 101 Freeway that minimizes the flow south of Butler Drive. There are no identified drainage issues in the area.

A similar analysis was performed on this proposed storm drain section as described above for 89th Avenue to determine if a storm drain is needed along 91st Avenue. At 91st Avenue & Butler Drive the total contributing area was estimated as being approximately 160 acres. This equates to 25% of subbasin NO91 after retention or $\approx$ 36 cfs (142 cfs $\div$ 4 = 36 cfs). Additionally, 14 cfs continues south along 91st Avenue from Olive Avenue. This makes a total flow at Butler Drive and 91st Avenue of approximately 50 cfs. The capacity of the Butler Drive storm drain at this location ranges from 105 to 150 cfs, more than sufficient capacity to handle the 10-year flows. For the roadway stretch along 91st Avenue south of Butler Drive another 1/8th of the subbasin NO91 would potentially contribute, or an additional 18 cfs. Based on an approximate slope of 0.003 ft/ft the roadway could convey approximately 30 cfs, more than the 18 cfs that would contribute. Based on these analyses it was determined that no master plan storm drain would need to be proposed along 91st Avenue between Butler Drive and Northern Avenue. See **Figure 7.7 – Network 4039** for details.

7.4.12 99th Avenue – ID199 in Network 4016

A planned 66-inch storm drain with the design capacity of 107 cfs was proposed along 99th Avenue from approximately Butler Drive to Las Palmaritas Drive. Currently, there is an existing 48-inch pipe along 99th Avenue from Las Palmaritas Drive to Northern Avenue with the flow full capacity of approximately 70 cfs.

An analysis was performed to determine if a storm drain would need to be proposed along 99th Avenue from Butler Drive to Las Palmaritas Drive. If the street capacity is large enough to handle all contributing flow, then no storm drain would need to be proposed along this reach.

The analysis showed that the street capacity at the above mentioned location is adequate to handle the contributing flows. Contributing flows along 99th Avenue were approximated by taking the subbasin flow after the retention and multiplying it with the ratio of local contributing area to the total subbasin area. Street capacity were approximated based on sizes, geometry and prevailing ground slopes. Flow magnitudes and street capacity are presented in **Table 7.7 – 99th Avenue – ID199 in Network 4016 Hydraulic Analysis**.

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N-Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
99th Ave – Butler Dr to Las Plamaritas Dr	1000	0.0060	0	0.013	0	43	43	0.03 * ERNONR [1]	24-hr	3

[1] Only a portion of the total HEC-1 subbasin area contributes at this location

Table 7.7 – 99th Avenue – ID199 in Network 4016 Hydraulic Analysis

Based on this analyses it was determined that no master plan storm drain would need to be proposed along 99th Avenue from Butler Drive to Las Palmaritas Drive. See **Figure 7.8 – Network 4016** for details.

7.4.13 Northern Avenue – ID301

A planned 66-inch storm drain was proposed in the original Master Plan along Northern Avenue from 107th Avenue to 103rd Avenue with the design full flow capacity of 182 cfs. The previous Master Plan also proposed a 66-inch storm drain connecting to a proposed 84-inch storm drain at Northern and 103rd Avenue that would ultimately drain into the New River. As part of this current Master Plan, improvements have been proposed along Northern from 103rd Avenue to the New River. This was analyzed as part of Drainage Issue #25 and details regarding this drainage issue can be seen in **Section 8.4.4.3 Drainage Issue No. 25 – 103rd Avenue – Northern Avenue to Olive Avenue**.

An analysis was performed to determine if a storm drain would need to be proposed along Northern Avenue from 107th Avenue to 103rd Avenue, connecting to the already proposed infrastructure. If the street capacity is large enough to handle all contributing flow, then no storm drain would need to be proposed for this reach.

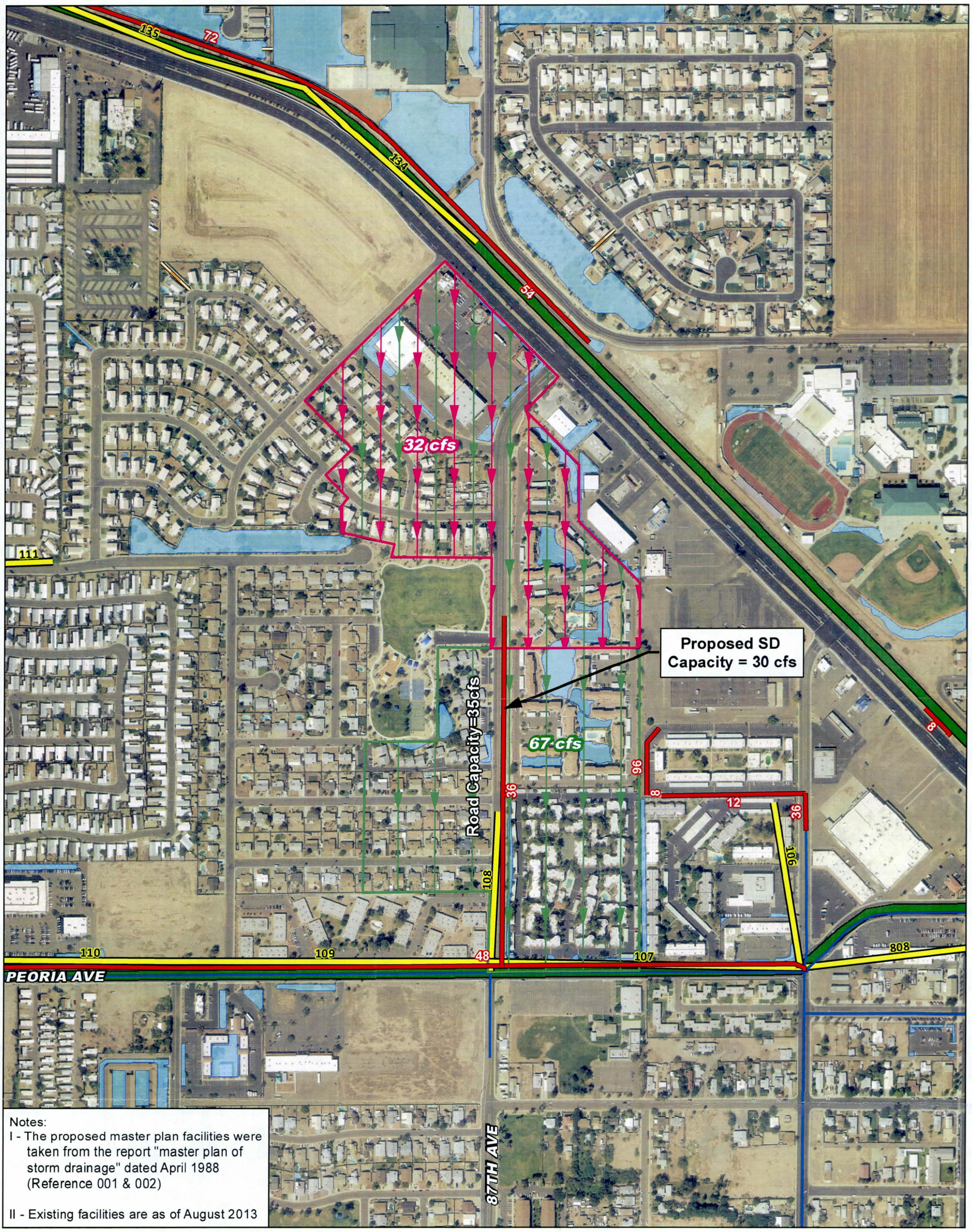
The analysis showed that the street capacity at the above mentioned location is adequate to handle the contributing flows. Contributing flows along Northern Avenue were approximated by taking the subbasin flow after the retention and multiplying it with the ratio of local contributing area to the total subbasin area. Street capacity was approximated based on sizes, geometry and prevailing ground slopes. Flow magnitudes and street capacity are presented in **Table 7.8 – Northern Avenue – ID301 Hydraulic Analysis.**

Location	Len. [ft]	Slope [ft/ft]	Pipe Dia. [in]	N-Value	Capacity [cfs]			HEC-1		
					Pipe	Street	Total	Card	Storm	Flow
Northern Ave – 107th Ave to 103rd Ave	2520	0.0024	0	0.013	0	27	27	0.07 * ERNO99 (1)	6-hr	13

[1] Only a portion of the total HEC-1 subbasin area contributes at this location

Table 7.8 – Northern Avenue – ID301 Hydraulic Analysis

Based on this analyses it was determined that no master plan storm drain would need to be proposed along Northern Avenue from 107th Avenue to 103rd Avenue. See **Figure 7.9 – ID301 (Northern Avenue)** for details.

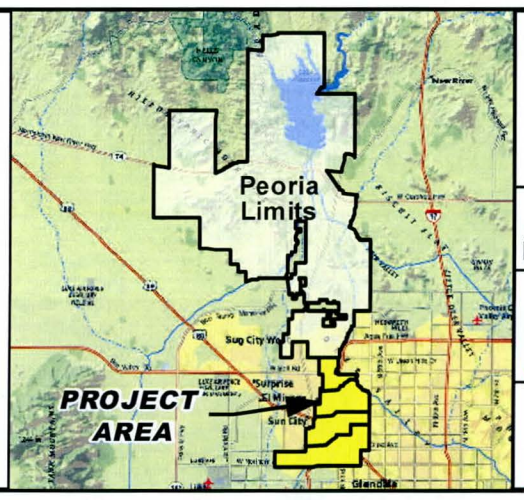


Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Proposed Storm Drain
- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin PE91 (Q After Retention=381cfs)



CITY OF PEORIA
PEORIA STORM DRAIN
MASTER PLAN

NORTH

0 400 800 Feet

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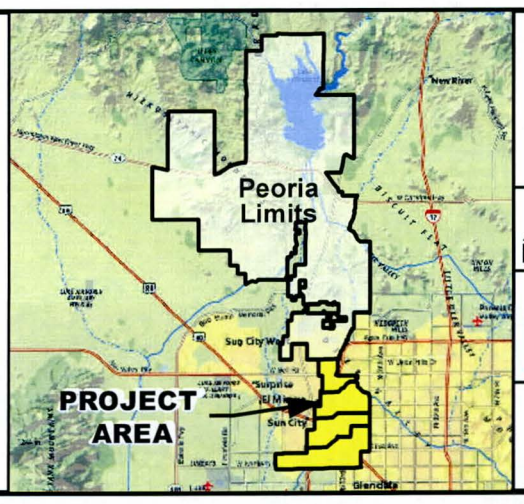
FIGURE 7.2
NETWORK 3012

Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin GR75 (Q After Retention=251cfs)
- Proposed Storm Drain



CITY OF PEORIA
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NORTH

0 750 1,500 Feet

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FIGURE 7.3
NETWORK 4021

91ST AVE
83RD AVE
CACTUS RD
PEORIA AVE
118 cfs
66 cfs
Proposed SD Capacity = 120 cfs
Proposed SD Capacity = 79 cfs

Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Proposed Storm Drain
- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin GR91 (Q After Retention=118cfs)

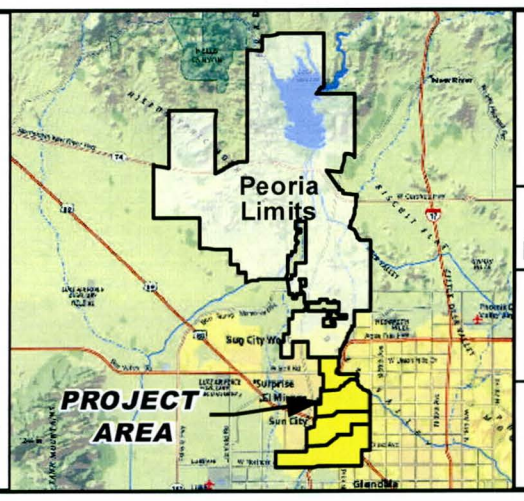

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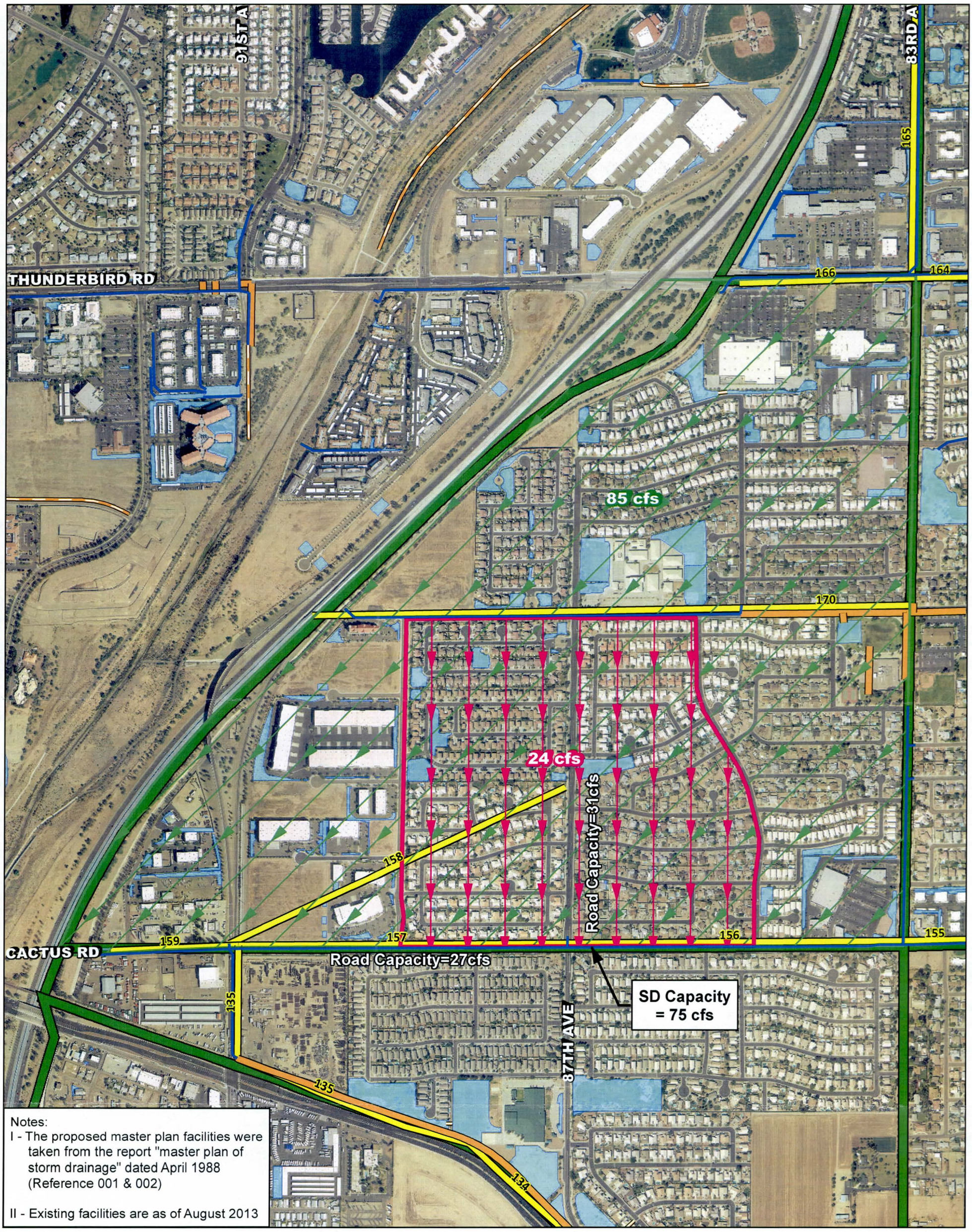
FIGURE 7.4
NETWORK 3010 (Grand Ave.)



Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin CTLO (Q After Retention=85cfs)
- Proposed Storm Drain

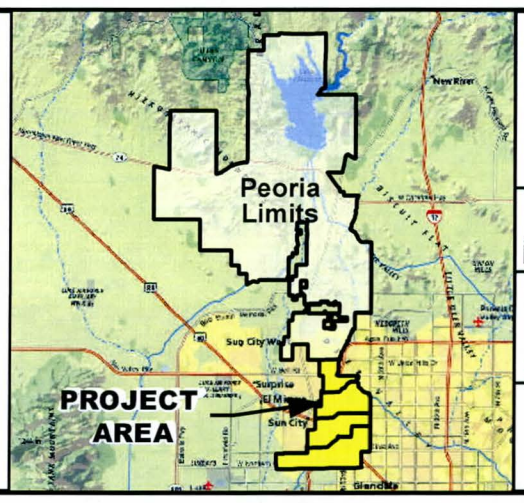


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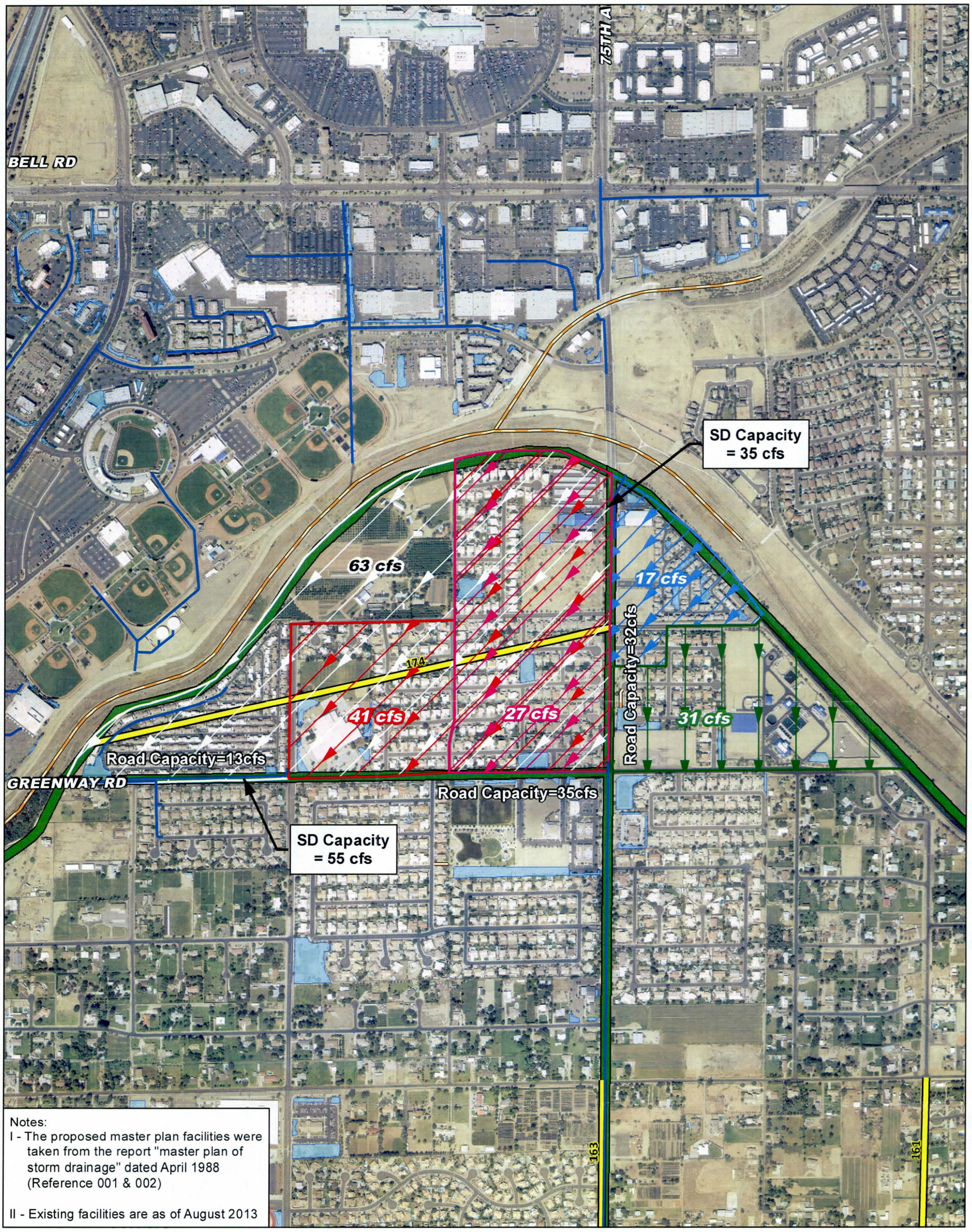
FIGURE 7.5
NETWORK 3010 (Cactus Rd.)

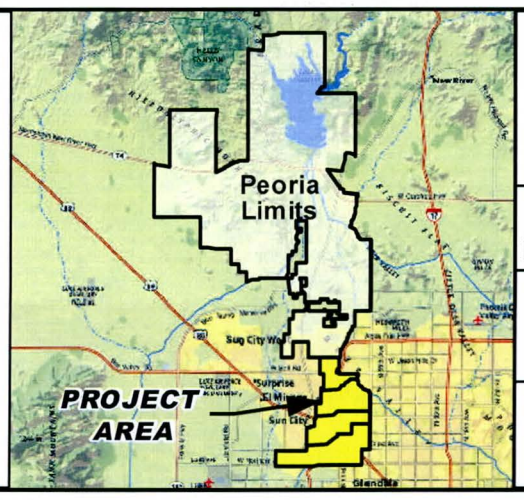


Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin GW83 (Q After Retention=63cfs)
  Subbasin TB75 (Q After Retention=408cfs)



CITY OF PEORIA
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MASTER PLAN

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0 800 1,600 Feet

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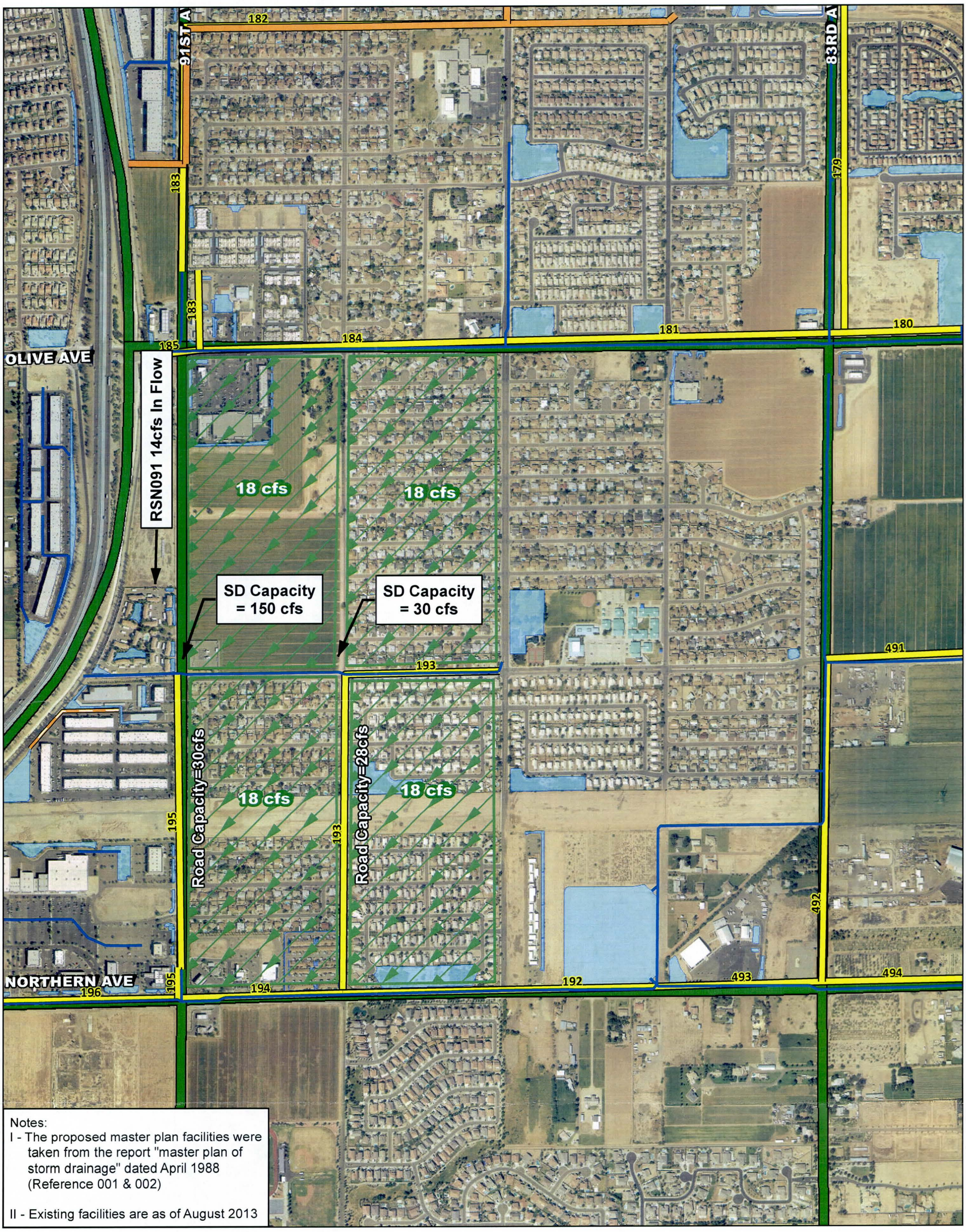
FIGURE 7.6
NETWORK 2030



Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin NO91 (Q After Retention=142cfs)
- Proposed Storm Drain

