FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

LOWER INDIAN BEND WASH AREA DRAINAGE MASTER STUDY/PLAN

DATA COLLECTION REPORT

Contract No.: FCD 2011C019

February, 2013

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1.0 INTRODUCTION

1.1 PURPOSE OF STUDY

The purpose of the Lower Indian Bend Wash (LIBW) Area Drainage Master Study/Plan (ADMS/P) is to identify and quantify flooding hazards within the study area and develop alternative solutions to mitigating the flooding problems.

1.2 PURPOSE OF REPORT

The purpose of this report is to organize and summarize pertinent data collected for the LIBW ADMS/P.

1.3 STUDY AREA

The study area encompasses approximately 29 square miles and represents the watershed for the lower portion of Indian Bend Wash, hence the name *Lower* Indian Bend Wash. It is roughly bounded by Shea Boulevard on the north, Salt River on the south, and the ridgeline through the Papago Buttes, Camelback Mountain and Mummy Mountain on the west. On the eastern side it is bounded by Loop 101 (Pima Freeway) above the Arizona Canal and the ridgeline between Indian Bend Wash and Granite Reef Wash below the Arizona Canal.

The most prominent feature within the study area is Indian Bend Wash, which flows southerly through the middle of the watershed. Other significant features include the Arizona Canal, Papago Park, Camelback Mountain, Mummy Mountain and the lakes and golf courses throughout McCormick and Gainey Ranch.