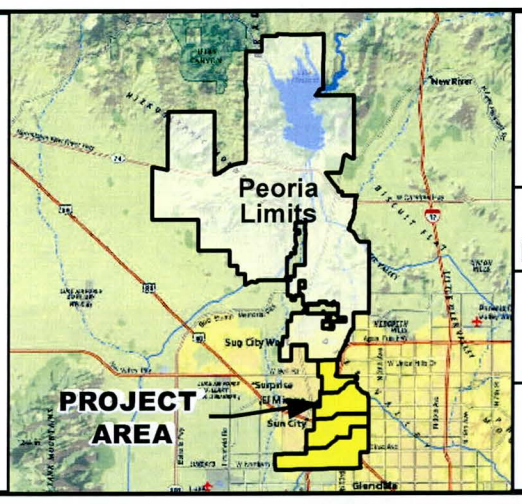


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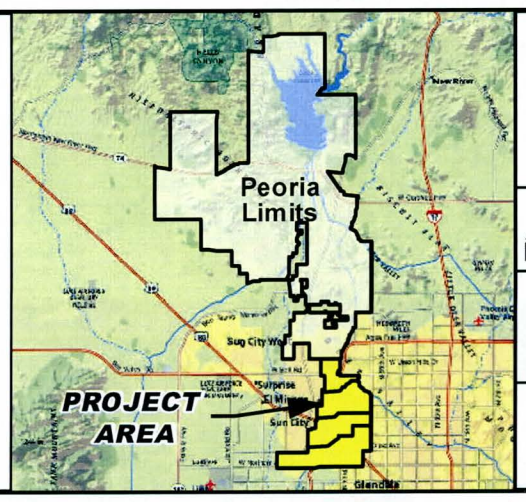
FIGURE 7.7
NETWORK 4039

Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin NONR (Q After Retention=120cfs)



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NORTH

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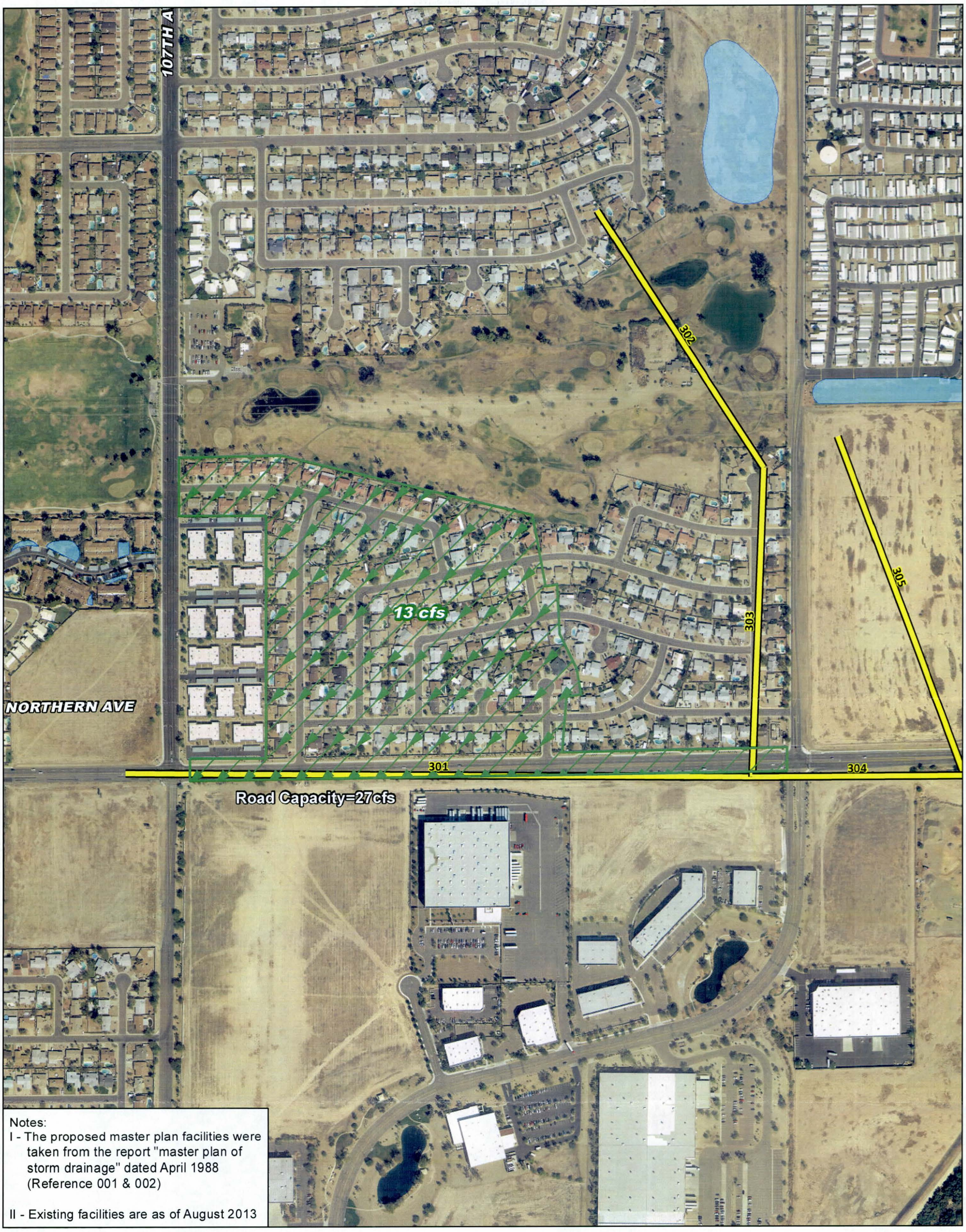
FIGURE 7.8
NETWORK 4016



Notes:
I - The proposed master plan facilities were taken from the report "master plan of storm drainage" dated April 1988 (Reference 001 & 002)

II - Existing facilities are as of August 2013

LEGEND

- Original Master Plan Proposed Facilities
- Existing Storm Drain
- Existing Channel
- Existing Retention Basin
- Subbasin NO99 (Q After Retention=184cfs)

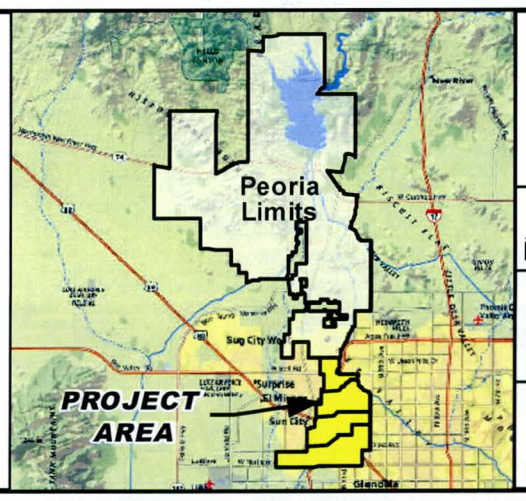


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FIGURE 7.9
ID301 (Northern Ave)

7.5 ADDITIONAL MASTER PLANNED FACILITIES

Modifications to the original Master Plan's proposed facilities that were not resolved as part of the Alternatives Analysis of the various identified Drainage Issues are limited to a single location - Cholla / Varney & 83rd Avenue. This is discussed in the following sections.

7.5.1 Cholla Street & 83rd Avenue to Peoria Avenue

As discussed previously, the proposed infrastructure from the original Master Plan is not compatible with the existing storm drain facilities and the existing infrastructure is not capable of conveying the 10-year storm event. The previously proposed facilities are larger than the existing downstream storm drain. Additionally, the Peoria Avenue storm drain is smaller than what was proposed in the original Master Plan. Due to these circumstances alternatives were developed that would provide a 10-year level of protection for this area.

7.5.1.1 Micro-Hydrology

The hydrology models were modified to gain a more accurate understanding of the drainage conditions in the area. This included the area draining to Cholla Street / Varney Road as well as to the downstream Peoria Avenue storm drain. The existing Maryvale ADMS HEC-1 model was utilized to determine 10-year peak flows and runoff volumes at various locations throughout the area of interest. The existing one square mile subbasin PE83 was divided into four subbasins (PE83N, PE83S, PE83W and PE83E). In addition, a new subbasin OL91N was created on the south side of Peoria Avenue between Grand Avenue and 91st Avenue. Based on the ground topography and the existing storm drain network, the area enclosed by subbasin OL91N drains into the Peoria Avenue storm drain. See **Figure 7.10 – 83rd Avenue to Peoria Avenue - Micro-Hydrology** for details.

Subbasin parameters were generated using the Green and Ampt method in DDMSW and the new HEC-1 cards were assembled in the existing Maryvale ADMS models. This analysis considered both, the 10-year, 6-hour and 24-hour storm events.

The 10-year base hydrology represents existing conditions, with the following assumptions:

- MAG 2007 future land use was utilized to generate basin parameters.
- Flow does not cross Varney Road from north to south at 77th Avenue, 79th Avenue and 81st Avenue. Valley gutters present at these intersections would direct most of the flow west along Varney Road.
- The amount of retention assumed for the existing Maryvale ADMS subbasin PE83 was 80% of the 100-year, 2-hour precipitation volume.

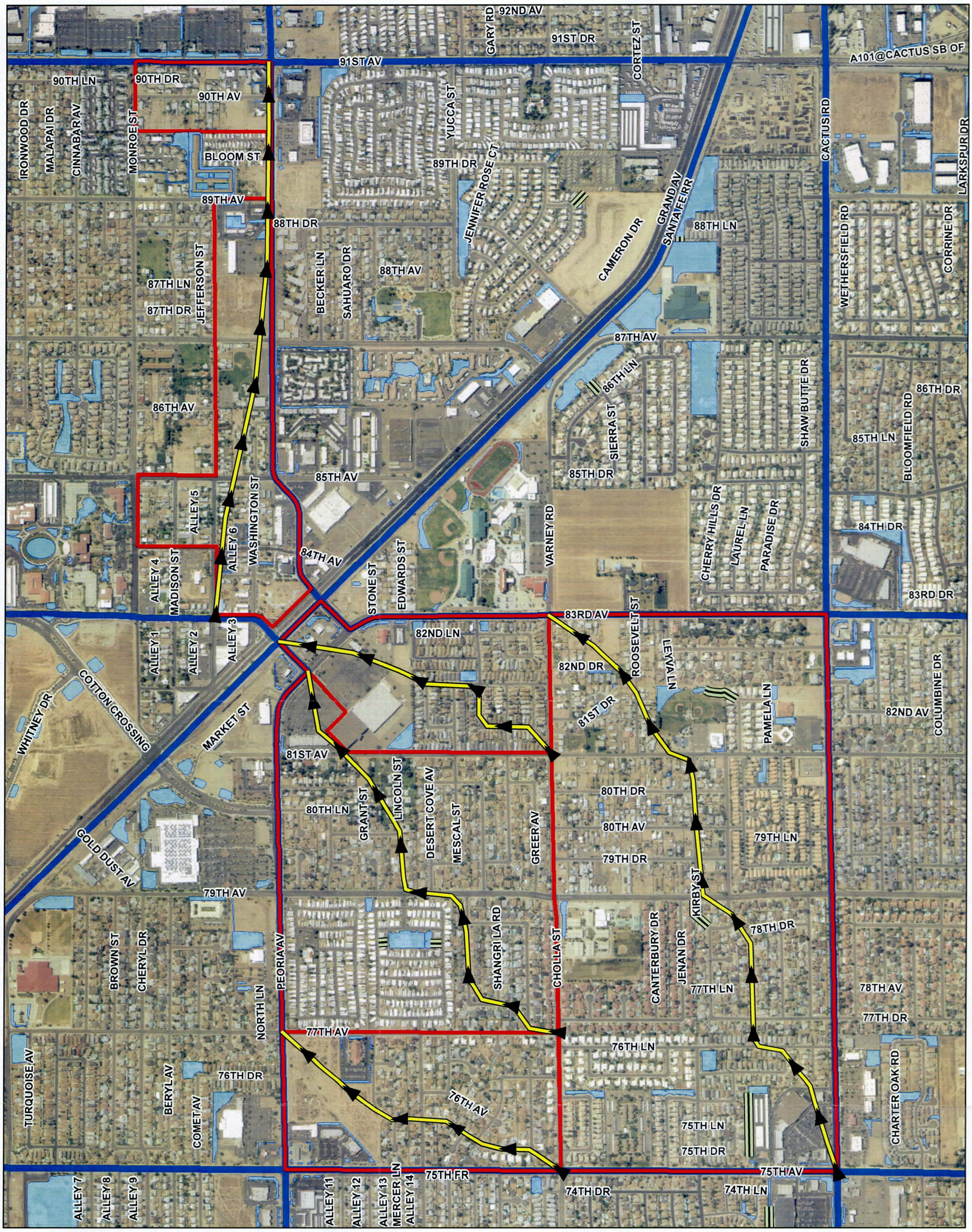
The 100-year, 2-hour retention volume for the existing conditions Maryvale ADMS models was derived utilizing the NOAA Atlas 2 precipitation. The original retention volume was split proportionally among the new subbasins.

- Only 60% of the subbasin PE91 total flow drains south toward Peoria Avenue, whereas the remaining 40% of the flow drains west along 91st Avenue.

Based on the HEC-1 modeling, flow magnitudes at key locations are presented in **Table 7.9 – 83rd Avenue to Peoria Avenue - Micro-Hydrology Results** below. It is important to note that flow magnitudes along Peoria Avenue between 85th and 91st Avenues were adjusted based on the assumption that only 60% of the subbasin PE91 total flow drained south toward Peoria Avenue, whereas the remaining 40% of the flow drained west on 91st Avenue.

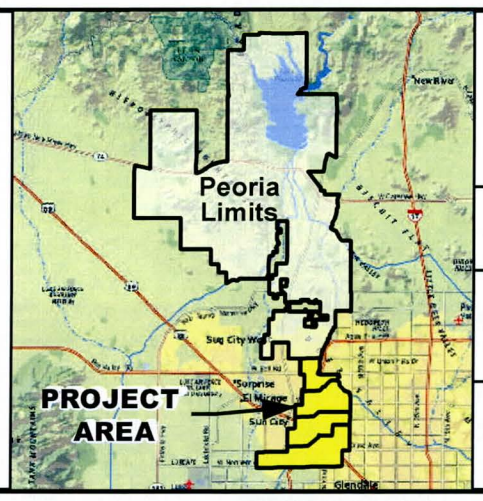
Location	10-Year Peak Flow [cfs]
83rd Ave - Varney Rd to 180 ft north of Shangri La Rd	132
83rd Ave - 180 ft north of Shangri La Rd to Grand Ave	119
Peoria Ave - 77th Ave to 130 ft southeast of 83rd Ave	170
Peoria Ave - 130 southeast of 83rd Ave	170
Peoria Ave - across Grand Ave	225
Peoria Ave - 150 ft west of Grand Ave to 85th Ave	225
Peoria Ave - 85th Ave to 91st Ave	224
Peoria Ave - 91st Ave to ADOT Channel	224

Table 7.9 – 83rd Avenue to Peoria Avenue - Micro-Hydrology Results



LEGEND

- Exist. Retention Basin
- Subbasin
- Maryvale ADMS Subbasins
- Concentration Flow Path



CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 900 1,800 Feet

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FIGURE 7.10
83RD AVE TO PEORIA AVE
MICRO-HYDROLOGY

7.5.1.2 Hydraulics

The existing storm drain capacities were previously estimated and utilized in this analysis. Additionally, the street capacities within the drainage area were approximated using normal depth. No street capacity was estimated or utilized for 83rd Avenue north of Grand Avenue or Peoria Avenue east of 83rd Avenue & Grand Avenue. This was due to the fact that there is no outlet for street flow in this area and including the street capacity as conveyance would not eliminate the potential for street flooding and/or ponding. Street flow was estimated and utilized downstream along Peoria Avenue from Grand Avenue to the ADOT channel along the Loop 101 Freeway. The assumptions and estimated street capacity of Peoria Avenue is shown in **Table 7.10 – 83rd Avenue to Peoria Avenue - Street Capacities**, below.

	Peoria Ave
	77th Ave to 91st Ave
Roadway Width	60 ft
Cross Slope	2%
Crown	Normal
Gutter Depth	6 inches
Long. Slope	0.33%
Street Capacity	32 cfs

Table 7.10 – 83rd Avenue to Peoria Avenue - Street Capacities

7.5.1.3 Alternatives Analysis

Alternatives were developed to address the lack of adequate conveyance facilities on 83rd Avenue between Varney Road and Grand Avenue and on Peoria Avenue between 77th Avenue and 91st Avenue. In general, the alternatives considered conveyance facilities sized to carry the 10-year flows that could not be carried by the existing facilities. Furthermore, the alternatives considered adding new retention basins to reduce the need for and / or size of the proposed storm drains.

Alternative 1: Conveyance

This is a mostly conveyance alternative that includes storm drain pipes along 83rd Avenue between Varney Road and Grand Avenue and on Peoria Avenue between 77th Avenue and 91st Avenue (see **Figure 7.11 – 83rd Avenue to Peoria Avenue - Alternative 1**). This alternative does not include adding any additional storage facilities. The corresponding proposed facility sizes for this alternative are shown in **Table 7.11 – 83rd Avenue to Peoria Avenue - Alternative 1 Proposed Facilities** below and details of the estimation (facility size and cost) can be found in **Appendix F.18 Cholla Street & 83rd Avenue to Peoria Avenue**.

Location	Facility Size
83rd Ave - Varney Rd to 180 ft north of Shangri La Rd	54-Inch Dia.
83rd Ave - 180 ft north of Shangri La Rd to Grand Ave	54-Inch Dia.
Peoria Ave - 77th Ave to 81st Ave	54-Inch Dia.
Peoria Ave - 440 ft west of 81st Ave	54-Inch Dia.
Peoria Ave - 440 ft west of 81st Ave to 130 southeast of 83rd Ave	54-Inch Dia.
Peoria Ave - 130 southeast of 83rd Ave	54-Inch Dia.
Peoria Ave - across Grand Ave	54-Inch Dia.
Peoria Ave - 150 ft west of Grand Ave to 85th Ave	54-Inch Dia.
Peoria Ave - 85th Ave to 91st Ave	54-Inch Dia.

Table 7.11 – 83rd Avenue to Peoria Avenue - Alternative 1 Proposed Facilities (10-Year, No Additional Storage)

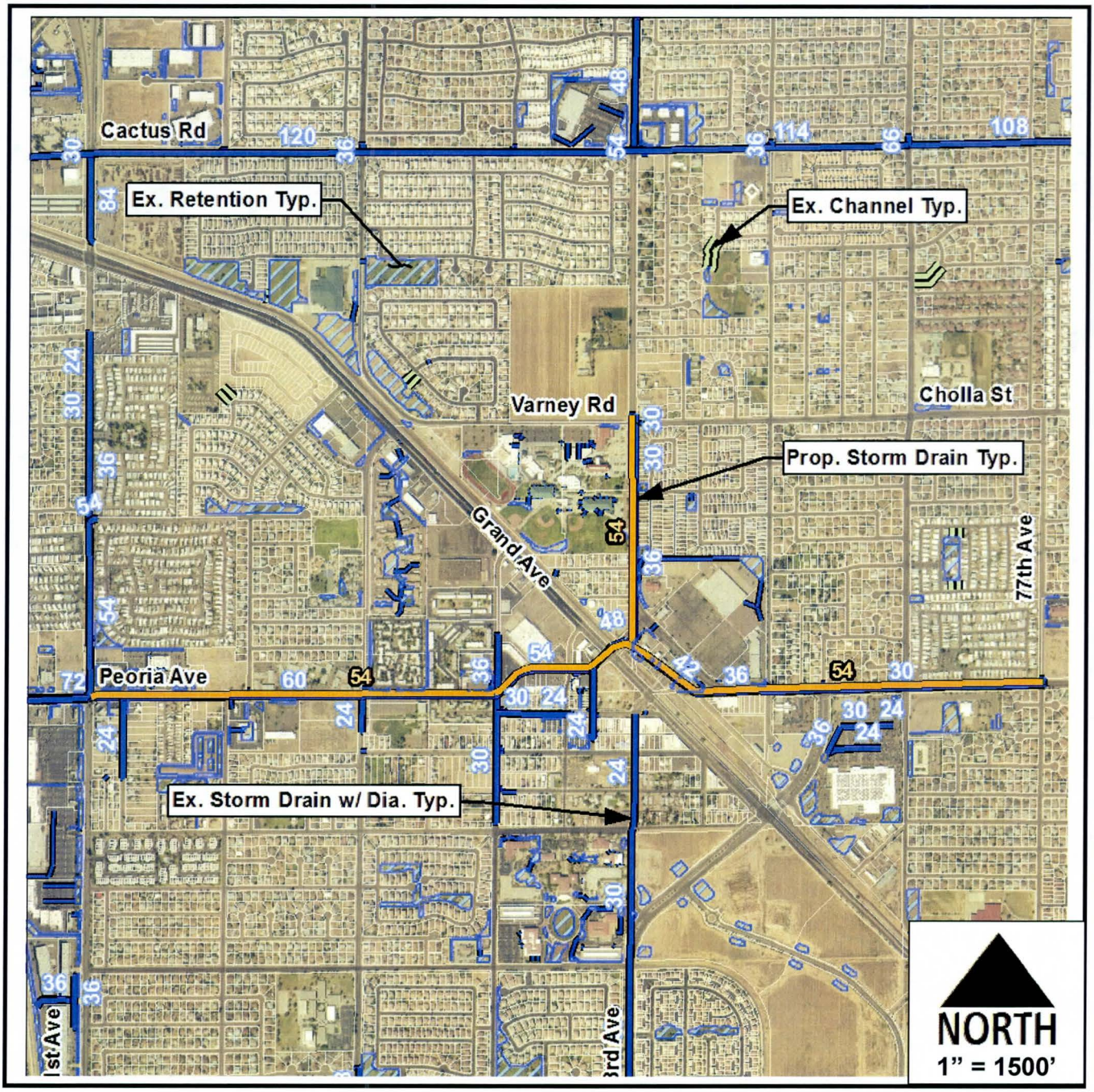
The estimated construction cost of this alternative would be approximately $4,000,000 with approximately $14,000 of annual maintenance costs due to the additional storm drains.

The potential advantages of this alternative include the fact that there is no right-of-way acquisition, all facilities would be constructed in existing easements, it reduces potential flooding on the streets and it has a relatively low maintenance cost.

The potential disadvantages of this alternative include road closures and disruptions on major arterials and adjoining neighborhoods including the intersections of Peoria Avenue and Grand Avenue as well as 83rd Avenue and Peoria Avenue. This would include constructing a storm drain across the BNSF railroad and Grand Avenue (ADOT). Coordination and approval by both ADOT and BNSF for the storm drain construction would be difficult. Additionally, this alternative includes the construction of a parallel storm drain system to an existing storm drain system along both 83rd Avenue and Peoria Avenue.

FIGURE 7.11 - 83rd AVE TO PEORIA AVE - ALTERNATIVE 1

Drainage Area: 3 | Alternative No: 1
Drainage Issue ID: Peoria and 83rd Ave | Alternative Type: Conveyance



Cost

- Construction ..... $ 4,085,000
- Right-of-Way ..... $ 0.00
- Annual Maintenance ..... $ 14,000

Advantages

- No right of way acquisition.
- Reduces flooding of the roadways.
- Lowest Maintenance Cost

Disadvantages

- Construction of large storm drains would require road closures, longer construction duration, and cause disruptions to adjoining neighborhoods.
- Requires constructing a new parallel storm drain on Peoria and 83rd Avenues.

Alternative 2: Conveyance and Storage

This alternative includes elements from Alternative 1 and adds new storm drains and retention to reduce the required storm drain sizes and eliminate critical sections of storm drain. New retention basins are proposed on the northeast corner of Varney Road and 83rd Avenue, and on the northeast corner of 77th Avenue and Peoria Avenue (see **Figure 7.12 – 83rd Avenue to Peoria Avenue - Alternative 2**). These would provide a total of 24 ac-ft of retention volume and will reduce the proposed storm drain sizes along Peoria Avenue and entirely eliminate the need for parallel storm drain pipes along 83rd Avenue and across Grand Avenue. This alternative includes additional storm drain pipes along Varney Road and along 77th Avenue. The corresponding proposed facility sizes for this alternative are shown in **Table 7.12 – 83rd Avenue to Peoria Avenue - Alternative 2 Proposed Facilities** below and details of the estimation (facility size and cost) can be found in **Appendix F.18 Cholla Street & 83rd Avenue to Peoria Avenue**.

Location	Facility Size
New Retention Basin at Northwest Corner of 83rd Ave and Varney Rd	16 acre-feet
New Retention Basin at Northeast Corner of 77th Ave and Peoria Ave	8 acre-feet
Varney Rd - 76th Ave to 83rd Ave	60-Inch Dia.
77th Ave - Hope Dr to 460 ft north of Peoria Ave	42-Inch Dia.
Peoria Ave - 77th Ave to 81st Ave	48-Inch Dia.
Peoria Ave - 440 ft west of 81st Ave	48-Inch Dia.
Peoria Ave - 440 ft west of 81st Ave to 130 ft southeast of 83rd Ave	48-Inch Dia.
Peoria Ave - 85th Ave to 91st Ave	48-Inch Dia.

Table 7.12 – 83rd Avenue to Peoria Avenue - Alternative 2 Proposed Facilities (10-Year, Additional Storage)

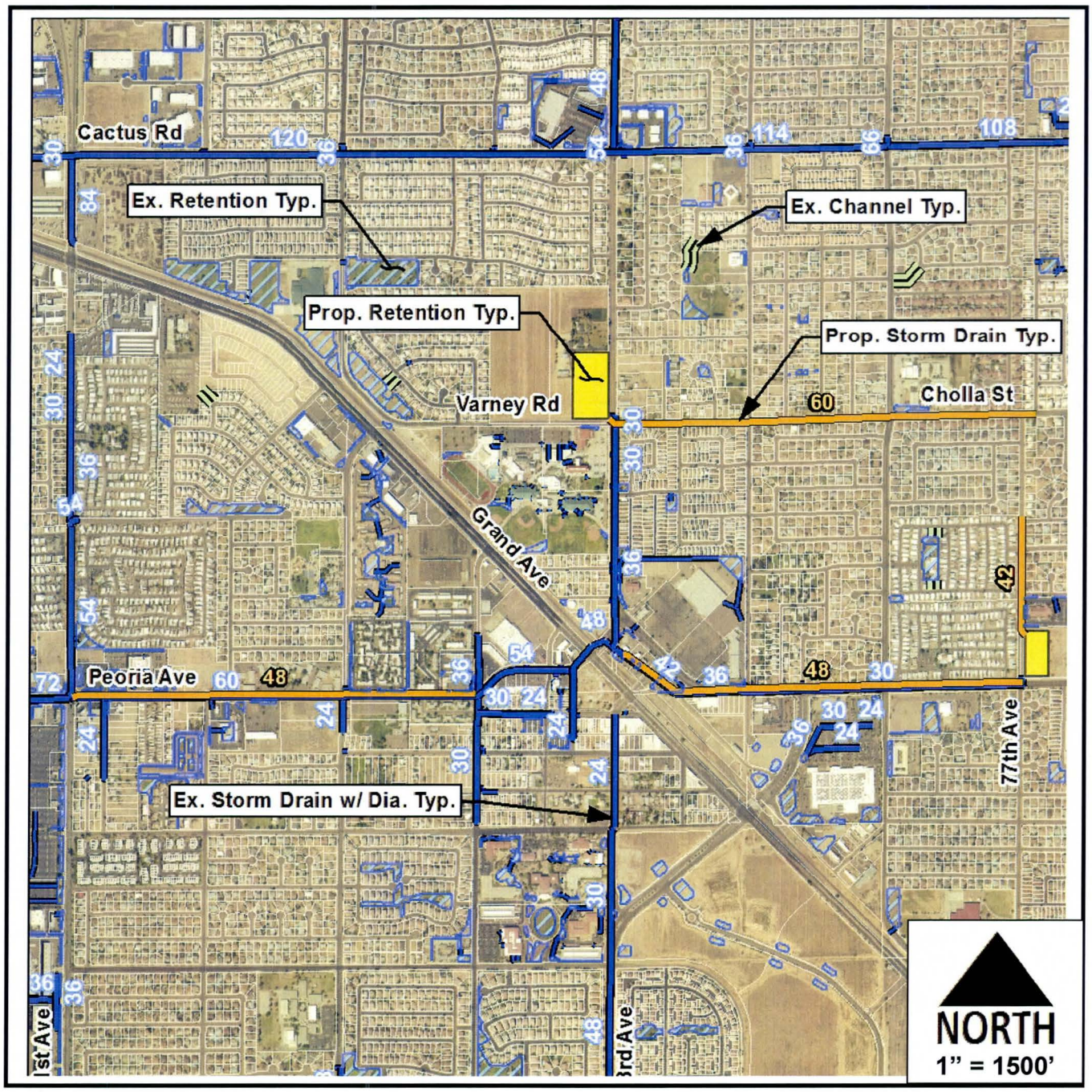
The estimated construction cost of this alternative would be approximately $8,470,000 as well as approximately $600,000 for the cost of land acquisition. The annual maintenance cost for this alternative would be approximately $120,000 due to the addition of 2 retention basins.

The potential advantages of this alternative include no construction disturbance along 83rd Avenue or across the BNSF railroad and Grand Avenue. It also minimizes the size of additional storm drain infrastructure that is needed.

The potential disadvantages to this alternative include the need for significant right-of-way acquisition for the proposed retention basins, significantly higher construction and maintenance costs compared to Alternative 1. Additionally there would be significant neighborhood disturbance with the construction of the Cholla Street and 77th Avenue storm drains.

FIGURE 7.12 - 83rd AVE TO PEORIA AVE - ALTERNATIVE 2

Drainage Area: 3 | Alternative No: 2
Drainage Issue ID: Peoria and 83rd Ave | Alternative Type: Conveyance/Storage



Cost

- Construction ..... $ 7,330,000
- Right-of-Way ..... $ 595,000
- Annual Maintenance ..... $ 120,000

Advantages

- No construction disturbance on 83rd Ave
- Minimizes required storm drain sizes

Disadvantages

- Requires significant right of way acquisition
- Increased maintenance costs associated with additional basins and storm drains
- Highest construction costs

7.5.1.4 Preferred Alternative

An Alternatives Evaluation Matrix was completed can be found in **Appendix F.18 Cholla Street & 83rd Avenue to Peoria Avenue**. The results show that Alternative 2, while more costly, is the preferred alternative. Some of the major factors include the feasibility of crossing the railroad and Grand Avenue with a parallel storm drain for Alternative 1 as well as the increased size of the parallel storm drain and a lack of City and Stakeholder acceptance in doing this. The evaluation results are shown below in **Table 7.13 – 83rd Avenue to Peoria Avenue - Alternative Evaluation Results**.

Description	Total Score	Rank
Alternative 1	5.90	2
Alternative 2	6.50	1

Table 7.13 – 83rd Avenue to Peoria Avenue - Alternative Evaluation Results

The infrastructure for the preferred Alternative 2 includes the following:

- 60-inch storm drain along Cholla Street from 77th Avenue to 83rd Avenue.
- Proposed retention basin on the northeast corner of Cholla/Varney and 83rd Avenue. This will bleed off into the existing storm drain along 83rd Avenue.
- 42-inch storm drain along 77th Avenue north of Peoria Avenue.
- Proposed retention basin on the northwest corner of Peoria Avenue and 77th Avenue. This retention basin will take flow from the proposed 77th Avenue storm drain and street flow off of Peoria Avenue.
- 48-inch storm drain along Peoria Avenue from 77th Avenue to 83rd Avenue parallel to the existing 30/36/42-inch storm drain.
- 48-inch storm drain along Peoria Avenue from 85th Avenue to the ADOT channel along the Loop 101 Freeway parallel to the 60/72-inch existing storm drain.

SECTION 8. ALTERNATIVES FORMULATION AND EVALUATION

8.1 ALTERNATIVES EVALUATION PROCESS

This Alternatives Formulation and Evaluation task of the Peoria SDMP was initiated to identify and then evaluate feasible 10-year storm event alternatives for each of the drainage issue areas. After identifying and evaluating the proposed alternatives, the most viable alternatives were recommended for further development.

The primary focus of this section of the Peoria SDMP is to document the results of the alternatives evaluation, outline the decision making process used, and present the pre-design solutions for the drainage issue areas. As part of this process, the Peoria SDMP project team conducted an alternative evaluation workshop where alternatives for each drainage issue were evaluated and scored based on an evaluation matrix. The evaluation matrix used as part of this process is described in detail in the following subsection. The following project team members participated in the alternatives evaluation workshop held at the City of Peoria on May 7th and 8th, 2013.

Mr. Burton Charron, PE
Senior Civil Engineer
COP Engineering Department

Mr. Dan Nissen, PE
Assistant City Engineer
COP Engineering Department

Ms. Janet Ramsay
Public Works Operations Manager
COP Public Works Division

Mr. Joe Kurrus, PE
Engineering Supervisor
COP Engineering Department

Mr. Adam Pruett, AICP
Senior Planner
COP Planning & Zoning Division

Mr. Richard Waskowsky, PE
Civil Engineer
FCDMC, Hydrology & Hydraulics Branch

Ms. Valerie Swick, PH, CFM
Project Manger
FCDMC Planning Branch

Mr. Keith Nath, PE
Senior Project Manager
Entellus, Inc.

Mr. Hernan Aristizabal, PE
Director of Water Resources
Entellus, Inc

Mr. Ryan Sauer, PE, CFM, MSE
Project Manager
Entellus, Inc.

Mr. Arban Londo, PE, MSE
Project Engineer
Entellus, Inc.

Mr. Chris Christensen, GISP
GIS Manager
Entellus, Inc.

8.2 DRAINAGE PROBLEM AREAS

A list of areas prone to flooding was identified and compiled by City staff prior to the start of this project. These areas were identified based on private property flooding complaints, input from City roadways maintenance team (maintenance hot spots), and

hydrology/hydraulic analysis results. Furthermore, a preliminary selection process was performed at the start of this task to identify the drainage issues that would be analyzed as part of the alternative formulation and evaluation process. During the preliminary selection process all the drainage issues that were already resolved or were being addressed under different projects were identified and were not studied further. The result of this process is graphically illustrated on the Drainage Issues / Problems Identification Exhibit included in **Appendix F.1 Drainage Issues / Problems Identification Exhibit**.

The overall study area for the Peoria SDMP is more than 23 square miles and encompasses a large portion of the City of Peoria. The study area includes the City of Peoria south of Union Hills Drive. The vast size of the project area presented a particular challenge with regard to product deliverables and management. Therefore, to facilitate the drainage alternatives formulation and evaluation process, the study area was divided into 4 (four) drainage problem areas. Drainage problem areas contain several drainage issues and are shown in **Appendix F.1 Drainage Issues / Problems Identification Exhibit**.

8.3 PROPOSED ALTERNATIVES DEVELOPMENT

This subsection documents the methodology followed in the development of drainage alternatives. Alternatives were formulated to include a variety of measures to mitigate the drainage issue by collecting, conveying and storing storm water runoff. The measures include storm drains, regional detention basins, channels and roadway re-grading. The analysis followed in the development of proposed alternatives included hydrologic and hydraulic analysis based on existing conditions, evaluation of existing drainage facilities, the impact on the existing storm drain system and preliminary cost analysis. In general, the development of proposed alternatives for all drainage issues followed the steps described below.

- Review previously proposed regional storm drains and review hydraulic analysis of existing storm drain system.
- Conduct field visits to observe existing conditions in the vicinity of drainage issue area and gather any relevant information that could be used in the alternative analysis.
- Develop the micro-hydrology to determine the peak flows reaching the drainage issue locations. The micro-hydrology included modifying the existing Base Hydrology Model or analyzing individual problems with watershed areas less than 160 acres by utilizing the rational method.
- Utilize as-built records of subdivisions, roadways, parks, and basins to assist in the hydrologic and hydraulic analysis. Where necessary, field surveying was performed to identify contributing drainage areas and splits.
- Identify where addressing regional issues may address the local drainage issues.
- Identify potential solutions and discuss the solutions with the City to make any necessary revisions before completing the analysis.

- Develop the alternatives and prepare the analysis and evaluation.

Detail description of all drainage issues, methodology used in developing proposed alternatives, hydrology/hydraulic analysis results, and cost estimate for all alternatives are included in **Appendix F Alternatives Formulation and Evaluation Supporting Data**.

8.4 SELECTION OF PREFERRED ALTERNATIVES

This subsection documents the results of the alternatives evaluation process. As mentioned earlier, the project team conducted a workshop, to select the preferred alternative for each drainage issue, at the City of Peoria on May 7th and 8th, 2013. The workshop was conducted in an interactive fashion, where all project team members had the opportunity to give their input in the selection process. At the beginning of the workshop, Entellus team members who had worked on the alternatives analysis for a particular drainage issue presented a detail summary of the existing drainage issue and the results of the alternative analysis. This was followed by an open discussion session about the alternatives analysis results and the adequacy of proposed solutions. Subsequently, the team completed the evaluation matrix after discussing and agreeing on the score given to each of the evaluation criteria. The alternative with the highest total score was selected as the preferred alternative for the particular drainage issue. The workshop concluded with an overview of the selection process including the preferred alternative for each drainage issue. The results of the preferred alternative selection workshop are described in the following subsections. In addition, the alternative analysis reports including the completed evaluation matrix for all drainage issues are included in **Appendix F Alternatives Formulation and Evaluation Supporting Data**.

8.4.1 Description of Evaluation Criteria (Evaluation Matrix)

The proposed alternatives for each drainage issue area were evaluated and ranked based on an evaluation matrix. The evaluation matrix consists of 10 (ten) evaluation criteria (see **Table 8.1 – Evaluation Matrix Definitions**) that were used to select the preferred solution based on cost, acceptance, reliability, feasibility, multi-use opportunities and other key criteria. For each of the evaluation criteria, the proposed alternatives were given a score between 0 and 10, where 0 means that the alternative does not meet the specific criterion and 10 means that the alternatives meet the criterion. Furthermore, after careful consideration and discussion with the City and the District, the evaluation criteria were given a specific percentage weight of the total score based on relative importance to the project. The alternative with the highest total score was chosen as the preferred alternative. A more detail description of the evaluation criteria, the percentage weight assigned to each one, and the definition of a low and high ranking criteria are provided in **Table 8.1 – Evaluation Matrix Definitions** on the next page.

Description	*% Weight*	*Low Rank*	*High Rank*
Acceptance			
City Acceptance	10%	Not fully supported or accepted by City Staff and/or Elected Officials	Fully supported by the City Staff and Elected Officials
Public / Stakeholder Acceptance	10%	Significant impact to residents and only minority supported by the public	Minimal impact to residents and majority supported by the public
Cost			
Construction Cost	15%	Relatively high construction cost	Relatively low construction cost
Operation & Maintenance Cost	15%	Extensive and expensive O & M required upon construction completion	Minimal O&M required upon completion of construction
Design / Construction			
Feasibility / Constructability	10%	Difficult to construct and implement solution (complicated solution)	Easy, relatively straightforward solution that is easy to construct
Compatibility with Existing Facilities	5%	Solution does not utilize existing facilities to solve drainage problem	Solution fits in and complements existing drainage facilities
Reliably Solve Drainage Issues	15%	Complicated solution that is difficult to maintain and ensure is functioning properly (i.e., manually opening gate required)	Solution that is simple and easy to maintain and can reliably function with minimal effort
Construction Disturbance	5%	Significant disturbance to major streets or private property, or restricting access to residents properties and/or businesses	Minimal disturbance to major streets or private property, and minimal access restrictions to residents properties and/or businesses
Other			
Multi-Use Opportunities	5%	No multi-use opportunities possible (i.e., storm drain only)	Significant multi-use opportunities by collocating drainage and recreation facilities (i.e., retention basin and park together)
Also Regional or Neighborhood Solution	10%	Only solves the local drainage issue	Solution becomes an intricate part of the Regional Drainage Solution

Table 8.1 – Evaluation Matrix Definitions

8.4.2 Problem Areas 1 and 2

Problem areas 1 and 2 cover the northern portion of the study area (see **Appendix F Alternatives Formulation and Evaluation Supporting Data**) and include drainage issues 2, 3, 4, 6 and 6A. The above mentioned drainage issues and the preferred alternatives including, advantages, disadvantages and cost estimates are described in the following subsections.

8.4.2.1 Drainage Issue No. 2 – 77th Avenue and Paradise Lane

Drainage Issue No. 2 is located at the intersection of 77th Avenue and Paradise Lane. During significant storm events, storm water runoff accumulates at the intersection of Paradise Lane and 77th Avenue and drains very slowly. The City has requested that a hydrologic/hydraulic analysis of the storm drain network, as well as inlet sizing calculation be performed as part of this issue.

The analysis of Drainage Issue No. 2 revealed that there is a lack of conveyance facilities at the intersection of Paradise Lane and 77th Avenue. Flows reaching this intersection exceed the capacity of the existing 24-inch storm drain, which in turn limits how much flow can get into the catch basins at the low point on the east side of Paradise Lane and 77th Avenue intersection. The reduction in catch basin capacity results in ponding and slow draining of this area.

Four alternatives were developed to address the lack of adequate conveyance facilities near the intersection of Paradise Lane and 77th Avenue. In general, the alternatives considered conveyance facilities sized to carry the 10-year flows that could not be carried by the existing storm drainage facilities. For detailed description of the alternatives analysis including the evaluation matrix, refer to the Drainage Issue No. 2 report included in **Appendix F.1 Drainage Issues / Problems Identification Exhibit**. Based on the scoring completed during the alternatives evaluation workshop Alternative 3 was selected as the preferred alternative for Drainage Issue No. 2. The final total score and ranking of the proposed solutions is presented in **Table 8.2 – Drainage Issue No. 2 Alternatives Evaluation Results** below.

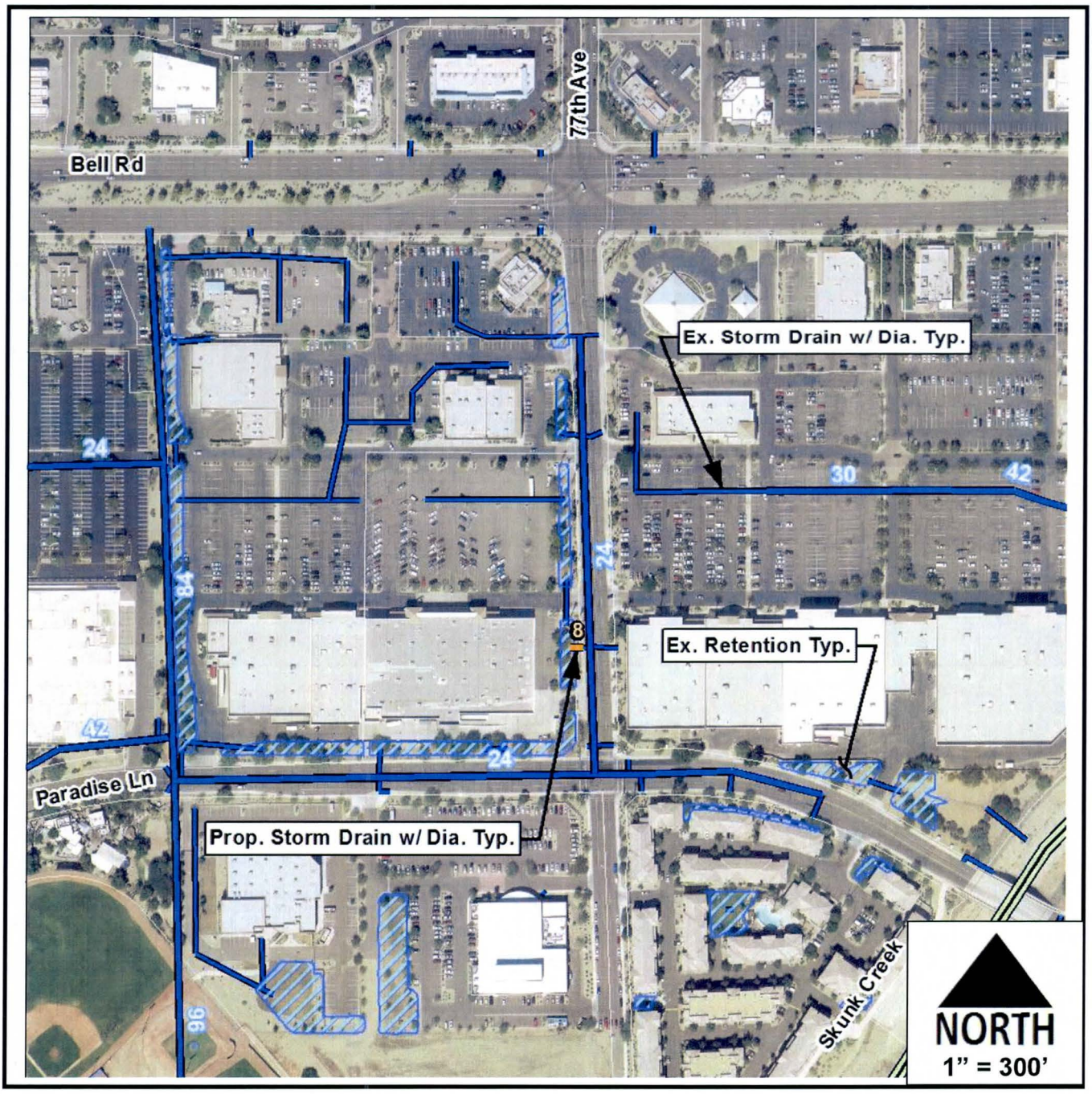
Description	Total Score	Rank
Alternative 1	5.90	3
Alternative 2	6.70	2
Alternative 3	7.75	1
Alternative 4	5.70	4

Table 8.2 – Drainage Issue No. 2 Alternatives Evaluation Results

Preferred Alternative – This alternative includes reducing the capacity of the storm drain inlet that drains a portion of Arrowhead Crossing Commercial Center parking lot into the 24-inch storm drain along 77th Avenue. This particular inlet is located along 77th Avenue approximately 250 ft north of Paradise Lane and is connected to the 24-inch storm drain via a 15-inch lateral pipe. This alternative would downsize the 15-inch storm drain lateral to 8-inch and limit the discharge from the parking lot to the 77th Avenue storm drain to 1 cfs. Proposed drainage facilities, costs, advantages, and disadvantages are shown on **Figure 8.1 – Drainage Issue No. 2 Preferred Alternative** on the next page.

Figure 8.1 – Drainage Issue No. 2 Preferred Alternative

Drainage Area: 1 Alternative No: 3
Drainage Issue ID: 2 Alternative Type: Conveyance



Cost

- Construction ..... $ 5,300
- Right-of-Way ..... $ 85
- Annual Maintenance ..... $ 70

Advantages

- No right of way acquisition.
- Minimizes impact to existing parking lot facilities.
- Reduces flooding of the roadways.
- Low construction cost.

Disadvantages

- Requires that more storm water be retained on the parking lot on the west side of 77th Ave.
- May increase pavement maintenance cost of parking lots for Arrowhead Crossing Commercial Center.
- Ponding will remain on the parking lot for a longer time.

8.4.2.2 Drainage Issue No. 3 – Redfield Road West of 67th Avenue

Drainage Issue No. 3 is located along Redfield Road, an 1100 ft long roadway west of 67th Avenue and north of Thunderbird Road. During significant storm events the roadway and adjacent properties often flood. The Peoria Heights Ranch Estates was designed as a low density, flood irrigated lots and built in 1978. Redfield Road was not design to carry any flow but to drain into the lots. Currently, the front portion of most of the lots drain to the street and since the street does not have a positive grade to drain or a curb to contain the flow in the street, the runoff ponds in the street and any low area adjacent to the street.

It appears many of the residents have placed fill to prevent the flow from flooding their front yards, which caused the drainage condition in the road. In addition, there are a few lots that have a significant portion of the total area covered with impervious material. This probably has increased the runoff from those properties and is contributing to the drainage issues on the road. Most of the lots appear to have flood irrigation infrastructure in the backyard and have the potential for being able to handle the street runoff but the grading of the front yards prevents these flows from reaching these areas.

Five alternatives were developed to address Drainage Issue No. 3. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis including evaluation matrix refer to the Drainage Issue No. 3 report included in **Appendix F.3 Drainage Issue No. 3 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 5 was selected as the preferred alternative for Drainage Issue No. 3. The final score and ranking of the proposed solution is presented in **Table 8.3 – Drainage Issue No. 3 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.85	2
Alternative 2	5.90	4
Alternative 3	4.40	5
Alternative 4	5.95	3
Alternative 5	7.05	1

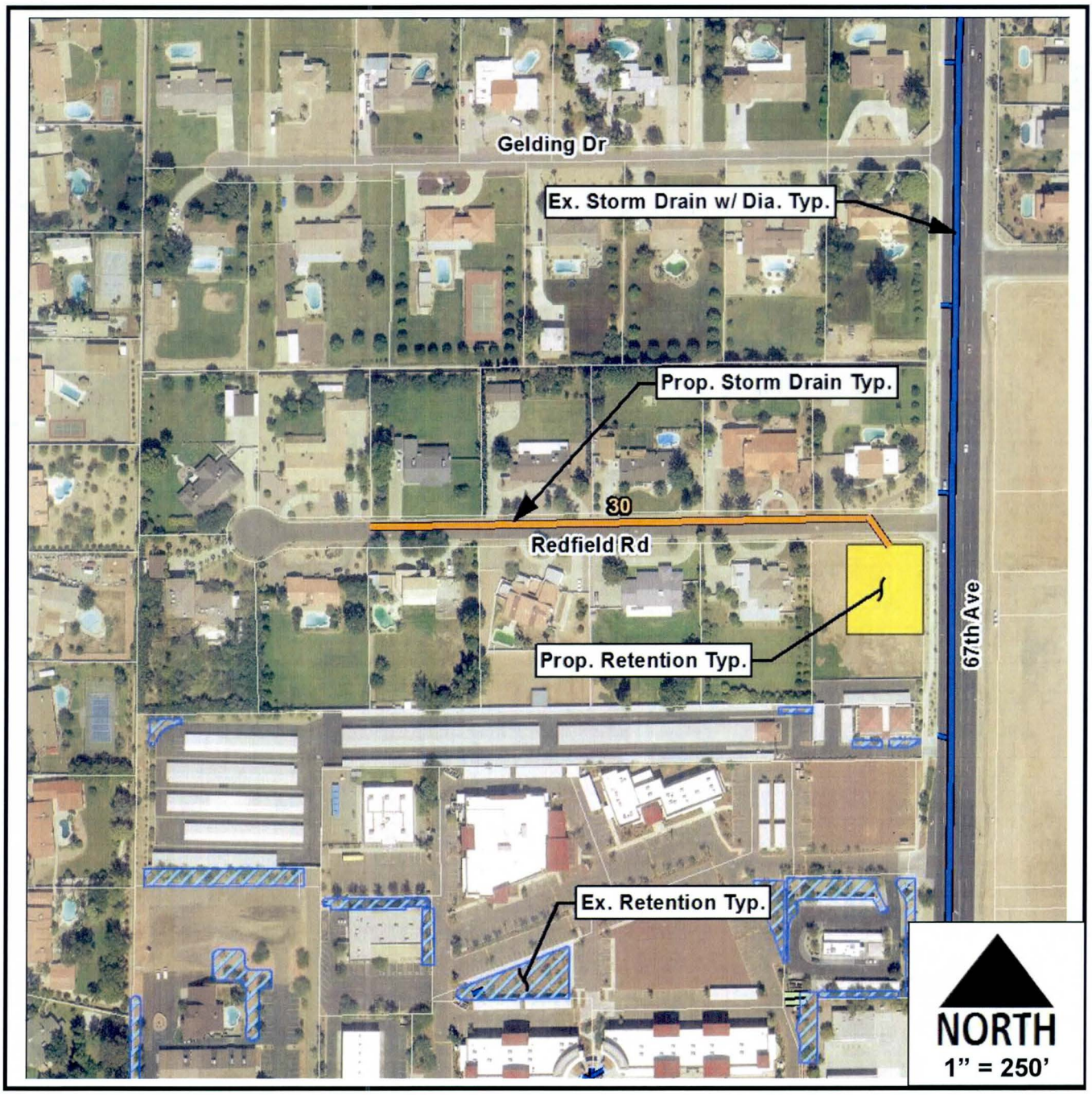
Table 8.3 – Drainage Issue No. 3 Alternatives Evaluation Results

Preferred Alternative – This alternative consists of installing a storm drain along this stretch of Redfield Road and placing catch basins to collect street flow. The proposed storm drain would outfall into a new retention basin located on the empty lot at the southwest corner of Redfield Road and 67th Avenue and be drained via drywells. As an optional method of draining the retention basin, there is the potential to install a 24-inch connection to the 67th Avenue storm drain that is owned by the City of Glendale. Proposed

drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.2 – Drainage Issue No. 3 Preferred Alternative** on the next page.

Figure 8.2 – Drainage Issue No. 3 Preferred Alternative

Drainage Area: 2 Alternative No: 5
Drainage Issue ID: 3 Alternative Type: Conveyance/Storage



Cost

- Construction ..... $ 390,000
- Right-of-Way ..... $ 51,000
- Annual Maintenance ..... $ 3,300*

  * Reduce ponding may result in reduction of maintenance cost for the street. This potential savings is not included in this cost

Advantages

- Provides 10-year level of protection along the storm drain alignment.
- Resolve access problem during normal storm events.
- Provides multi use opportunity for the neighborhood.
- Minimize disturbance to adjoining properties along Redfield Rd.

Disadvantages

- Requires acquisition of private property.
- Construction traffic disturbance on Redfield Road.
- Additional maintenance cost for new basin
- Requires drywell or bleed off to drain basin

8.4.2.3 Drainage Issue No. 4 – 72nd Avenue & Redfield Road - Weedville Well Waste Discharge

Drainage Issue No. 4, located on 72nd Avenue and Redfield Road, is associated with several flooding issues. These include the waste discharge from the Weedville well, runoff ponding around the well site, flooding of the property to the west of 73rd Avenue, runoff through property on the north side of Thunderbird Road at 73rd Avenue and flooding along 72nd Avenue from Thunderbird Road to Acoma Drive.

The analysis of Drainage Issue No. 4 revealed that there are two main flooding issues. The first issue is frequent flooding along 72nd and 73rd Avenues from Thunderbird Road to north of Redfield Road. Flows from the upstream watershed tend to concentrate in this area and the streets do not have curb and gutter and cannot carry any significant flow within the roadway cross section. This results in runoff flooding adjacent properties. There is an earthen berm along the south side of Redfield Road that prevents flows from continuing south through the City property (in the vicinity of the City's Weedville well site) and into the private property downstream. Runoff along 73rd Avenue near Redfield Road has to make four 90 degree turns to get around the Missionary Indian School property and some of these flows are likely flooding this property. All the flows reaching Acoma Dr. from 71st Avenue to 73rd Avenue gets directed south along 73rd Avenue and contributes to the drainage issues in this area.

The second issue is flooding along 71st Avenue. The upstream watershed consists mostly of irrigated lots and, for the most part, the irrigation system is fully functional with several irrigation canals for delivery and the typical flood irrigation configuration for the individual lots (berming around the yards to prevent irrigation flow from running off). Some property owners had already re-configured their front yards and it is likely the front yards may not be reliable storage areas today or in the future. This results in increasing runoff from these areas that ultimately will end up on 71st Avenue and, since this road does not have a curb, it does not have any capacity to convey these flows within the roadway section. Flows would spread and flood adjacent properties.

Three alternatives were developed to address Drainage Issue No. 4. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as the evaluation matrix, refer to the Drainage Issue No. 4 report included in **Appendix F.4 Drainage Issue No. 4 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 2 was selected as the preferred alternative for Drainage Issue No. 4. The final total score and ranking of the proposed solutions is presented in **Table 8.4 – Drainage Issue No. 4 Alternatives Evaluation Results** on the next page.

Description	Total Score	Rank
Alternative 1	6.55	3
Alternative 1A	6.95	2
Alternative 2	7.20	1

Table 8.4 – Drainage Issue No. 4 Alternatives Evaluation Results

Preferred Alternative – This alternative consists of three main elements:

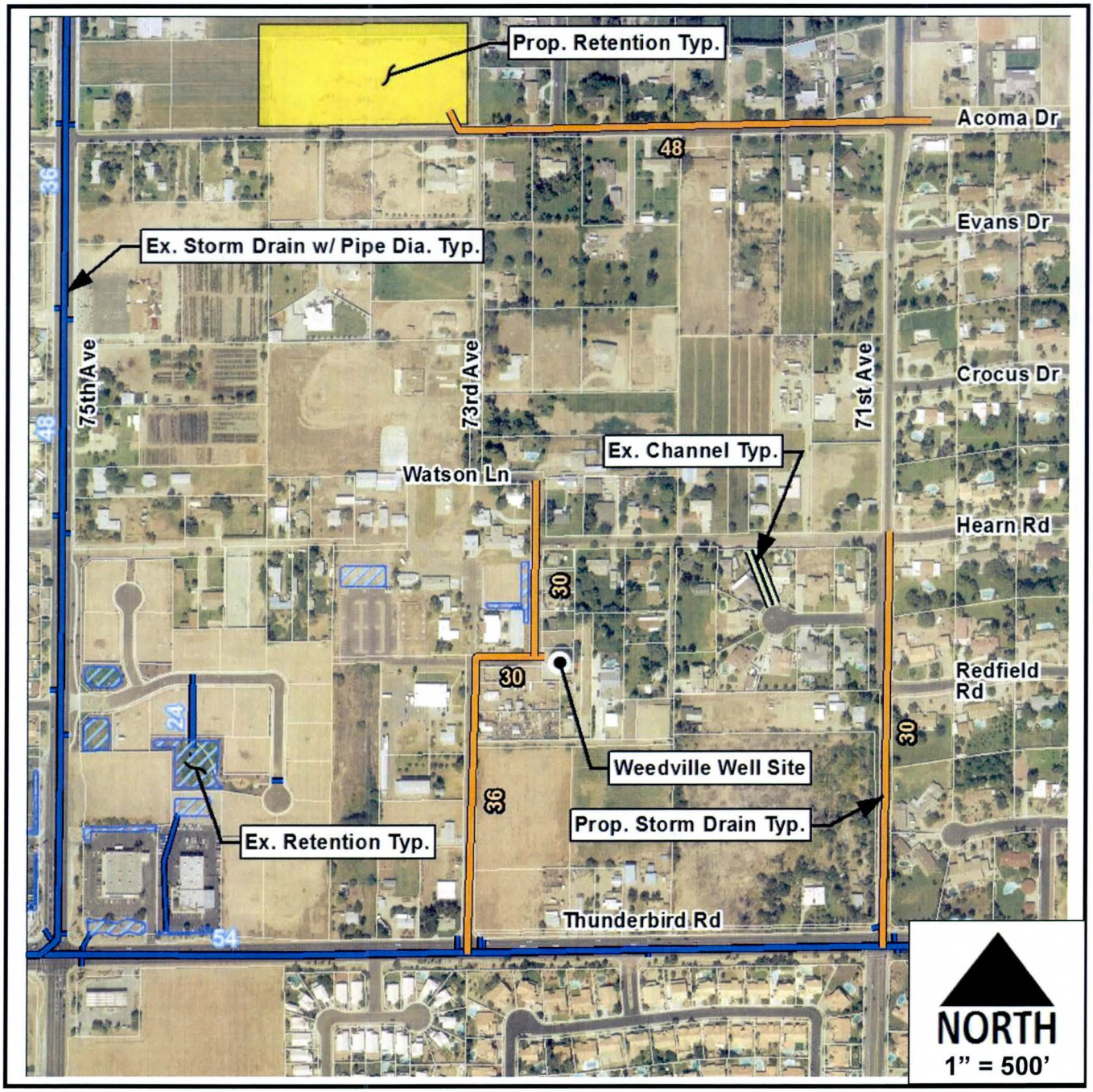
- Storm drain along Acoma Drive from 71st Avenue out falling to a proposed basin in the northwest corner of Acoma Drive and 73rd Avenue. Optionally, alternate locations that provide the same drainage benefits could be considered for the retention basin proposed as part of this alternative. Also, as part of this option, consider a bleed-off connection to the 75th Avenue storm drain.
- Storm drain along 72nd Avenue (Watson Lane to Redfield Road), storm drain along Redfield Road (72nd Avenue to 73rd Avenue), and storm drain on 73rd Avenue from Redfield connecting to the existing 54-inch storm drain on Thunderbird Road.
- Storm drain along 71st Avenue from Hearn Road connecting to the existing 54-inch storm drain on Thunderbird Road (modified Master Plan element).

In addition, this alternative may require re-grading along the shoulders of the roadways and installing proposed area inlets to direct flows to the storm drains. Alternately, curb and gutter could be installed to direct the flows to catch basins then into the storm drains. This alternative would provide an outfall for the waste discharge from the Weedville well site. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.3 – Drainage Issue No. 4 Preferred Alternative** on the next page.

Figure 8.3 – Drainage Issue No. 4 Preferred Alternative

Drainage Area: 2
Drainage Issue ID: 4

Alternative No: 2
Alternative Type: Conveyance/Storage



Cost

- Construction ..... $ 2,020,000
- Right-of-Way ..... $ 107,000
- Annual Maintenance ..... $ 30,000

Advantages

- Provide 10-year level of protection along storm drain alignments.
- Provide outfall for the Weedville well waste discharge.
- Improves access to the area during storm events.
- Reduces flows reaching the Thunderbird Road storm drain.
- Multi-use opportunities for basin site.

Disadvantages

- Traffic disturbance during construction.
- May have some negative impact to the 75th Ave storm drain.
- May require roadside ditches or curb to direct flow to catch basins.
- Large basin on Peoria Unified school district property.
- Requires additional maintenance.

8.4.2.4 Drainage Issue No. 6 – 91st Avenue and Thunderbird Road

The 91st Avenue Outlet Channel between the south property line of the Plaza Town Center development and the culvert outlet to the New River has not been maintained as it cannot be easily accessed and is full of vegetation and debris that is reducing the channel capacity. The channel's current capacity could carry somewhere between the 10-year and 25-year flows. However, if left unmaintained, debris and vegetation will continue to accumulate and will reduce the channel's capacity. Ultimately, the channel could be completely obstructed and flows could back-up and scour the channel banks, threatening the sewer line, power poles, and adjacent properties.

Separate from the issue of maintaining the outlet channel, the analysis revealed another potential drainage issue: Flows reaching the intersection of 91st Avenue and Thunderbird Road exceed the capacity of the 72-inch storm drain that drains the intersection into the 91st Avenue Outlet Channel and the excess flows appear as though they may spill into the Plaza Town Center property before they enter the 91st Avenue Outlet Channel. This issue was explored further as part of the Drainage Issue No. 6A analysis (see **Section 8.4.2.5 Drainage Issue No. 6A – 91st Avenue and Thunderbird Road**).

Four alternatives were developed to address Drainage Issue No. 6. In general, the base alternatives were developed to mitigate the 10-year to 25-year storm events. For detailed descriptions of the alternatives analysis as well as the evaluation matrix refer to the Drainage Issue No. 6 report included in **Appendix F.5 Drainage Issue No. 6 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 3 was selected as the preferred alternative for Drainage Issue No. 6. The final total score and ranking of the proposed solutions is presented in **Table 8.5 – Drainage Issue No. 6 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.10	4
Alternative 2	6.65	2
Alternative 3	6.95	1
Alternative 4	6.45	3

Table 8.5 – Drainage Issue No. 6 Alternatives Evaluation Results

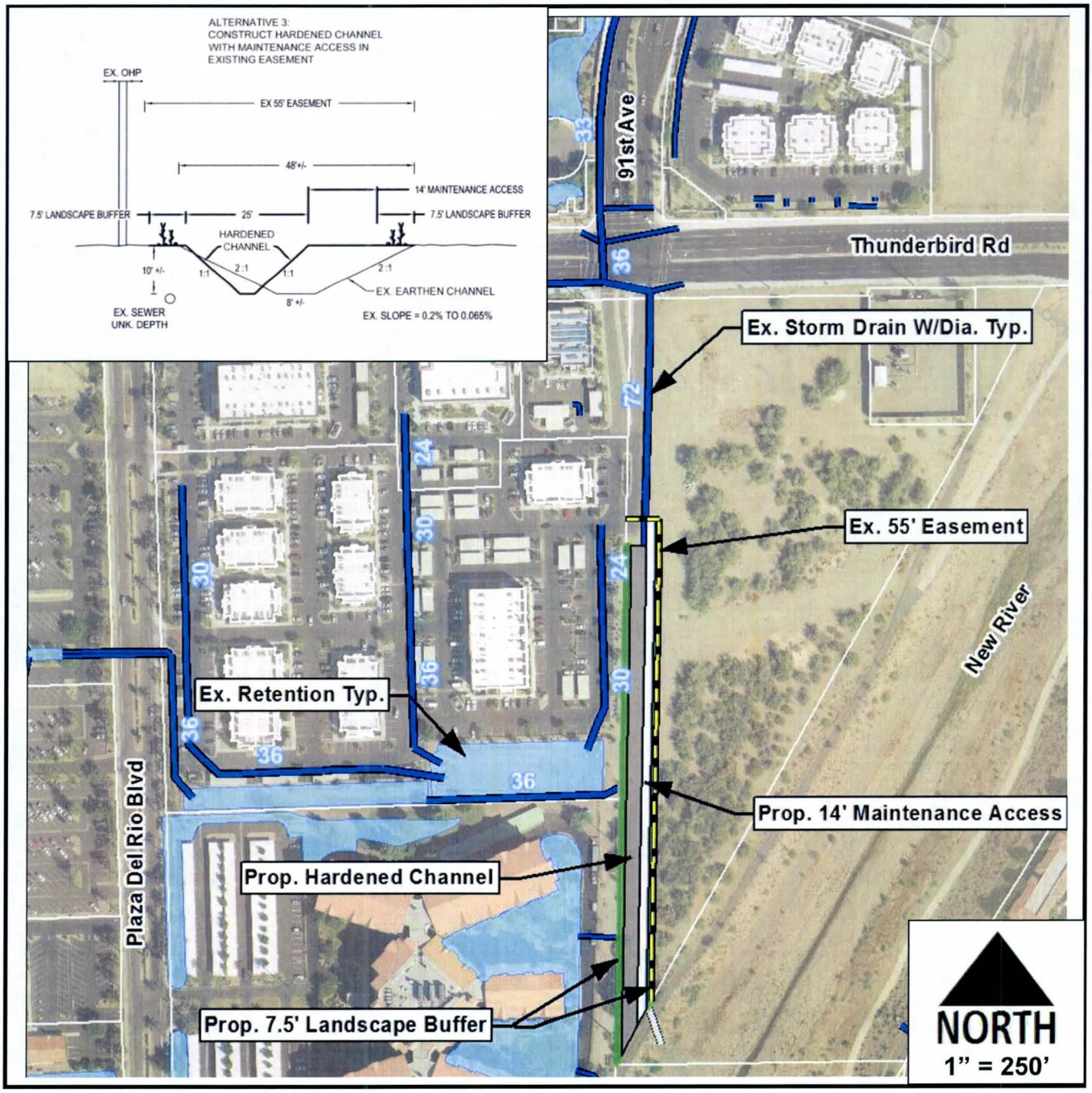
Preferred Alternative – This alternative consists of replacing the earthen channel with a hardened channel that has a narrower top width and maintenance access within the existing drainage easement. This alternative could provide conveyance for up to the 100-year flows within the existing drainage easement. The channel could be configured in a variety of different ways, including additional storm drain or culvert crossing, depending on City and Developer preferences. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown

on **Figure 8.4 – Drainage Issue No. 6 Preferred Alternative** on the next page.

Figure 8.4 – Drainage Issue No. 6 Preferred Alternative

Drainage Area: 2 Alternative No: 3

Drainage Issue ID: 6 Alternative Type: Conveyance



Cost

- Construction ..... $ 94,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 2,100

Advantages

- Provides 100-year conveyance capacity.
- Allows for on-going maintenance.
- No property acquisition required.
- Intercepts overland flows.
- Provides erosion protection.

Disadvantages

- Relatively high construction costs.
- May not be aesthetically desirable .

8.4.2.5 Drainage Issue No. 6A – 91st Avenue and Thunderbird Road

Hydrologic and hydraulic analysis performed as part of Drainage Issue No. 6 showed that during significant storm events flow magnitudes at the intersection of Thunderbird Road and 91st Avenue exceed the 72-inch storm drain capacity. Flows reaching the above mentioned intersection that exceed the capacity of the existing 72-inch storm drain will concentrate at the low point of the roadway and ultimately spill into the Plaza Town Center development before they would spill into the 91st Avenue Outlet Channel.

Four alternatives were developed to address the lack of adequate conveyance facilities near the intersection of Thunderbird Road and 91st Avenue. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as the evaluation matrix refer to the Drainage Issue No. 6A report included in **Appendix F.6 Drainage Issue No. 6A Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 4 was selected as the preferred alternative for Drainage Issue No. 6A. The final total score and ranking of the proposed solutions is presented in **Table 8.6 – Drainage Issue No. 6A Alternatives Evaluation Results** below.

The proposed channel for this drainage issue will be connected at the downstream end to the proposed hardened channel considered as part of Drainage Issue No 6. The cross-sectional geometries of the two channel segments are different. Therefore, an intermediate channel segmented must be constructed as a transition between the two proposed channels. More detail on the transition channel segment is provided on the 15% design Conceptual Plans (see **Section 9 Recommended Storm Drainage Master Plan**).

Description	Total Score	Rank
Alternative 1	7.25	2
Alternative 2	6.30	3
Alternative 3	5.60	4
Alternative 4	7.80	1

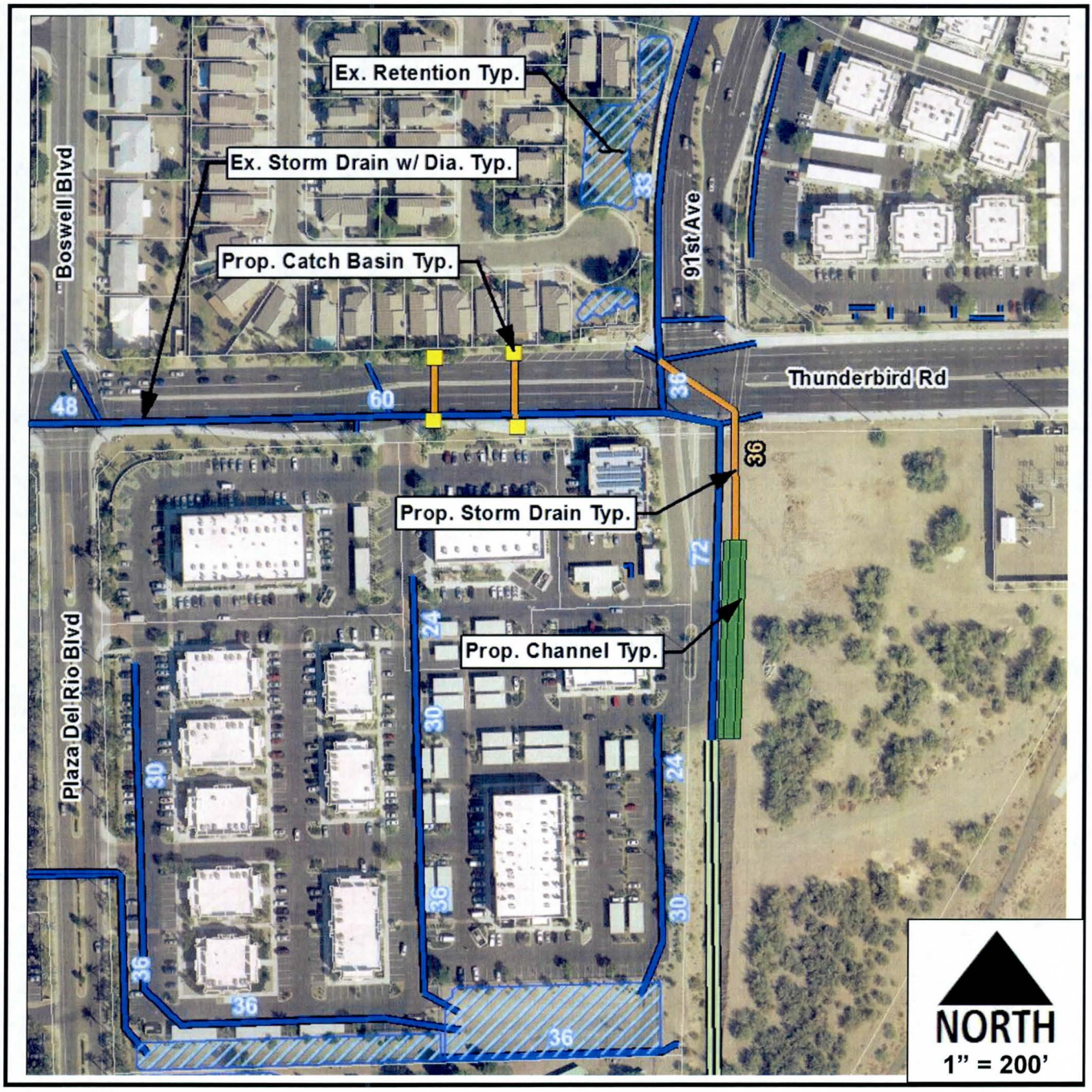
Table 8.6 – Drainage Issue No. 6A Alternatives Evaluation Results

Preferred Alternative – This alternative consists of constructing a new 250 ft long channel along the east side of 91st Avenue that would drain into the existing 91st Avenue Outlet Channel. The proposed channel would have a bottom width of 6 ft, depth of 4.5 ft (including 1 ft of freeboard), side slope 3:1 and longitudinal slope of 0.2 percent. Variation of this alternative could include additional storm drain or culvert crossing, depending on the City and Developer preferences. In addition, the 36-inch storm drain pipe along 91st Avenue, north of Thunderbird Road will be extended to drain directly into the new drainage channel. To increase the inlet capacity of the 60-inch storm drain along Thunderbird Road, new catch basins will be added near

the entrance of Town Plaza Center development. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.5 – Drainage Issue No. 6A Preferred Alternative** on the next page.

Figure 8.5 – Drainage Issue No. 6A Preferred Alternative

Drainage Area: 2 Alternative No: 4
Drainage Issue ID: 6A Alternative Type: Conveyance



Cost

- Construction ..... $ 113,000
- Right-of-Way ..... $ 34,000
- Annual Maintenance ..... $ 1,100

Advantages

- Reduces flooding of the roadways and adjacent property.
- Maximizes the use of existing drainage facilities.
- The lowest cost alternative.

Disadvantages

- Additional maintenance cost for new channel.
- Traffic disruption on Thunderbird Rd and 91st Ave.
- Requires the acquisition of an easement from the property at the southeast corner of Thunderbird Rd and 91st Ave intersection.

8.4.3 Problem Area 3

Problem area 3 covers the central portion of the study area (see **Appendix F.1 Drainage Issues / Problems Identification Exhibit**) and includes drainage issues 5, 8, 9, 10, 12, 15, 30, 32, 33, and 34. The above mentioned drainage issues and the preferred alternatives including, advantages, disadvantages and cost estimates are described in the following subsections.

8.4.3.1 Drainage Issues No. 5, 8, 32 and 33 – Sweetwater Park and Intersection of Cactus Road with 71st, 75th and 79th Avenues

The analysis of Drainage Issues No. 8, 32, and 33 revealed that all issues are related to a lack of conveyance facilities on 71st, 75th, 79th Avenues and Cactus Road. The previous SDMP proposed storm drains along 71st, 75th and 79th Avenues that were not constructed. In addition, Drainage Issue No 5 is associated with an inadequate dewatering system of Sweetwater Park. The lack of regional conveyance facilities is compounded by several developments within the drainage area that were constructed without retention.

Two alternatives were developed to address Drainage Issues No. 5, 8, 32 and 33. The base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issues No. 5, 8, 32 and 33 report included in **Appendix F.7 Drainage Issues No. 5, 8, 32 and 33 Report**. During alternatives evaluation workshop, Alternative 2 scored the highest. However, after City's internal discussion, it was recommended that Alternative 1 be selected as the preferred alternative. The final total score and ranking of the proposed solutions is presented in **Table 8.7 – Drainage Issues No. 5, 8, 32, and 33 Alternatives Evaluation Results** below.

Description	Total Score	Rank	Final Rank*
Alternative 1	6.55	2	1
Alternative 2	6.60	1	2

*Final rank after City's internal discussion regarding the proposed alternatives

Table 8.7 – Drainage Issues No. 5, 8, 32, and 33 Alternatives Evaluation Results

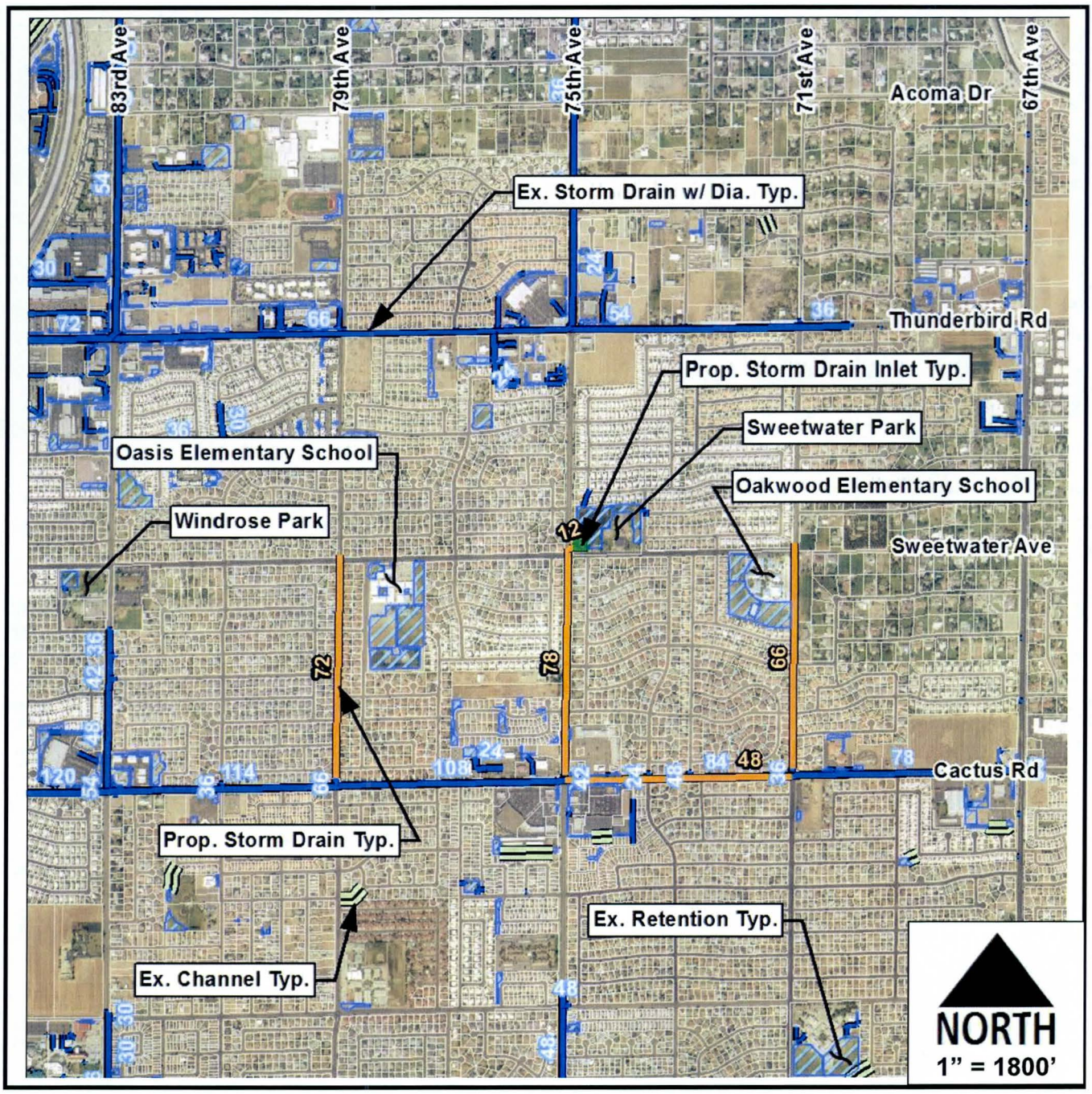
Preferred Alternative – This alternative includes storm drain pipes along 71st, 75th and 79th Avenues between Sweetwater Avenue and Cactus Road. Sweetwater Park will be connected via a 12-inch lateral pipe to the proposed storm drain at the intersection of 75th Avenue and Sweetwater Avenue. Also, a proposed storm drain parallel to the existing 84-inch diameter pipe will be constructed along Cactus Road between 71st and 75th Avenues. A variation to this alternative could be to add a new retention basin at the northwest corner of 67th Avenue and Cactus Road. This would eliminate the need for the proposed parallel storm drain along Cactus Road. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred

alternative are shown on **Figure 8.6 – Drainage Issues No. 5, 8, 32, and 33 Preferred Alternative**.

Figure 8.6 – Drainage Issues No. 5, 8, 32, and 33 Preferred Alternative

Drainage Area: 3
Drainage Issue ID: 5, 8, 32, 33

Alternative No: 1
Alternative Type: Conveyance



Cost

- Construction ..... $ 6,430,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 21,500

Advantages

- No right of way acquisition.
- Minimize impact to existing park facilities.
- Reduces flooding of the roadways.

Disadvantages

- Construction of large storm drains would require road closures, longer construction duration, and cause disruptions to adjoining neighborhoods.
- High construction cost.
- Requires constructing a new parallel storm drain on Cactus Rd.
- Additional maintenance cost for storm drains.

8.4.3.2 Drainage Issue No. 9 – 83rd Avenue – Sweetwater Avenue to Corrine Drive

Drainage Issue No. 9, located on 83rd Avenue from Sweetwater Avenue to Corrine Drive, has been a maintenance hot spot for the City of Peoria. Based on the analysis performed it is apparent that significant flows reach 83rd Avenue between Sweetwater Avenue and Corrine Drive and the existing drainage system is not adequate to handle the flows in a timely matter. Flow in this area is generated from three different sources: inflow from Sweetwater Avenue, runoff from the LDS church site, and flow from Corrine Drive.

Four alternatives were developed to address Drainage Issues No. 9. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 9 report included in **Appendix F.8 Drainage Issue No. 9 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 1 was selected as the preferred alternative for Drainage Issue No. 9. The final total score and ranking of the proposed solutions is presented in **Table 8.8 – Drainage Issue No. 9 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.10	1
Alternative 2	5.85	4
Alternative 3	6.00	3
Alternative 4	6.05	2

Table 8.8 – Drainage Issue No. 9 Alternatives Evaluation Results

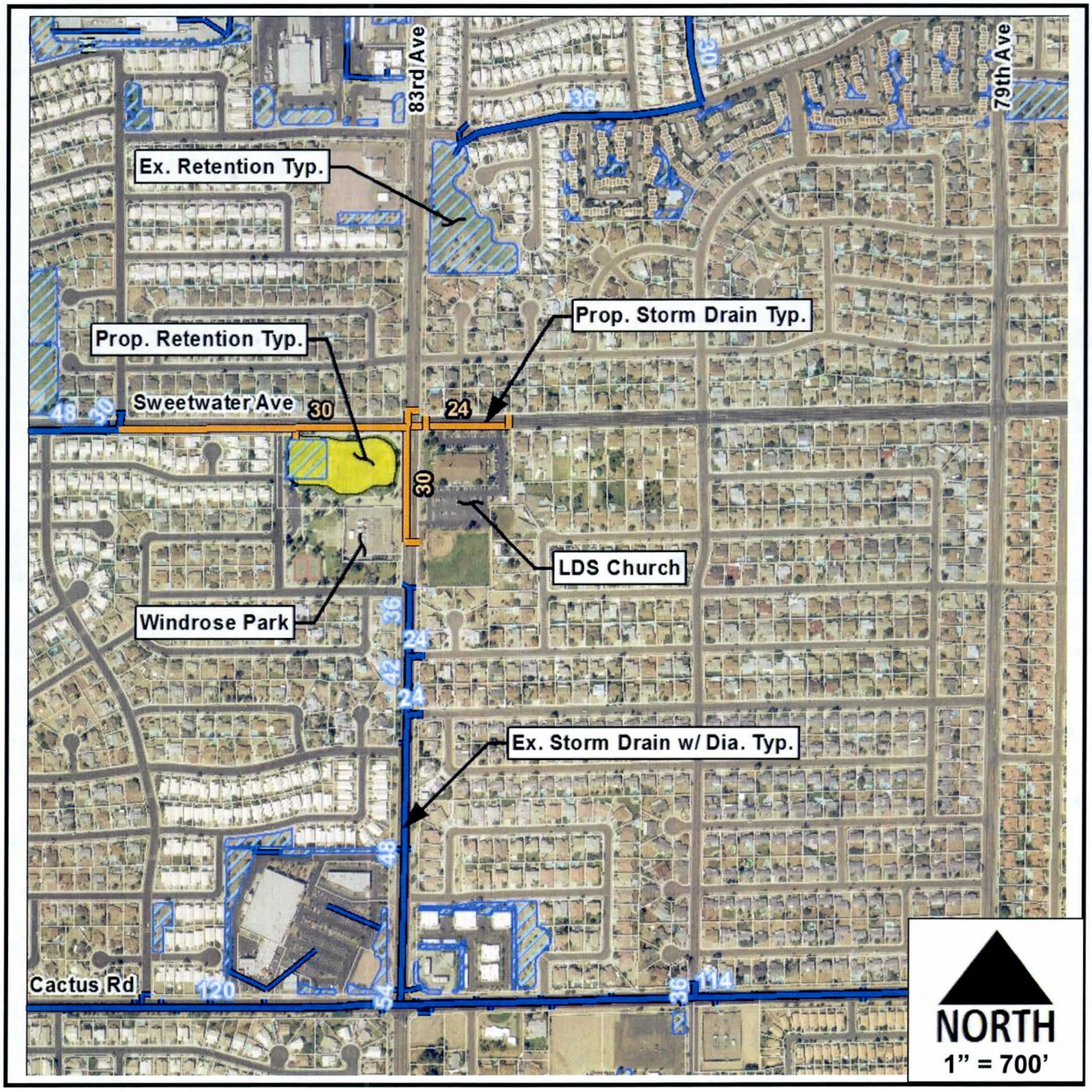
Preferred Alternative – This alternative consists of installing an 800 ft long storm drain along 83rd Avenue flowing north to Sweetwater Avenue and along Sweetwater Avenue connecting to the existing storm drains to the west (1300 ft). To prevent exceeding the capacity of the existing Sweetwater Avenue storm drain, the Windrose Park basin can be used as an offline basin to reduce peak flows in the storm drain.

This alternative will not affect the existing Sweetwater Avenue storm drain and may reduce the flows reaching the overtaxed Cactus Road storm drain. It also would provide a 10-year level of protection for a 1/4 of a mile of Sweetwater Avenue and alleviate the drainage and maintenance issues along 83rd Avenue between Corrine Drive and Sweetwater Avenue. It may also free up some of the capacity of the existing 83rd Avenue storm drain to better handle the flows reaching 83rd Avenue from the east. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.7 – Drainage Issue No. 9 Preferred Alternative** on the next page.

Figure 8.7 – Drainage Issue No. 9 Preferred Alternative

Drainage Area: 3 Alternative No: 1

Drainage Issue ID: 9 Alternative Type: Conveyance/Storage



Cost

- Construction ..... $ 1,560,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 15,400

Advantages

- Provide 10-year protection to 83rd Ave. (Sweetwater to Corrine).
- May improve drainage conditions on 83rd Ave. south of Corrine.
- May improve drainage along Sweetwater Ave in the vicinity of 83rd Ave.
- Provides outfall to drain Windrose Park basin.
- May reduce flows reaching the overtaxed Cactus system.

Disadvantages

- Traffic disturbance on Sweetwater and 83rd Ave. during construction.
- Disturbance and additional maintenance on Windrose Park.
- Highest cost alternative.

8.4.3.3 Drainage Issue No. 10 – Roosevelt Street and 81st Avenue

Several homes in the vicinity of 81st Avenue and Roosevelt Street flood regularly. These homes are slab on grade and even minor storms appear to cause flooding of the homes. Lack of retention on the upstream contributing area generates high flows throughout the contributing area and specifically in the vicinity of 81st Avenue and Roosevelt Street. As mentioned above, many of the homes in this area were built slab on grade and once the street capacity is exceeded flooding of the structures is almost certain. This is aggravated by the lack of capacity of the street section. Flat grades and roll curb result in very little roadway capacity and the potential for flooding is significant during even minor storm events. Fences and other obstructions within the properties in the problem area impede the movement of runoff through the private parcels and further contribute to the flooding by ponding the runoff on the properties.

Four alternatives were developed to address Drainage Issues No. 10. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 10 report included in **Appendix F.9 Drainage Issue No. 10 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 1 was selected as the preferred alternative for Drainage Issue No. 10. The final total score and ranking of the proposed solutions is presented in **Table 8.9 – Drainage Issue No. 10 Alternatives Evaluation Results** below.

During the alternatives evaluation meeting, there was some discussion between the team members whether to consider a more regional solution for Drainage Issue No. 10. However, after follow-up discussions, the City decided to keep the current local solution for this drainage issue, rather than develop a more regional solution.

Description	Total Score	Rank
Alternative 1	6.45	1
Alternative 2	6.05	3
Alternative 3	6.10	2
Alternative 4	5.85	4

Table 8.9 – Drainage Issue No. 10 Alternatives Evaluation Results

Preferred Alternative – This alternative consists of purchasing the three high risk properties and constructing a retention basin and a storm drain along 81st Avenue to collect runoff from the street and convey it to the retention basin.

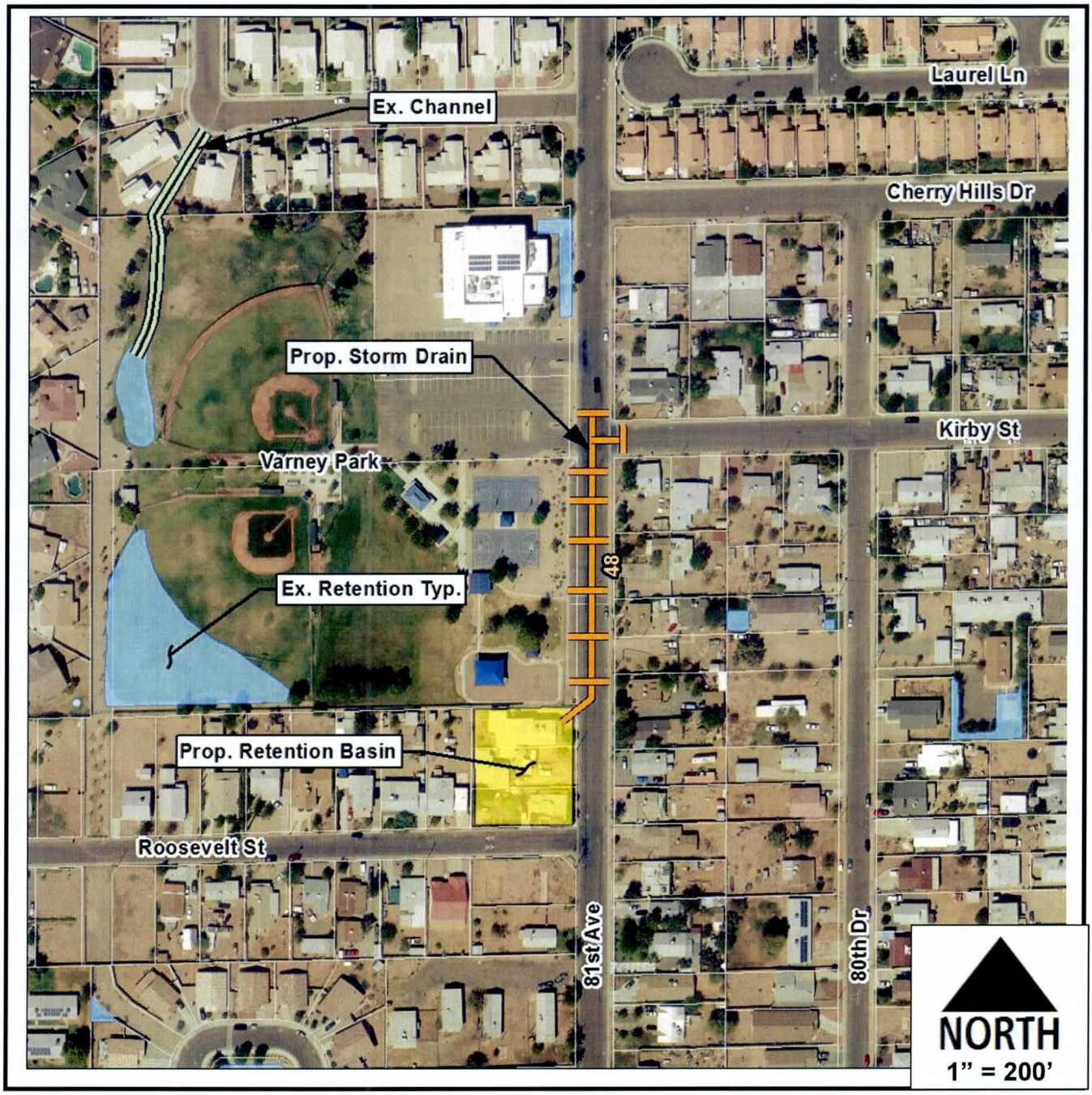
This alternative will eliminate the high risk properties and would provide 10-year protection along the alignment of the storm drain. Additionally it may provide some benefit to downstream properties. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative

are shown on **Figure 8.8 – Drainage Issue No. 10 Preferred Alternative** on the next page.

Figure 8.8 – Drainage Issue No. 10 Preferred Alternative

Drainage Area: 3
Drainage Issue ID: 10

Alternative No: 1
Alternative Type: Conveyance/Storage



Cost

Construction	$ 391,000
Right-of-Way	$ 90,000
Annual Maintenance	$ 3,000

Advantages

- Eliminate flooding liability for the three properties identified at risk.
- Mitigate some of the lack of retention in the neighborhood.
- May provide some additional flood protection for properties along 81st Ave. and Roosevelt Street.
- Basin can be incorporated with Varney Park.

Disadvantages

- Requires purchase of three homes.
- Traffic disturbance during construction.
- Low benefit/cost ratio.

8.4.3.4 Drainage Issue No. 12 – Peoria Gardens Apartments at 85th Avenue and Grand Avenue

The apartment complex at 10860 N. 85th Avenue (Peoria Gardens) has little or no retention and does not have an adequate drainage outlet. The City has requested that discharge facilities be sized as part of this study. The apartment complex drains towards a small depressed area at the southwest corner of the property. Besides this depressed area, and some other slightly depressed areas along the western property border, the apartments lack any retention facilities. Historically, overflow from the apartments would accumulate along the western property boundary and eventually spill to a previously undeveloped parcel to the west. When the parcel to the west was developed, improvements were made that appear to prevent the overflow from the apartments from spilling west into it. These conditions result in ponding on the apartment property. Additionally, runoff originating from a portion of the commercial property north of the apartments appears to drain into the apartment parking lot, which could exacerbate the issue.

Three alternatives were developed to address Drainage Issue No. 12. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 12 report included in **Appendix F.10 Drainage Issue No. 12 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 3 was selected as the preferred alternative for Drainage Issue No. 12. The final total score and ranking of the proposed solutions is presented in **Table 8.10 – Drainage Issue No. 12 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.40	3
Alternative 2	6.40	2
Alternative 3	6.45	1

Table 8.10 – Drainage Issue No. 12 Alternatives Evaluation Results

Preferred Alternative – This alternative would increase the retention volume on the property to 100-year, 2-hour. A retention basin (0.75 acre-feet) and underground storage pipes (0.25 acre-feet) would be added on the west side of the property. Drywell(s) would also be constructed to drain the underground storage. In addition, a bleed off pipe would be constructed to connect the proposed retention basin to the existing 85th Avenue storm drain. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.9 – Drainage Issue No. 12 Preferred Alternative** on the next page.

Figure 8.9 – Drainage Issue No. 12 Preferred Alternative

Drainage Area: 3
Drainage Issue ID: 12

Alternative No: 3
Alternative Type: Conveyance/Storage

Cost

- Construction ..... $ 290,000
- Right-of-Way ..... $ 4,300
- Annual Maintenance ..... $ 2,800

Advantages

- Promotes draining of basins.
- Complies w/City requirement for storage of storm water.
- Highest level of protection of all alternatives.

Disadvantages

- High construction and maintenance costs.
- Most construction disruptions to apartments.

8.4.3.5 Drainage Issue No. 15 – Peoria Avenue and 98th Avenue

Drainage Issue No. 15 is related to flooding on Peoria Avenue from 99th Avenue to the New River Bridge and along 98th Avenue just south of Peoria Avenue. Runoff generated along 99th Avenue, portions of Sun City South, and the Arrowhead Mall concentrates on Peoria Avenue. Due to the levee along New River, flow tends to pond on the road and the capacity of existing 18-inch storm drain is not adequate to drain the area resulting in flows moving south through the streets and parcels.

Four alternatives were developed to address Drainage Issues No. 15. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 15 report included in **Appendix F.11 Drainage Issue No. 15 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 3 was selected as the preferred alternative for Drainage Issue No. 15. The final total score and ranking of the proposed solutions is presented in **Table 8.11 – Drainage Issue No. 15 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.35	2
Alternative 2	5.75	3
Alternative 3	6.95	1
Alternative 4	5.60	4

Table 8.11 – Drainage Issue No. 15 Alternatives Evaluation Results

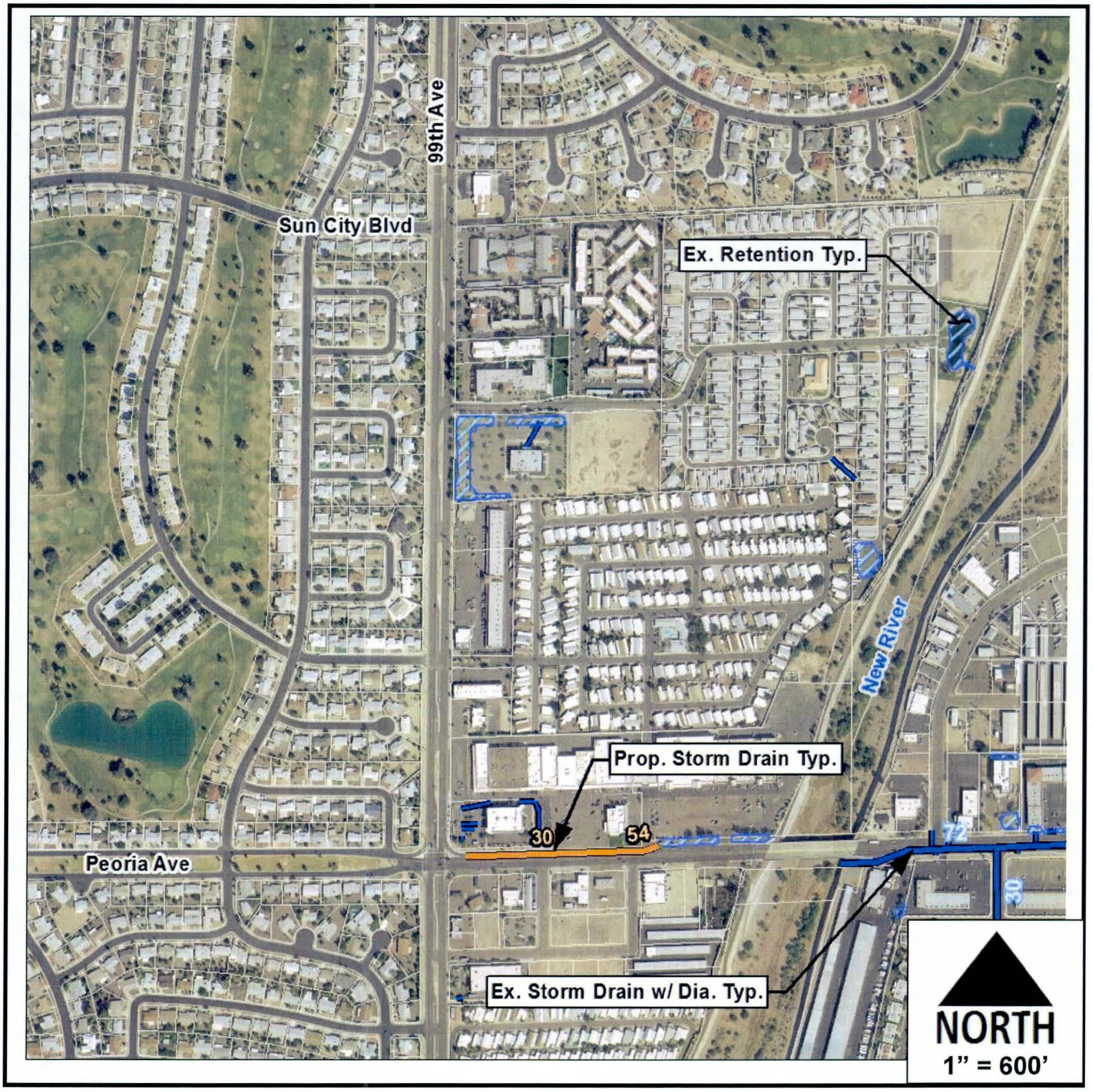
Preferred Alternative – This alternative proposed infrastructure is only for the reach of Peoria Avenue between just east of 99th Avenue and New River (incorporated City of Peoria). It utilizes the existing 36-inch culvert and the existing detention basin on the north side of Peoria Avenue. This preferred alternative only considers the regional solution for Peoria Avenue.

Should participation from the County become an option, this alternative could be modified to provide additional conveyance capacity by upsizing the proposed facilities along Peoria Avenue, thus creating the opportunity to implement a more regional solution for this area. This larger potential regional solution could be implemented to provide protection for the entire 99th Avenue and Peoria Avenue area including flooding in Sun City along 99th Avenue north of Peoria Avenue.

Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.10 – Drainage Issue No. 15 Preferred Alternative** on the next page.

Figure 8.10 – Drainage Issue No. 15 Preferred Alternative

Drainage Area: 3 Alternative No: 3
Drainage Issue ID: 15 Alternative Type: Conveyance



Cost

- Construction ..... $ 275,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 1,600

Advantages

- Provide 10-year level of protection along the alignment of the improvements.
- No new connection through New River levee required.
- Smaller infrastructure and less disturbance on Peoria Ave.
- Maximize use of existing infrastructure.
- May provide some protection south of Peoria Ave.
- All improvements within the City of Peoria.
- Low cost alternative.

Disadvantages

- Construction traffic disturbance
- Does not provide any protection along 99th Ave

8.4.3.6 Drainage Issue No. 30 – Grand Avenue Southwest of Intersection at 85th Avenue

Drainage Issue No. 30 is related to ponding along the north side of Grand Avenue, just southeast of the intersection with 85th Ave, in an apparent sag area between the roadway and the railroad. This runoff originates from two 36-inch culverts that outflow into this area and curb openings along the north half of Grand Avenue, just southeast of the intersection with 85th Avenue. The 36-inch culverts drain an area on the north side of the tracks that has a Zone AH floodplain designation. Increasing runoff from the culverts and from the roadway could increase the ponding area and depth until the runoff flows over the curb and into the roadway.

Three alternatives were developed to address Drainage Issues No. 30. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 30 report included in **Appendix F.12 Drainage Issue No. 30 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 2 was selected as the preferred alternative for Drainage Issue No. 30. The final total score and ranking of the proposed solutions is presented in **Table 8.12 – Drainage Issue No. 30 Alternatives Evaluation Results** below.

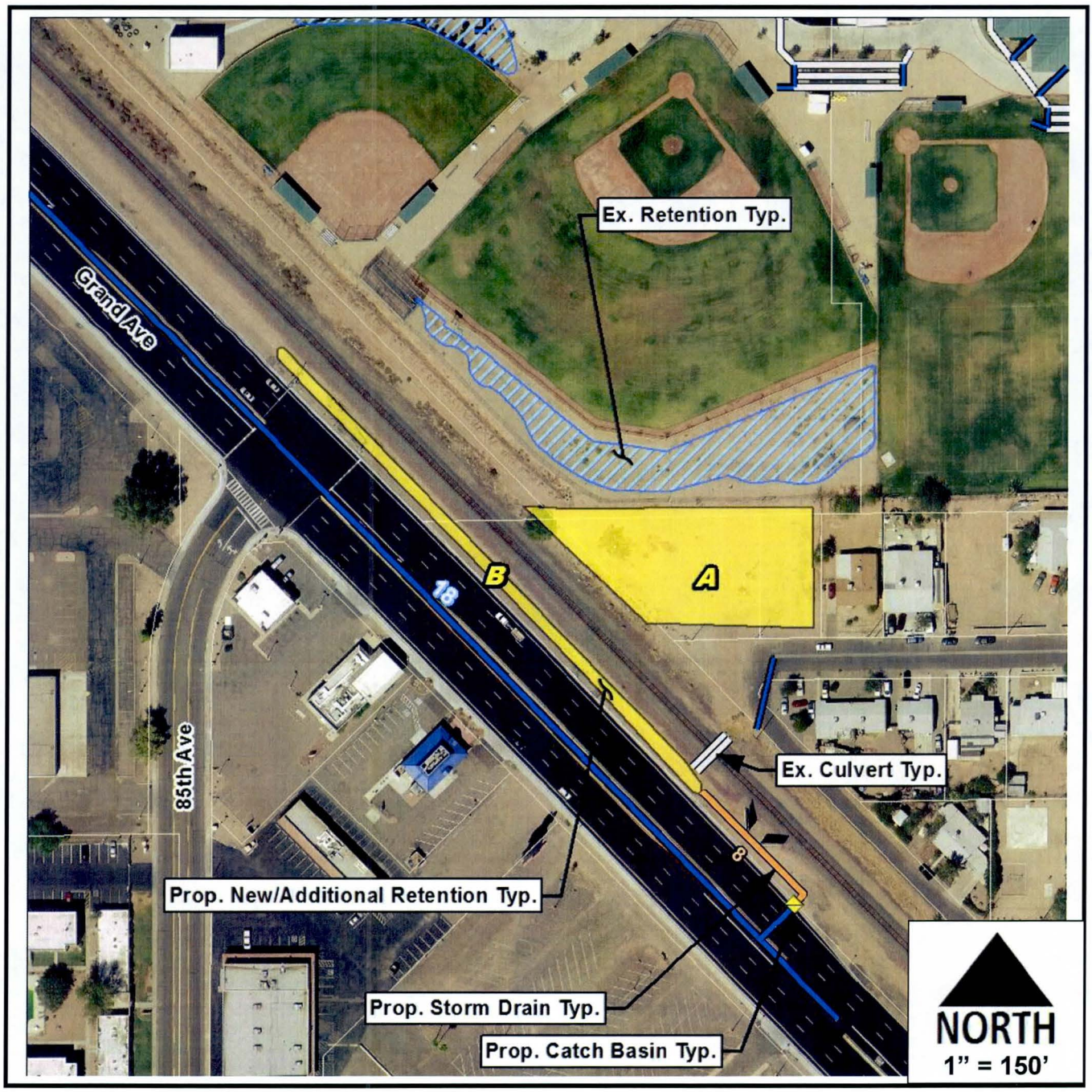
Description	Total Score	Rank
Alternative 1	6.00	2
Alternative 2	7.30	1
Alternative 3	5.75	3

Table 8.12 – Drainage Issue No. 30 Alternatives Evaluation Results

Preferred Alternative - This alternative would construct a new retention basin in a vacant, undeveloped area near the culvert inlets on the north side of the tracks. The retention basin would be designed and sized to retain up to the 10-year runoff volumes. Flow through the culverts would be reduced and the corresponding ponding issue would be lessened. The alternative would also construct storage along Grand Avenue in the area between the railroad tracks and the roadway to collect roadway runoff. Furthermore, the ponding area would be drained via an 8-inch bleed-off pipe connected to an existing Grand Avenue catch basin located 160 ft southeast of the culverts crossing the railroad. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.11 – Drainage Issue No. 30 Preferred Alternative** on the next page.

Figure 8.11 – Drainage Issue No. 30 Preferred Alternative

Drainage Area: 3 Alternative No: 2
Drainage Issue ID: 30 Alternative Type: Storage



Cost

- Construction $ 118,000
- Right-of-Way $ 65,000
- Annual Maintenance $ 3,000

Advantages

- Provides flood protection for a 10-year event.
- May improve drainage for the development to the east.
- Reduce the potential for ponding on the north side of Grand Ave.
- Reduce flows on Grand Ave.

Disadvantages

- Require acquisition of property for the basin.
- Some construction disruption (noise, dust, etc) for neighborhood to the east.

8.4.3.7 Drainage Issue No. 34 – Mountain View Road - 91st Avenue to 89th Avenue

Drainage Issue No. 34 is related to street flooding along Mountain View Road from 89th Avenue to 91st Avenue. There is little retention in the area contributing to the above-mentioned location. This results in a large flow concentrating on the roadway. The longitudinal slope along Mountain View Road is very flat resulting in poor conveyance capacity and the accumulation of flows over time since flows cannot be quickly conveyed out of the area.

The Drainage Master Plan recommendations would improve conditions in the area by providing a storm drain to intercept and convey the flows to the Olive Avenue storm drain via the proposed and the existing storm drains in 91st Avenue.

Five alternatives were developed to address Drainage Issues No. 34. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix, refer to the Drainage Issue No. 34 report included in **Appendix F.13 Drainage Issue No. 34 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 2 was selected as the preferred alternative for Drainage Issue No. 34. The final total score and ranking of the proposed solutions is presented in **Table 8.13 – Drainage Issue No. 34 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	6.35	3
Alternative 2	6.85	1
Alternative 3	6.20	4
Alternative 4	5.45	5
Alternative 5	6.65	2

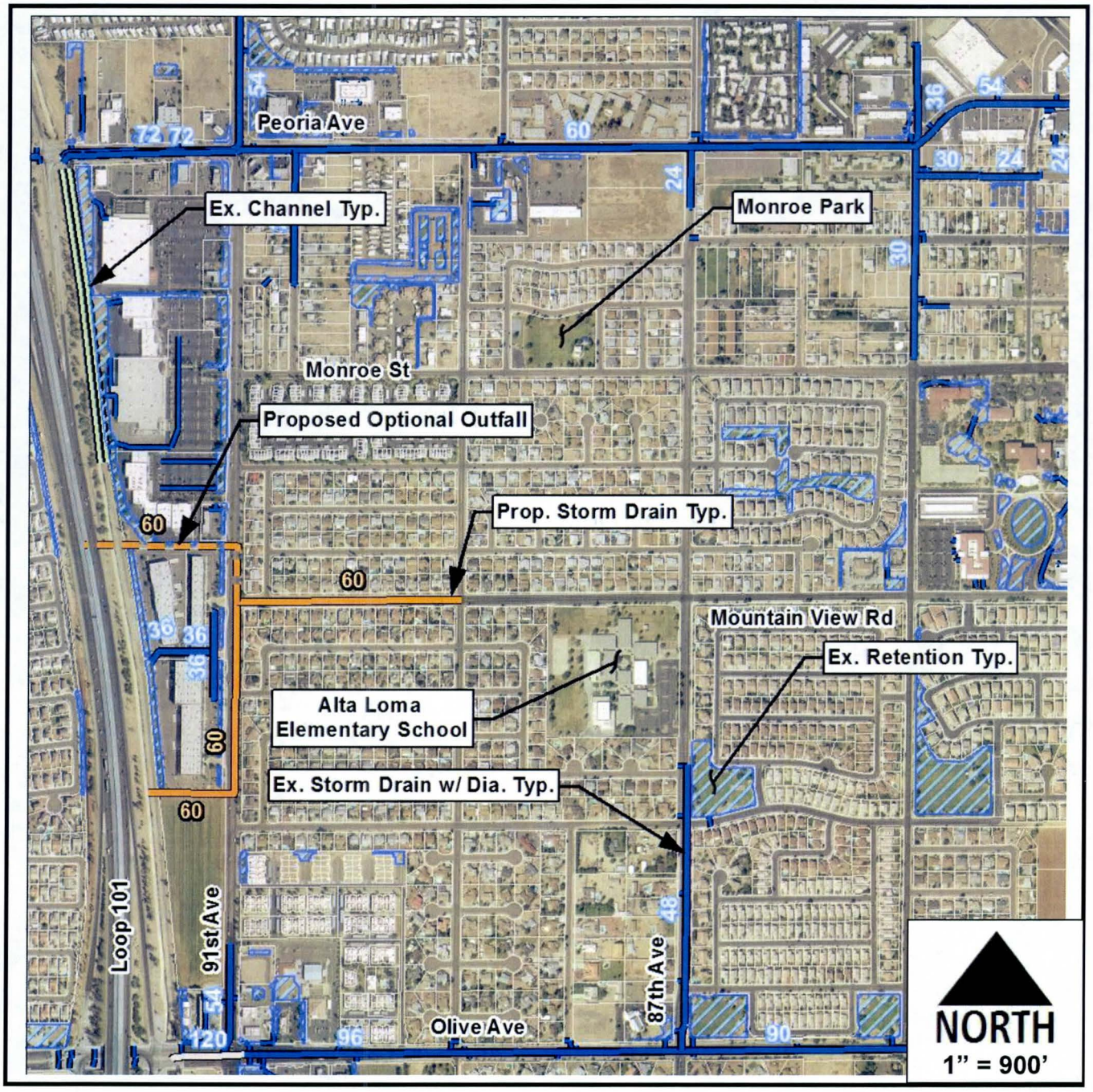
Table 8.13 – Drainage Issue No. 34 Alternatives Evaluation Results

Preferred Alternative – This alternative consists of constructing a storm drain along Mountain View Road from approximately 89th Avenue to 91st Avenue, then continue south along 91st Avenue to the edge of the commercial development on the west side of 91st Avenue (1,100 ft) and a connection between the 91st Avenue storm drain to the ADOT channel along the Loop 101 Freeway (500 ft). The extension on Mountain View Road storm drain should be done in conjunction with connecting the 91st Avenue storm drain directly to the ADOT channel in order to provide hydraulic relief to the Olive Avenue storm drain. A variation of this alternative would be to go north along 91st Avenue and connect to the ADOT channel through the commercial properties 680 ft north of Mountain View Road. Since this alternative does not use the Olive Avenue storm drain system but creates a separate outfall it may reduce the flows reaching this system and improve conditions elsewhere in that system. Proposed drainage facilities, costs,

advantages, and disadvantages for the preferred alternative are shown on **Figure 8.12 – Drainage Issue No. 34 Preferred Alternative** on the next page.

Figure 8.12 – Drainage Issue No. 34 Preferred Alternative

Drainage Area: 3 Alternative No: 2
Drainage Issue ID: 34 Alternative Type: Conveyance



Cost

- Construction ..... $ 1,671,000
- Right-of-Way ..... $ 8,500
- Annual Maintenance ..... $ 6,000

Advantages

- Provides 10-year protection along storm drain alignment.
- May improve drainage conditions South of Mountain View Rd.
- Takes flows away from Olive Ave storm drain.
- Minimize traffic disturbances on 91st Avenue.

Disadvantages

- Construction traffic disturbance on 91st Ave and Mountain View Rd.
- Requires purchase of ROW for new outfall pipe.
- Requires new connection to ADOT's channel.
- Does not take advantage of existing 54-inch storm drain in 91st Ave.

8.4.4 Problem Area 4

Problem area 4 covers the south portion of the study area (see **Appendix F.1 Drainage Issues / Problems Identification Exhibit**) and includes drainage issues 16, 18, 19, 25, and 31. The above mentioned drainage issues and the preferred alternatives including, advantages, disadvantages and cost estimates are described in the following subsections.

8.4.4.1 Drainage Issue No. 16 – 69th Drive/Shangri La Road - Channel to Sundance Park

Prior to the development of Sundance Elementary School and Sundance Park, the outfall from the Fairwood neighborhood located between Cholla Road and Shangri La Drive and between 69th Drive and 67th Avenue, was clogged and caused the ponding of runoff in the 69th Drive and Shangri La intersection and threatened homes. With development of Sundance Elementary School and Sundance Park, the channel outfall from the Fairwood neighborhood was improved.

Based on Drainage Issue No. 16 analysis results, the improved outfall channel from the Fairwood subdivision into Sundance Park appears to have adequate capacity to nearly convey the 100-year flows originating from the Fairwood subdivision.

Alternatives were not developed for this drainage issue because the outlet channel has adequate capacity to convey 100-year runoff originating from the subdivision.

8.4.4.2 Drainage Issue No. 18 and 19 – 71st Avenue/73rd Avenue - Peoria Avenue to Mountain View Road

Drainage Issue No. 18 is associated with storm water runoff from Peoria Avenue east of 71st Avenue and from 71st Avenue concentrating and overtopping the median curb along the south side of Peoria Avenue. Flows in the frontage road overtop the south curb and enter front yards. Wave action from vehicles causes some flooding. Storm water runoff flows to 73rd Avenue and then to Mountain View Road. A drainage outfall channel from the Leith Lane cul-de-sac collects sediment and debris, which backs up runoff and creates an odor and vector issue. The well site at 7021 West Peoria Avenue does not have a connection for discharge.

Drainage Issue No. 19 is related to runoff accumulating in 73rd Avenue from North Lane to Mountain View Road. This results in storm water ponding on 73rd Avenue at the intersection of Mountain View Drive.

Three alternatives were developed to address Drainage Issues No. 18 and 19. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as the evaluation matrix refer to the Drainage Issue No. 18 and 19 report included in **Appendix F.15 Drainage Issues No. 18 and 19 Report**. Based

on the scoring completed during the alternatives evaluation workshop, Alternative 1 was selected as the preferred alternative for Drainage Issue No. 18 and 19. The final total score and ranking of the proposed solution is presented in **Table 8.14 – Drainage Issues No. 18 and 19 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	7.15	1
Alternative 2	7.05	2
Alternative 3	5.95	3

Table 8.14 – Drainage Issues No. 18 and 19 Alternatives Evaluation Results

Preferred Alternative – This is mostly a conveyance alternative that includes a continuous storm drain on 71st Avenue between Cholla Street and Mountain View Road and on Mountain View Road between 71st Avenue and the Hayes Park retention basin. This alternative does not include adding any additional storage facilities except the consideration of potentially needing to increase the storage capacity of the Hayes Park retention basin. The proposed facility sizes for this alternative are shown in **Table 8.15 – Drainage Issues No. 18 and 19 Proposed Facilities** below.

Location	Facility Size
71st Ave, Cholla Road to Peoria Ave	60-Inch Diam.
71st Ave, Peoria Avenue to Cheryl Drive	60-Inch Diam.
71st Ave, Cheryl Drive to Mountain View Road	72-Inch Diam.
Mountain View Road, 71st Avenue to Hayes Basin	72-Inch Diam.
73rd Ave, Cheryl Drive to Mountain View Road	54-Inch Diam.
Leith Lane Outlet	18-Inch Diam.

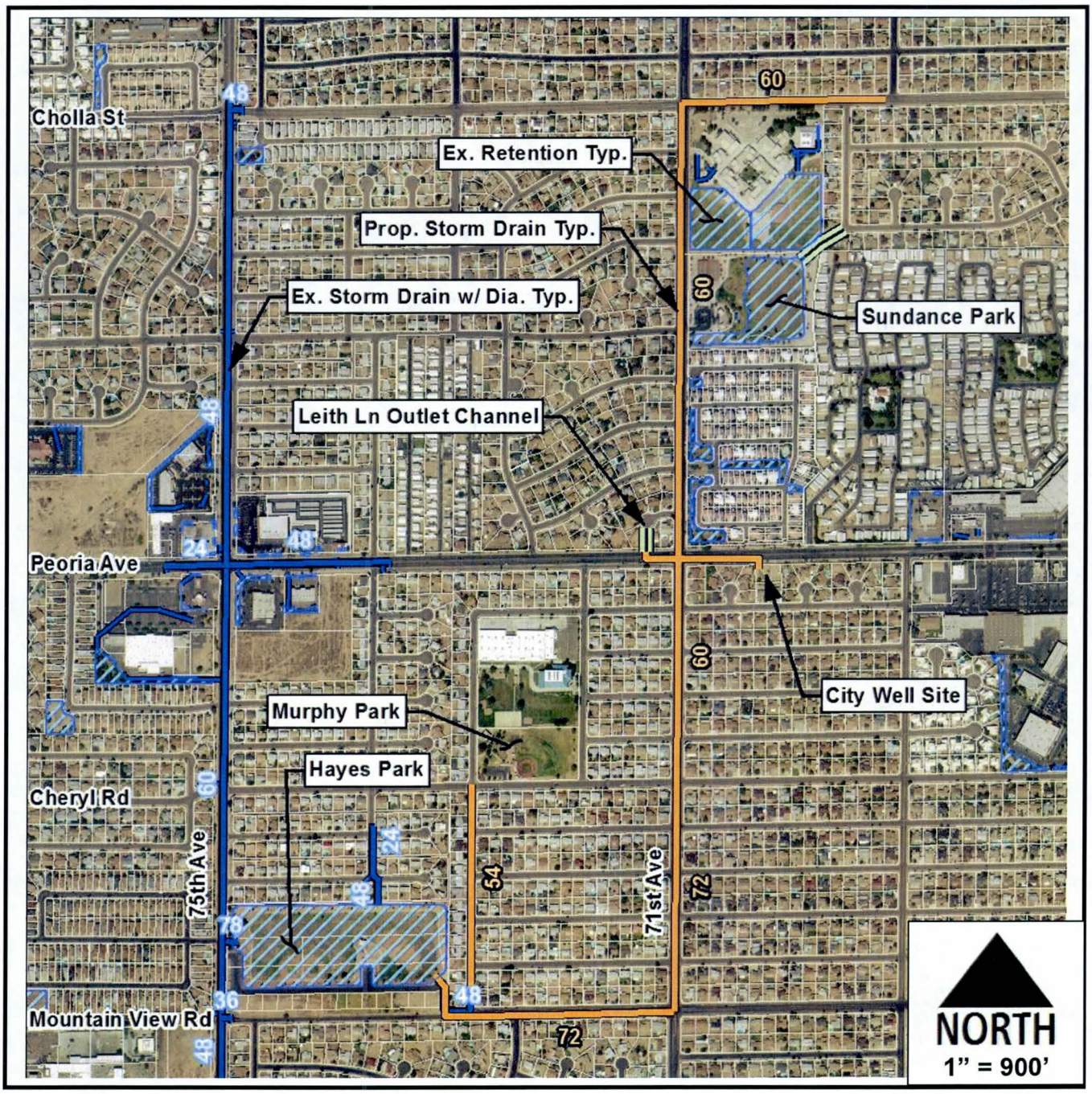
Table 8.15 – Drainage Issues No. 18 and 19 Proposed Facilities

Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.13 – Drainage Issues No. 18 and 19 Preferred Alternative** on the next page.

Figure 8.13 – Drainage Issues No. 18 and 19 Preferred Alternative

Drainage Area: 4
Drainage Issue ID: 18 & 19

Alternative No: 1
Alternative Type: Conveyance



Cost

- Construction ..... $ 5,238,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 16,500

Advantages

- No right of way acquisition.
- No impacts to existing park facilities.
- Minimizes construction on Peoria Ave.
- Eliminates flow heading south on 71st Ave from Mountain View Road.

Disadvantages

- May increase runoff volume to Hayes Park Basin, which may reduce the storm frequency at which the basin would overtop.
- Construction of large storm drains would require road closures and longer construction duration.

8.4.4.3 Drainage Issue No. 25 – 103rd Avenue – Northern Avenue to Olive Avenue

The Master Drainage plans calls for storm drains in the vicinity of 103rd Avenue draining into a storm drain along Northern Avenue and discharging into New River. In addition to the storm runoff, there is a groundwater well in this area that the City desires to connect to the storm drain. Also, a portion of the north part of the Country Meadows development does not have an adequate outfall and may need to be collected by the 103rd Avenue drainage system. The City is planning to improve 103rd Avenue from Olive to Northern Avenues and wants to know the size of improvements that should be constructed as part of these improvements.

Three alternatives were developed to address Drainage Issues No. 25. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as the evaluation matrix refer to the Drainage Issue No. 25 report included in **Appendix F.16 Drainage Issue No. 25 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 3 was selected as the preferred alternative for Drainage Issue No. 25. The final total score and ranking of the proposed solutions is presented in **Table 8.16 – Drainage Issue No. 25 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	7.05	2
Alternative 2	6.85	3
Alternative 3	7.10	1

Table 8.16 – Drainage Issue No. 25 Alternatives Evaluation Results

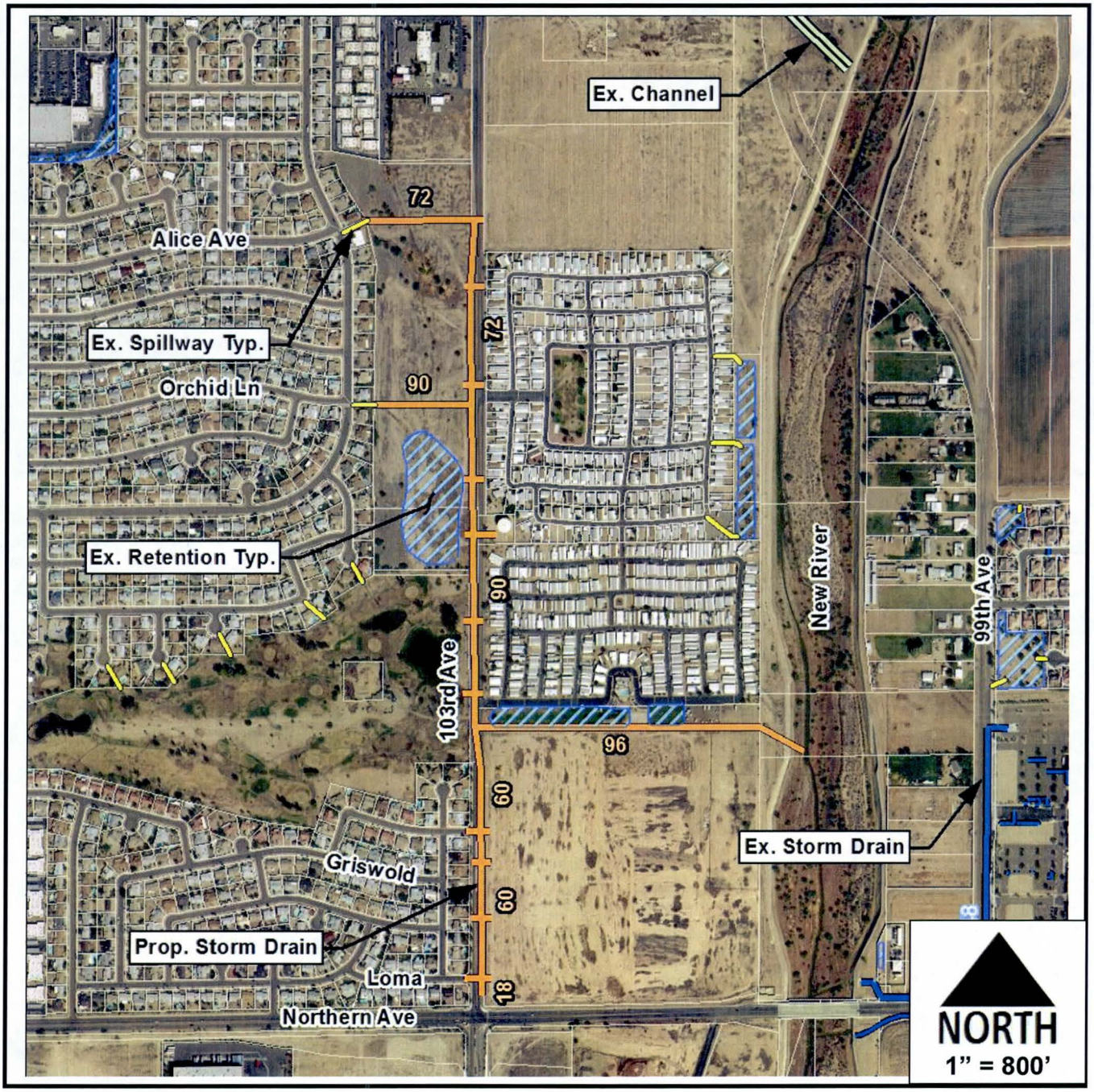
Preferred Alternative – This alternative consists of a single drainage system that conveys flows into the New River via a storm drain. This alternative will require the construction of a new culvert through the New River levee. Disturbance to the levee and discharge of unretained flows directly into the river may have some permitting and liability issues. However, a conveyance facility is more compatible with a power transmission line than a storage facility. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.14 – Drainage Issue No. 25 Preferred Alternative** on the next page.

After the City's internal discussion regarding this drainage issue, it was decided that as part of this study, none of the proposed alternatives would be advanced in the design phase of this project. This drainage issue is being addressed under a City of Peoria 103rd Avenue Roadway Improvement project.

Figure 8.14 – Drainage Issue No. 25 Preferred Alternative

Drainage Area: 4
Drainage Issue ID: 25

Alternative No: 3
Alternative Type: Conveyance



Cost

- Construction ..... $ 5,000,000
- Right-of-Way ..... $ 27,000
- Annual Maintenance ..... $ 18,000

Advantages

- More compatibility with Power Line Easement.
- No temporary infrastructure along Northern Ave. (Independent of improveme at Northern).

Disadvantages

- Requires new levee crossing structure and permits and potential liability associated with construction through levee.
- South portion of storm drain goes against grade.

8.4.4.4 Drainage Issue No. 31 – 71st Avenue and Olive Avenue Intersection

Flooding occurs at the intersection of Olive Avenue and 71st Avenue. Flooding extends north along 71st Avenue and inundates the Sunnyslope Park parking lot. Surface flows enter the Sunnyslope regional retention basin and cause erosion of the side slopes of the basin. The City has bermed the perimeter of the basin and concentrated the flows at locations where erosion protection was installed.

Two alternatives were developed to address Drainage Issues No. 31. In general, the base alternatives were developed to mitigate the 10-year storm event. For detailed descriptions of the alternatives analysis as well as evaluation matrix refer to the Drainage Issue No. 31 report included in **Appendix F.17 Drainage Issue No. 31 Report**. Based on the scoring completed during the alternatives evaluation workshop, Alternative 1 was selected as the preferred alternative for Drainage Issue No. 31. The final total score and ranking of the proposed solutions is presented in **Table 8.17 – Drainage Issue No. 31 Alternatives Evaluation Results** below.

Description	Total Score	Rank
Alternative 1	7.50	1
Alternative 2	6.80	2

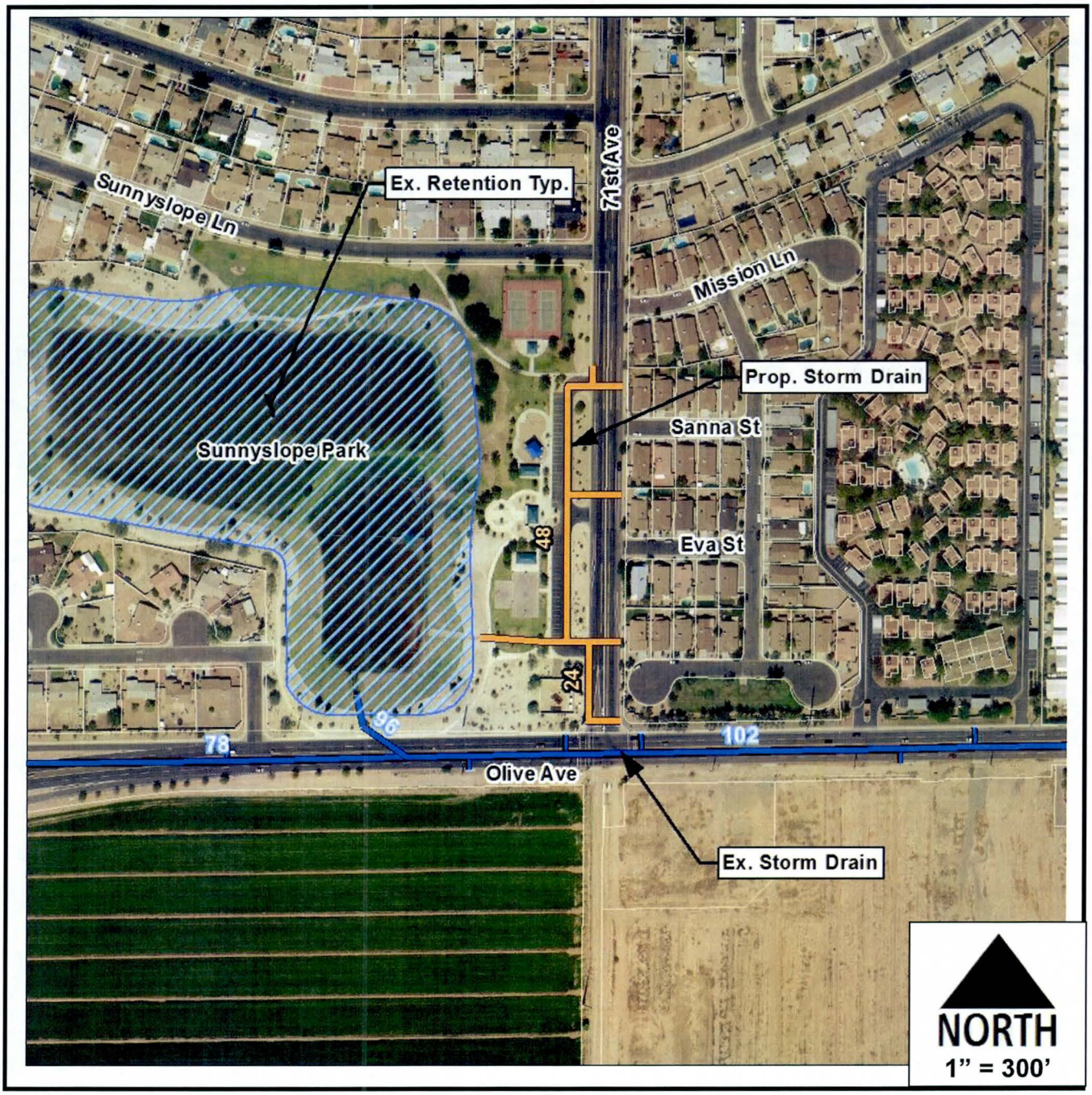
Table 8.17 – Drainage Issue No. 31 Alternatives Evaluation Results

Preferred Alternative - This alternative consists of constructing a storm drain through the Sunnyslope Park parking lot and extending into 71st Avenue to drain the roadway more efficiently and intercept the flows in 71st Avenue before they reach the Olive Avenue intersection. This storm drain will discharge directly into the Sunnyslope Park regional retention basin. Alternately, to ease the impact of nuisance flows and maximize the effectiveness of the regional retention basin, this storm drain could be connected to the Olive Avenue storm drain or a bypass drain installed to the basin outlet. This alternative should alleviate potential sheet flow through the park facilities on the east side of the basin. Proposed drainage facilities, costs, advantages, and disadvantages for the preferred alternative are shown on **Figure 8.15 – Drainage Issue No. 31 Preferred Alternative** on the next page.

Figure 8.15 – Drainage Issue No. 31 Preferred Alternative

Drainage Area: 4
Drainage Issue ID: 31

Alternative No: 1
Alternative Type: Conveyance



Cost

- Construction ..... $ 404,000
- Right-of-Way ..... $ 0
- Annual Maintenance ..... $ 1,760

Advantages

- Limited disruption of traffic on Olive Avenue during construction.
- Limited utility conflicts.

Disadvantages

- Direct nuisance flows directly into the basin (wet conditions more often).
- On line condition may reduce capacity for offline flows.
- Disruption of parking lot during construction.

8.5 CONCLUSIONS AND RECOMMENDATIONS

The main goal of Peoria SDMP is to identify drainage issues and develop alternatives to mitigate flooding issues throughout the project area. The primary focus of this task was to present and identify the preferred solution for each drainage issue. The preferred alternatives were selected during a two day interactive workshop held at the City of Peoria on May 7th and 8th, 2013. Proposed alternatives for each drainage issue were evaluated and ranked by project team members based on well established criteria. Key evaluation criteria that were used to select the preferred solution were construction cost, disturbance, acceptance, reliability, feasibility, multi-use opportunities, and others key factors. The preferred solutions selected by the project team during the alternatives evaluation workshop were advanced further in the design phase of this project. The results of the preferred alternative selection workshop were described in the previous subsection and are summarized in the **Table 8.18 – Alternatives Evaluation Workshop Results** below.

	Drainage Issue	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
		[Rank]				
Area 1 & 2	DI 2	3	2	1	4	NA
	DI 3	2	4	5	3	1
	DI 4	3	2	1	NA	NA
	DI 6	4	2	1	3	NA
	DI 6A	2	3	4	1	NA
Area 3	DI 5, 8, 32, 33	1	2	NA	NA	NA
	DI 9	1	4	3	2	NA
	DI 10	1	3	2	4	NA
	DI 12	3	2	1	NA	NA
	DI 15	2	3	1	4	NA
	DI 30	2	1	3	NA	NA
	DI 34	3	1	4	5	2
Area 4	DI 16	NA	NA	NA	NA	NA
	DI 18, 19	1	2	3	NA	NA
	DI 25	2	3	1	NA	NA
	DI 31	1	2	NA	NA	NA

Table 8.18 – Alternatives Evaluation Workshop Results

In the event that the preferred alternative becomes unfeasible the next highest ranking alternative should be considered, especially when there are alternatives that scored very close to each other. If none of the remaining alternatives are acceptable, it may be necessary to repeat the alternatives formulation and evaluation process for that location.

SECTION 9. RECOMMENDED STORM DRAINAGE MASTER PLAN

9.1 CONCEPTUAL DESIGN PLANS (15%)

The purpose of this section is to present the recommended Peoria Storm Drain Master Plan conceptual design plans. This was accomplished by refining the design for the preferred alternatives identified in **Section 8 Alternatives Formulation and Evaluation**. This entailed further refinement of items such as, preliminary design and probable cost. In addition, the 15 percent conceptual design plans include proposed facility sizes, slopes, horizontal and vertical alignments, major utilities and other key features for specific solutions. It is important to note that the storm drain pipes shown in the conceptual design plans are the main trunk lines of the selected drainage solutions. It is expected that at a later design phase additional analysis will be performed for each proposed solution to design and include a storm drain collection system in the upstream part of the contributing drainage area. Also, it is important to note that the Hydraulic Grade Line (HGL) is not shown on the conceptual plans since it coincides with the top of pipe unless otherwise noted on the plans. This occurs for Drainage Issues 18 & 19 (73rd Avenue from Mountain View Road to Cheryl Drive) and along Peoria Avenue from 91st Avenue to 77th Avenue.

The conceptual design plans include a few deviations from the proposed alternatives as presented in **Section 8 Alternatives Formulation and Evaluation**. The deviations are as follows:

- **Drainage Issues No. 18 and 19**: some of the large diameter single pipes were replaced with equivalent area twin pipes in order to achieve profiles that worked with existing sewer lines.
- **Drainage Issues No. 9 and 10**: additional retention areas were added in the existing City parks adjacent to the specific drainage issue in order to achieve the needed retention volumes.
- **Drainage Issue No. 6A**: due to limited right-of-way the channel concept of the preferred alternative was replaced with a 36-inch storm drain.
- **Drainage Issue No. 12**: the 12" storm drain along 85th Avenue was changed to a 36" storm at the City's request to facilitate the possibility of providing future drainage improvements for other locations in the 85th Avenue and Grand Avenue area.
- **Drainage Issue No. 34**: The preferred alternative for Drainage Issue No. 34 was modified due to changes associated with potential future redevelopment plans for the City of Peoria downtown area. A detailed description of the analysis performed as part of these changes is includes in the Drainage Issue No. 34 Addendum in **Appendix F.13 Drainage Issue No. 34 Report**. As a result of the above mentioned update, the proposed storm drain along Mountain View Road was extended upstream to 85th Avenue and a new proposed 36-inch storm drain pipe was added along 87th Avenue from Monroe Street to Mountain View Road.

In addition, at the City's request a 24-inch bleed-off connection was included to connect the City Complex to the proposed storm drain at the intersection of Mountain View Road and 85th Avenue.

Exhibits of the conceptual design plans (15%) for the selected alternatives are shown in **Appendix G.1 Conceptual Design Plans (15%)**.

9.2 PROBABLE PROJECT COST

As mentioned earlier, the cost estimate for the selected alternatives were updated to reflect the 15 percent conceptual design plans. The final probable cost for each proposed drainage alternative includes construction, land acquisition, relocation of known utility conflicts, and engineering (estimated at 10% of the construction cost). In addition, contingencies were included in the probable cost to account for engineering, administration, variable unit prices and other unforeseen items. The final estimated cost for all the selected alternatives, based on the 15 percent design conceptual plans are shown in **Table 9.1 – Preferred Alternatives Estimated Cost**. Backup documentation can be found in **Appendix G.2 Probable Project Cost**.

For the 15 percent conceptual design plans, existing facilities for all utility companies with known facilities in the area were requested. However, only the City of Peoria provided any information on their existing facilities. The City indicated that due to the level of design of these conceptual design plans, significant effort should not be exerted to obtain information from these utility companies. Therefore, when a more detailed design is performed and more existing utility information is obtained, some modifications to the alignments may be necessary to avoid existing utility facilities.

Problem Area	Drainage Issue	Probable Project Cost
Areas 1 & 2	Drainage Issue No. 2	$4,500
	Drainage Issue No. 3	$511,000
	Drainage Issue No. 4	$1,905,500
	Drainage Issue No. 6	$283,500
	Drainage Issue No. 6A	$221,500
Area 3	Drainage Issue No. 5, 8, 32 & 33	$5,404,500
	Drainage Issue No. 9	$1,578,000
	Drainage Issue No. 10	$643,500
	Drainage Issue No. 12	$284,000
	Drainage Issue No. 15	$220,500
	Drainage Issue No. 30	$409,000
	Drainage Issue No. 34	$2,278,000
Area 4	Drainage Issue No. 16	N/A
	Drainage Issue No. 18 & 19	$5,726,000
	Drainage Issue No. 25	N/A
	Drainage Issue No. 31	$385,000
Additional Master Planned Facilities	Cholla St & 83rd Ave to Peoria Ave	$7,683,500
	Grand Avenue in Network 3010	$2,051,000
	87th Avenue in Network 3012	$380,000

Table 9.1 – Preferred Alternatives Estimated Cost

9.3 PRIORITIZATION PLAN

The prioritization plan was developed as a guide to aid the City in prioritizing and implementing the drainage improvements identified in this study. The implementation of drainage improvements were prioritized based upon benefit, need, safety, cost, time of anticipated development, and other criteria and benefits, not necessarily listed in order of importance. Additionally, the timing of construction for the drainage improvements proposed in this study is highly affected by the timing of future roadway improvements, utility improvements, other agencies projects, and future developments. The need to construct from downstream to upstream played a major part in the prioritization as well. All the drainage improvements, listed from highest to lowest priority, are presented in **Table 9.2 – Drainage Improvements Prioritization Plan**.

In general, due to the large area of benefit, drainage improvements that include regional solutions were given the highest priority under the prioritization plan. For instance, the drainage improvements near Peoria Avenue and 83rd Avenue were ranked high as they complement the existing drainage infrastructure and provide flood protection for a large urban area. Improvements that were proposed as part of a specific drainage issue are listed together in **Table 9.2 – Drainage Improvements Prioritization Plan**. However, to facilitate their placement into the City of Peoria Capital Improvement Program (CIP), major components of the proposed drainage improvements could be broken down into separate projects or construction phases.

The drainage improvements cost and prospective funding source were important factors taken into consideration in the prioritization plan for Peoria SDMP. Based on this, future improvements were placed into four main classes that are described below and are presented graphically in **Figure 9.1 – Potential Funding Sources for Master Plan Improvements**. Also, **Figure 9.3 – Recommended Storm Drain Master Plan Infrastructure** shows all the proposed improvements for the Peoria Storm Drain Master Plan.

1. Drainage improvements to be funded by the City Obligation Bonds.

2. Major drainage improvements to be funded with other funding partners (FCDMC, ADOT, other cities, etc). It was assumed that partner's contribution to project cost would cover 50% of the construction cost.

3. Small drainage improvements to be funded through FCDMC Small Projects Assistance Program. Based on Small Project Assistance Program Intergovernmental Agreement, District contributions to project costs are limited to 75% of the construction cost, or $250,000, whichever is less.

4. Drainage improvements to be funded by others (not the City of Peoria). It was assumed that project partner's contribution would cover the entire construction cost.

Based on the above-mentioned criteria, the drainage improvements identified in this study were classified as high, medium or low priority. With the exception of improvements that are already in the City of Peoria CIP for fiscal years 2014-2023, the

priority ranking was used to group drainage improvements into specific implementation time intervals (see **Figure 9.2 – Prioritization Schedule of Master Plan Improvements for Capital Improvement Program**), where the high priority improvements were selected to be constructed first. Also, to facilitate the funding and to create a more realistic future project implementation schedule, some of the improvements that were ranked high were placed in a later time interval. For instance, improvements associated with Drainage Issues No. 18 and 19 that were identified as high priorities were placed in the second time interval between the years 2019 and 2023. The implementation time interval for the improvements that were identified as future projects in the CIP was not changed.

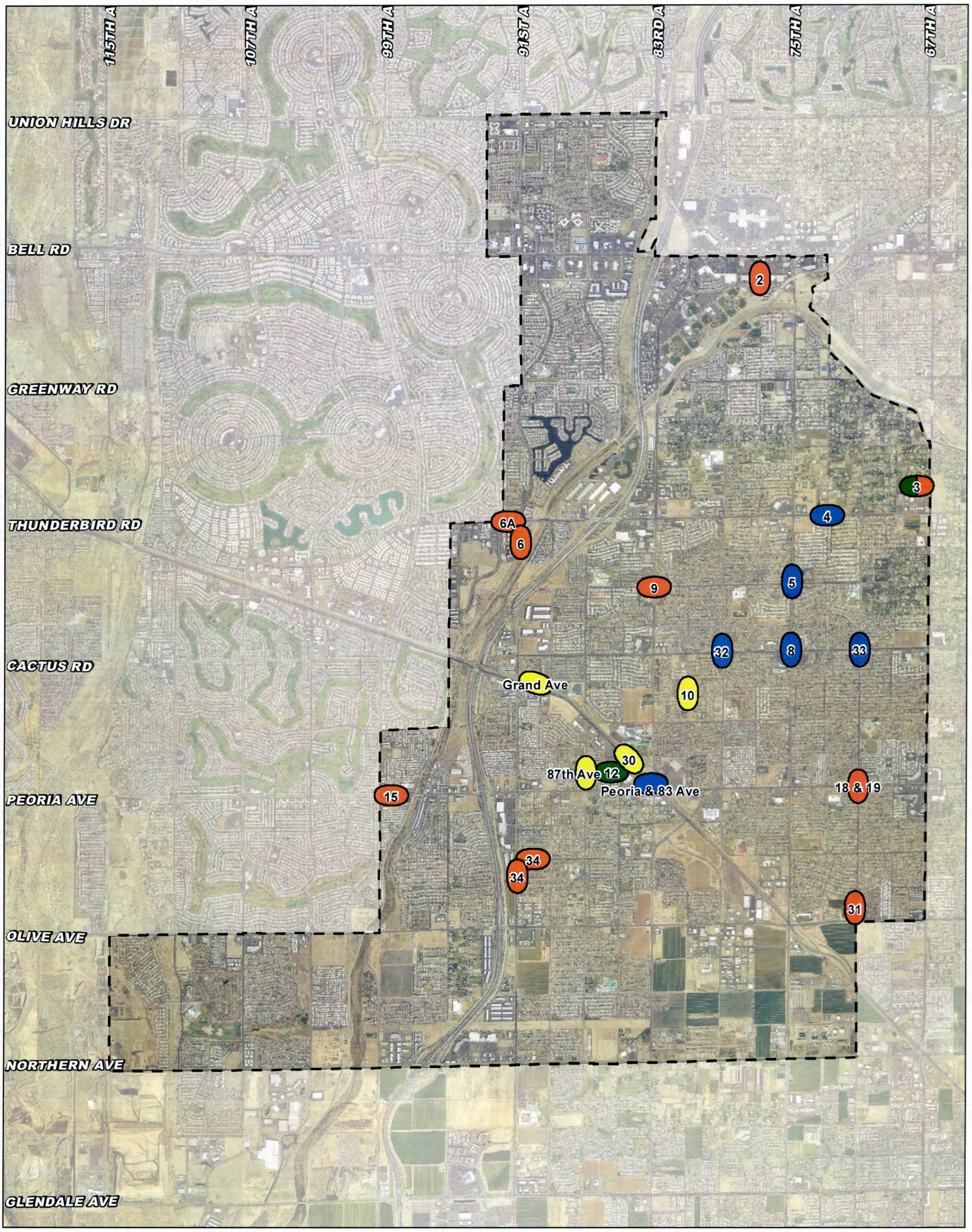
Table 9.2 Drainage Improvements Prioritization Plan

Drainage Issue	Street	Location	Type	Nominal Size	Length / Volume	Budgetary Cost	Partner Cost	City Cost	Funding Category	Priority	Notes	Construction Year
DI 5, 8, 32, 33 - Sweetwater Park and Intersection of Cactus Rd with 71st Ave, 75th Ave and 79th Ave	75st Ave	Sweetwater Ave to Cactus Rd	Pipe	66, 78	1345, 1344	$ 1,760,500	$ 880,250	$ 880,250	2	High	Related CIP project-75th Ave & Cactus Rd Intersection Improvements (EN00088). Provides flood protection for a relatively large area.	2014
	75st Ave	Sweetwater Park Lateral Pipe	Pipe	12	40	$ 10,500	$ 5,250	$ 5,250	2	High	Provides flood protection for a relatively large area.	2014-2018
	Cactus Rd	71st Ave to 75th Ave	Pipe	48	2667	$ 912,000	$ 456,000	$ 456,000	2	High	Related CIP project-75th Ave & Cactus Rd Intersection Improvements (EN00088). Provides flood protection for a relatively large area.	2014
	71st Ave	Sweetwater Ave to Cactus Rd	Pipe	60, 66	1340, 1363	$ 1,306,000	$ 653,000	$ 653,000	2	High	Provides flood protection for a relatively large area.	2014-2018
	79th Ave	Sweetwater Ave to Cactus Rd	Pipe	60, 72	1353, 1340	$ 1,416,500	$ 708,250	$ 708,250	2	High	Provides flood protection for a relatively large area.	2014-2018
DI 10 - Roosevelt St and 81st Ave	81st Ave	NW Corner of Roosevelt St and 81st Ave	Retention	Retention w/land [ac-ft]	2.9	$ 385,500	$ 289,125	$ 96,375	3	Medium	Land acquisition for new retention might be time sensitive. Provides flood protection for a small local area. Due to the nature and cost of the drainage solution could be a good fit for FCDMC Small Project Assistance Program	2014-2015
	81st Ave	North of Roosevelt St	Pipe	48	613	$ 258,000	$ 193,500	$ 64,500	3	Medium	Provides flood protection for a small local area. Due to the nature and cost of the drainage solution could be a good fit for FCDMC Small Project Assistance Program	2014-2015
Peoria Ave and 83rd Ave	Cholla St	Northwest of 83rd Ave	Retention	Retention w/land [ac-ft]	16	$ 1,734,000	$ 867,000	$ 867,000	2	High	Land acquisition for new retention might be time sensitive. Provides flood protection for a relatively large area.	2014-2018
	Cholla St	76th Ave to 83rd Ave	Pipe	36, 60	1185, 2840	$ 1,574,000	$ 787,000	$ 787,000	2	High	Provides flood protection for a relatively large area.	2014-2018
	Peoria Ave	85th Ave to 91st Ave	Pipe	48	4110	$ 1,459,500	$ 729,750	$ 729,750	2	High	Provides flood protection for a relatively large area.	2014-2018
	Peoria Ave	77th Ave to 130ft Southeast of 83rd Ave	Pipe	48	4457	$ 1,558,500	$ 779,250	$ 779,250	2	High	Provides flood protection for a relatively large area.	2014-2018
	Peoria Ave	Northeast of 77th Ave	Retention	Retention w/land [ac-ft]	8	$ 925,000	$ 462,500	$ 462,500	2	High	Land acquisition for new retention might be time sensitive. Provides flood protection for a relatively large area.	2014-2018
	77th Ave	Hope Dr to 460 ft North of Peoria Ave	Pipe	36, 42	355, 1107	$ 434,500	$ 217,250	$ 217,250	2	High	Provides flood protection for a relatively large area.	2014-2018
87th Ave	87th Ave	Mescal St to Peoria Ave	Pipe	36	1473	$ 380,000	$ 285,000	$ 95,000	3	Medium	Provides flood protection for a small local area. Due to the nature and cost of the drainage solution could be a good fit for FCDMC Small Project Assistance Program	2014-2018
DI 34 - Mountain View Rd - 91st Ave to 89th Ave	91st Ave	Mountain View Rd to Loop 101 Channel	Pipe	60	1586	$ 652,000	$ -	$ 652,000	1	Medium	Related CIP project-91st Ave Street and Drainage Improvement (EN00177). Provides flood protection for a medium size area.	2014
	87th Ave	Monroe St to Mountain View Rd	Pipe	36	913	$ 368,250	$ -	$ 359,750	1	Medium	Related CIP project-Mountain View Rd Drainage; 91st Ave to 89th Ave (EN00130). Provides flood protection for a medium size area.	2021
	Mountain View Rd	85 Ave to 91st Ave	Pipe	24, 36, 48, 60	82, 1326, 2306, 187	$ 1,275,000	$ -	$ 1,266,500	1	Medium	Related CIP project-Mountain View Rd Drainage; 91st Ave to 89th Ave (EN00130). Provides flood protection for a medium size area.	2021
DI 2 - 77th Ave and Paradise Ln	77th Ave	Arrowhead Crossing Center Parking - Lateral Piping	Pipe	8	20	$ 4,200	$ -	$ 4,200	1	Low	Very inexpensive solution. Provides flood protection for a small local area.	2014-2018
DI 18, 19 - 71st Ave/73rd Ave - Peoria Ave to Mountain View Rd	71st Ave	Cholla St to Peoria Ave	Pipe	2x42, 2x36	1430, 1304	$ 1,607,000	$ -	$ 1,607,000	1	High	Provides flood protection for a relatively large area.	2019-2023
	71st Ave	Peoria Ave to Cheryl Dr	Pipe	2x42	1320	$ 933,000	$ -	$ 933,000	1	High	Provides flood protection for a relatively large area.	2019-2023
	71st Ave	Cheryl Dr to Mountain View Rd	Pipe	2x54	1300	$ 1,098,500	$ -	$ 1,098,500	1	High	Provides flood protection for a relatively large area.	2019-2023
	Mountain View Rd	71st Ave to Hayes Basin	Pipe	2x54, 72	1469, 224	$ 1,329,500	$ -	$ 1,329,500	1	High	Provides flood protection for a relatively large area.	2019-2023
	73rd Ave	Cheryl Dr to Mountain View Rd	Pipe	54	1370	$ 557,500	$ -	$ 557,500	1	High	Provides flood protection for a relatively large area.	2019-2023
	Peoria Ave	Leith Ln Outlet	Pipe	18	179	$ 74,500	$ -	$ 74,500	1	High	Provides flood protection for a relatively large area.	2019-2023
	Peoria Ave	City Well Discharge Pipe	Pipe	18	589	$ 130,000	$ -	$ 130,000	1	High	Provides flood protection for a relatively large area.	2019-2024
DI 4 - 72nd Ave and Redfield Rd - Weedville Well Waste Discharge	Acoma Dr	NW Corner of Acoma Dr and 73rd Ave	Retention	Retention w/land [ac-ft]	5	$ 712,500	$ 356,250	$ 356,250	2	Medium	Land acquisition for new retention might be time sensitive. Provides flood protection for a relatively large area. Some of the protected area is within unincorporated Maricopa County Limits	2019-2023
	Acoma Dr	East of 71st Ave to New Ret Basin	Pipe	36, 48	700, 856	$ 497,000	$ 248,500	$ 248,500	2	Medium	Provides flood protection for a relatively large area. Some of the protected area is within unincorporated Maricopa County Limits	2019-2023

Drainage Issue	Street	Location	Type	Nominal Size	Length / Volume	Budgetary Cost	Partner Cost	City Cost	Funding Category	Priority	Notes	Construction Year
DI 4 - 72nd Ave and Redfield Rd - Weedville Well Waste Discharge	71st Ave	Hearn Rd to Thunderbird	Pipe	30	1354	$ 293,000	$ 146,500	$ 146,500	2	Medium	Provides flood protection for a medium size area. Some of the protected area is within unincorporated Maricopa County Limits	2019-2023
	72nd Ave, Redfield Rd, 73rd Ave	Watson Ln to Thunderbird Rd	Pipe	30, 36	781, 947	$ 403,500	$ 201,750	$ 201,750	2	Medium	Provides flood protection for a medium size area. Some of the protected area is within unincorporated Maricopa County Limits	2019-2023
DI 9 - 83rd Ave - Sweetwater Ave to Corrine Dr	Sweetwater Ave	SW Corner of Sweetwater Ave and 83rd Ave	Retention	Retention wo/land [ac-ft]	21.8	$ 1,068,500	$ -	$ 1,068,500	1	Medium	Provides flood protection for a medium size area.	2024-2028
	Sweetwater Ave	85th Ave to 500 ft east of 83rd Ave	Pipe	24, 30	2030	$ 372,500	$ -	$ 372,500	1	Medium	Provides flood protection for a medium size area.	2024-2028
	83rd Ave	Aster Dr to Sweetwater Ave	Pipe	30	660	$ 137,500	$ -	$ 137,500	1	Medium	Provides flood protection for a medium size area.	2024-2028
Grand Ave	North of Grand Ave	Varney Rd to 91st Ave	Pipe	54, 72	673, 2900	$ 2,051,000	$ 1,025,500	$ 1,025,500	2	Medium	Provides flood protection for a medium size area.	2024-2028
DI 6 - 91st Ave and Thunderbird Rd	91st Ave	91st Ave Outlet Channel	Channel	25	725	$ 283,000	$ -	$ 283,000	1	Low	Solves a maintenance issue	2024-2028
DI 6A - 91st Ave and Thunderbird Rd	91st Ave	Thunderbird Rd to Existing Channel	Pipe	36	600	$ 169,000	$ -	$ 169,000	1	Low	Provides flood protection for a medium size area.	2024-2028
	Thunderbird Rd	Plaza Town Center Entrance-Lateral Piping	Pipe	18	185	$ 86,500	$ -	$ 86,500	1	Low	Provides flood protection for a medium size area.	2024-2028
DI 31 - 71st Ave and Olive Ave Intersection	71st Ave	North of Parking Lot to Basin	Pipe	48, 60	565, 270	$ 349,000	$ -	$ 349,000	1	Low	Provides flood protection for a small local area.	2024-2028
	71st Ave	Olive Ave to South Parking Lot	Pipe	24	200	$ 36,500	$ -	$ 36,500	1	Low	Provides flood protection for a small local area.	2024-2028
DI 15 - Peoria Ave and 98th Ave	Peoria Ave	99th Ave to West of 98th Ave	Pipe	30, 54	791	$ 220,000	$ -	$ 220,000	1	Low	Provides flood protection for a small local area.	2024-2028
DI 30 - Grand Ave Southeast of Intersection at 85th Ave	Grand Ave	SE of 85th Ave	Retention	Retention w/land [ac-ft]	3	$ 390,000	$ 292,500	$ 97,500	3	Low	Provides flood protection for a small local area.	2024-2028
	Grand Ave	Proposed Retention to Existing Grand Ave Catch Basin	Pipe	8	158	$ 19,500	$ 14,625	$ 4,875	3	Low	Provides flood protection for a small local area.	2024-2028
DI 12 - Peoria Gardens Apartments at 85th Ave and Grand Ave	85th Ave	Peoria Gardens Apartments	Retention	Retention wo/land [ac-ft]	1	$ 135,000	$ 135,000	$ -	4	Low	Provides flood protection for a small local area.	2024-2028
	85th Ave	Peoria Gardens Apartments to Existing 85th Ave SD	Pipe	12, 36	766	$ 149,000	$ 149,000	$ -	4	Low	Provides flood protection for a small local area.	2024-2028
DI 3 - Redfield Rd West of 67th Ave	Redfield Rd	SE Corner of Redfield Rd and 67th Ave	Retention	Retention w/land [ac-ft]	2.1	$ 313,500	$ -	$ 313,500	1, 4	Low	Provides flood protection for a small local area.	2024-2028
	Redfield Rd	67th Ave West to Cul-de-suc	Pipe	30	928	$ 197,500	$ -	$ 197,500	1, 4	Low	Provides flood protection for a small local area.	2024-2028

Funding Category Description

1) Drainage improvements to be funded by City General Obligation Bonds
2) Major drainage improvements to be funded with other funding partners (FCDMC, ADOT, other cities, etc)
3) Small drainage improvements to be funded through FCDMC Small Projects Assistance Program
4) Drainage Improvements to be funded with others (not the City of Peoria)



LEGEND

Project Boundary

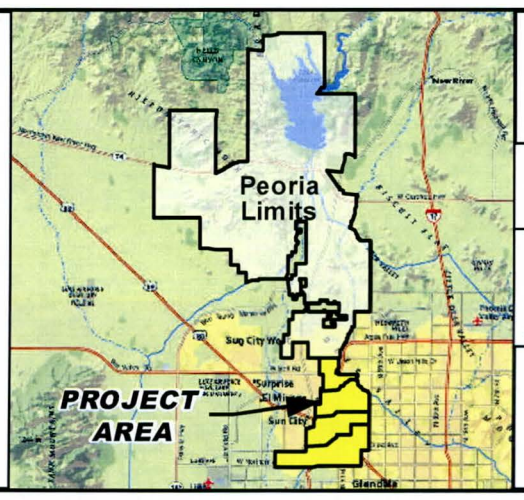
Drainage Issue Area Potential Funding Sources

1 - City General Obligation Bonds

2 - With Other Funding Partners

3 - FCDMC Small Projects Assistance Program

4 - By Others (Not the City of Peoria)



CITY OF PEORIA
PEORIA STORM DRAIN
MASTER PLAN

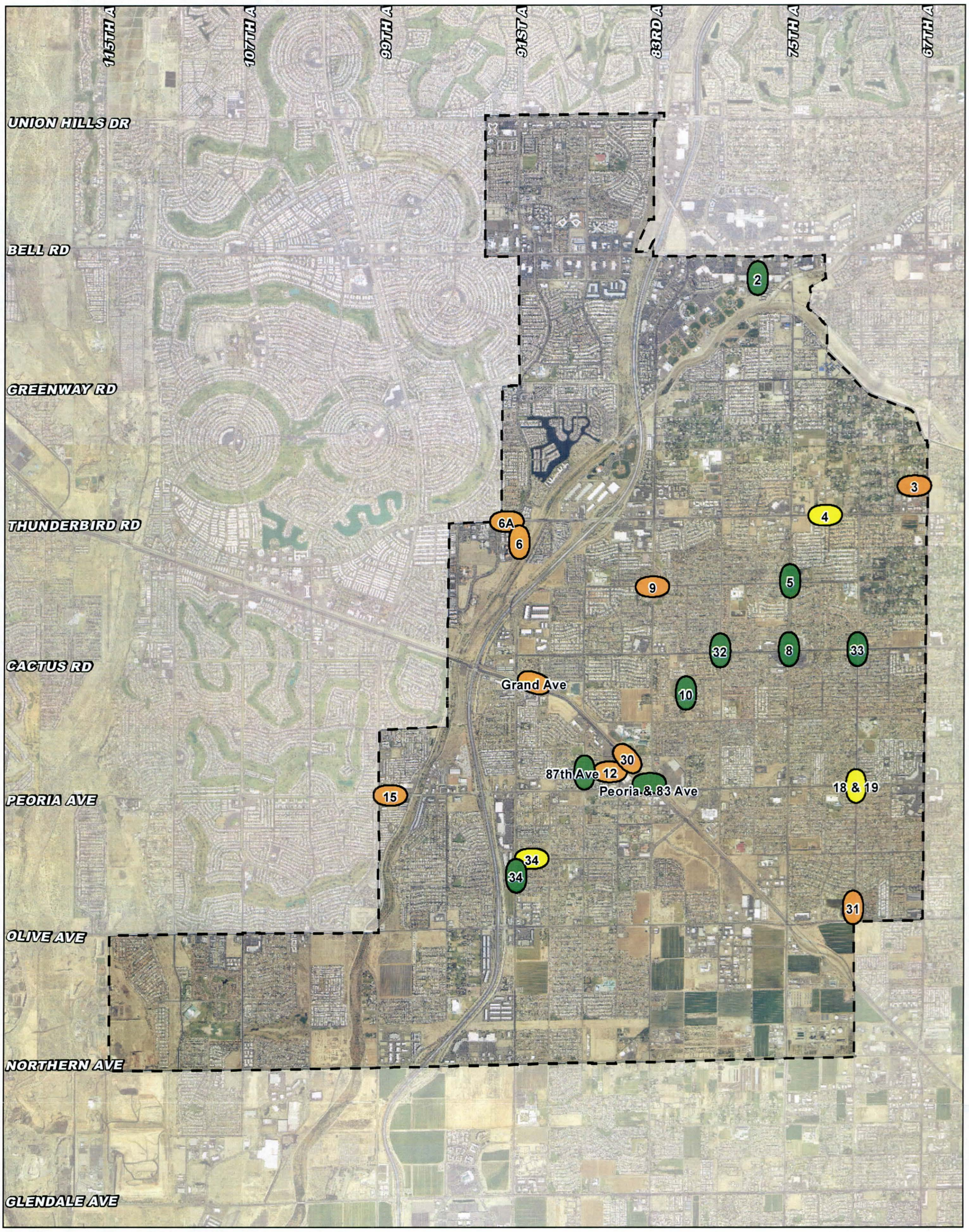
NORTH

0 0.5 1 Miles

Entellus
2255 N. 44th Street Suite 125
Phoenix, Arizona 85008.3299
Tel. 602.244.2566
Fax. 602.244.8947
Web. www.entellus.com

FIGURE 9.1

POTENTIAL FUNDING SOURCES
FOR MASTER PLAN IMPROVEMENTS

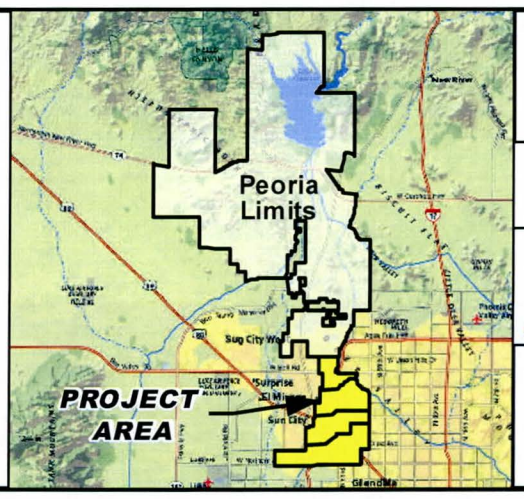


LEGEND

Project Boundary

Drainage Issue Area Prioritization Schedule

- 2014-2018
- 2019-2023
- 2024-2028



CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 0.5 1 Miles

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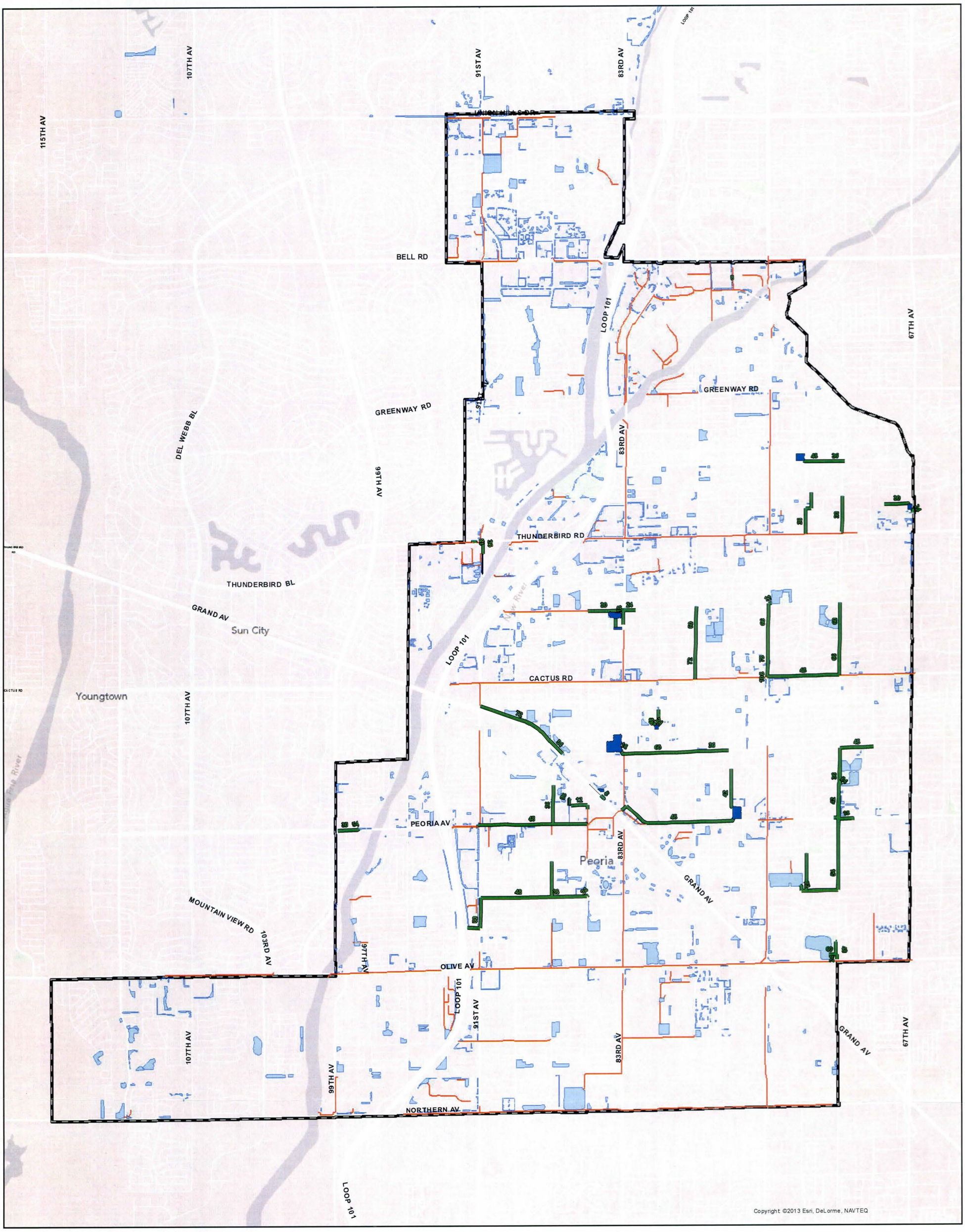
Web. www.entellus.com

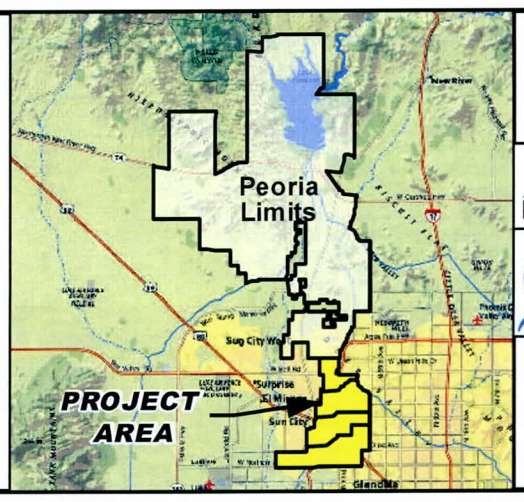
FIGURE 9.2

PRIORITIZATION SCHEDULE OF MASTER PLAN IMPROVEMENTS FOR CAPTIAL IMPROVEMENT PROGRAM



LEGEND

- Recommended Retention Basin
- Existing Retention Basin
- Recommended Storm Drain
- Existing Storm Drain Mains
- Project Boundary



CITY OF PEORIA
PEORIA STORM DRAIN MASTER PLAN

NORTH

0 3,500 7,000 Feet

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Phoenix, Arizona 85008.3299
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FIGURE 9.3
RECOMMENDED STORM DRAIN MASTER PLAN INFRASTRUCTURE

9.4 MASTER PLAN HYDROLOGIC MODELS

The existing conditions hydrologic models (see **Section 5 Base Hydrology Review and Analysis**) for the 10-year event for the 6-hr and 24-hr storm durations were modified based on the preferred alternatives from the alternatives evaluation (see **Section 8: Alternatives Formulation and Evaluation**). Several of the drainage issues were small localized occurrences that did not require modeling in HEC-1. Only those drainage issues that required the utilization of HEC-1 to analyze (drainage issues that are regionally significant) have been incorporated into the over-all Master Plan hydrologic models. Two additional modification areas related to **Section 7 Review of Original Storm Drain Master Plan** were also added to the Master Plan hydrologic models.

The drainage issues that have been incorporated into the various HEC-1 models are as follows:

Maryvale Model

- DI04 – 72nd Avenue & Redfield Road – Weedville Well Waste Discharge
- DI05, 08, 32, 33 – Sweetwater Park and Intersection of Cactus Road with 71st, 75th and 79th Avenues
- DI18, 19 – 71st Avenue/73rd Avenue - Peoria Avenue to Mountain View Road
- DI30 – Grand Avenue Southwest of Intersection at 85th Avenue
- Cholla Street & 83rd Avenue to Peoria Avenue (see **Section 7.5.1 Cholla Street & 83rd Avenue to Peoria Avenue**)
- Grand Avenue – ID134 & ID135 in Network 3010 (see **Section 7.4.7 Grand Avenue – ID134 & ID135 in Network 3010**)

Glendale/Peoria Model

- DI06 & 06A – 91st Avenue and Thunderbird Road

The model modifications specific to each of the drainage issues have been documented in the HEC-1 model Job Title Information records (ID cards) at the beginning of the HEC-1 model. There were several modifications made to the over-all HEC-1 models, in particular to the Maryvale models that were not necessary to make during the alternatives evaluation process. These additional modifications incorporated the smaller drainage issue models into the over-all Master Plan hydrology model and included such items as model logic modifications and additional minor subbasin modifications. In addition, only regionally significant proposed infrastructure (retention basins and storm drains crossing subbasin boundaries) were modeled in the HEC-1 models. Schematic drawings of the HEC-1 model modifications are provided in **Appendix G.3 Master Plan Hydrologic Models**.

Table 9.3 – Summary of Peak Discharges at Significant Locations summarizes the existing and proposed 10-year flows for a few key locations in the watershed. A complete summary table of all the peak discharges from the various models and a hard copy of portions of the 10-year, 6-hr models can be found in **Appendix G.3 Master Plan Hydrologic Models**. DDMSW reports and files of the modified subbasins can also be

found in **Appendix G.3 Master Plan Hydrologic Models** and digital versions of the HEC-1 models can be found on the Report DVD in **Appendix J**.

Location	HEC-1 ID	Existing Conditions		Proposed Conditions	
		10-Year 6-Hour	10-Year 24-Hour	10-Year 6-Hour	10-Year 24-Hour
Immediately downstream of DI-4 at the Intersection of Thunderbird Rd and 75th Ave	CTB75	441	390	169	150
Immediately downstream of DI-5,8,32,33 at the Intersection of Cactus Rd and 83rd Ave	CCT83	313	314	177	194
At the intersection of Peoria Ave and 83rd Ave	CPE83	284	290	116	117
At the intersection of Peoria Ave and 91st Ave	CPE91	244	261	331	300
At the intersection of Olive Ave and 75th Ave	CPOL75	388	493	400*	555*
At the intersection of Cactus Rd and 91st Ave	CCT91	NA	NA	640	744
At the intersection of Olive Ave and 91st Ave	CPOL91	446	454	460*	467*
At the intersection of Northern Ave and 83rd Ave	CNO83	303	349	303	349
At the intersection of Northern Ave and 91st Ave	CNO91	171	238	171	238
Immediately downstream of DI-5,8,32,33 at the Intersection of Cactus Rd and 83rd Ave	CCT83	313	314	177	194

Table 9.3 – Summary of Peak Discharges at Significant Locations

* Increases in flows in the proposed models along Olive Avenue (CPOL75 & CPOL91) are a result of modeling differences between the existing and proposed models in the 75th Avenue area. In this area there are two regional retention basins: Hayes Park on Mountain View Road and 75th Avenue, and the 71st Avenue retention basin on 71st Avenue and Olive Avenue. The existing conditions model assumes that 25% of the local subbasin (OL75) contributes to the Hayes Park basin and the remaining 75% of the subbasin contributes to the 71st Avenue retention basin. The proposed model further delineated the local subbasin (OL75) into eight smaller subbasins. Upon further analysis it was determined that one of these subdivided subbasins (OL75G) did not contribute to either retention basin, and instead directly contributed to CPOL75. This is not reflected in the existing conditions models and this is the main factor contributing to increased flows along Olive Avenue. This increase in flow attenuates downstream along Olive Avenue as can be seen by a minimal increase in flow at the intersection of Olive Avenue and 91st Avenue (CPOL91).

SECTION 10. DRAINAGE FACILITY OPERATION AND MAINTENANCE GUIDELINES

10.1 OPERATION AND MAINTENANCE GUIDELINES

Operation and maintenance guidelines were created to describe recommended maintenance activities for existing and proposed drainage improvements within the City of Peoria. This includes a description of the current level of maintenance provided for the drainage facilities, current equipment and regulatory requirements. These preliminary guidelines also include descriptions of the appropriate level of maintenance, sediment removal activities, specialized equipment required, and recommended maintenance intervals. These guidelines are presented in a "Standard Operating Procedure" format and have been compiled and developed with input from the City of Peoria maintenance and engineering staff. Costs associated with the recommended maintenance procedures are included and are presented as a "unit cost basis" and overall cost basis.

The full Operations and Maintenance document is include in **Appendix H.1 Operation and Maintenance Guidelines**.

10.2 STORMWATER POLLUTION MANAGEMENT REVIEW

The Storm Water Pollution Management review entailed reviewing the current City Stormwater Management Plan, current Municipal Separate Storm Sewer System (MS4) permit, and the existing City Code (Chapter 24). The purpose of this review was to determine if the current code gives the City the proper authority to enforce the regulations set forth by their current MS4 permit and their current Stormwater Management Plan (SWMP). Also, permits from other agencies were reviewed to determine if there are any additional activities and code modifications that may be necessary once the City receives their next MS4 permit.

A few minor deficiencies were found during the review and the report provides suggested language for the additions/revisions to the existing code that would give the City the authority to comply with the City's existing Stormwater Management Plan.

The full Storm Water Pollution Management report is included in **Appendix H.2 Storm Water Pollution Management Review**.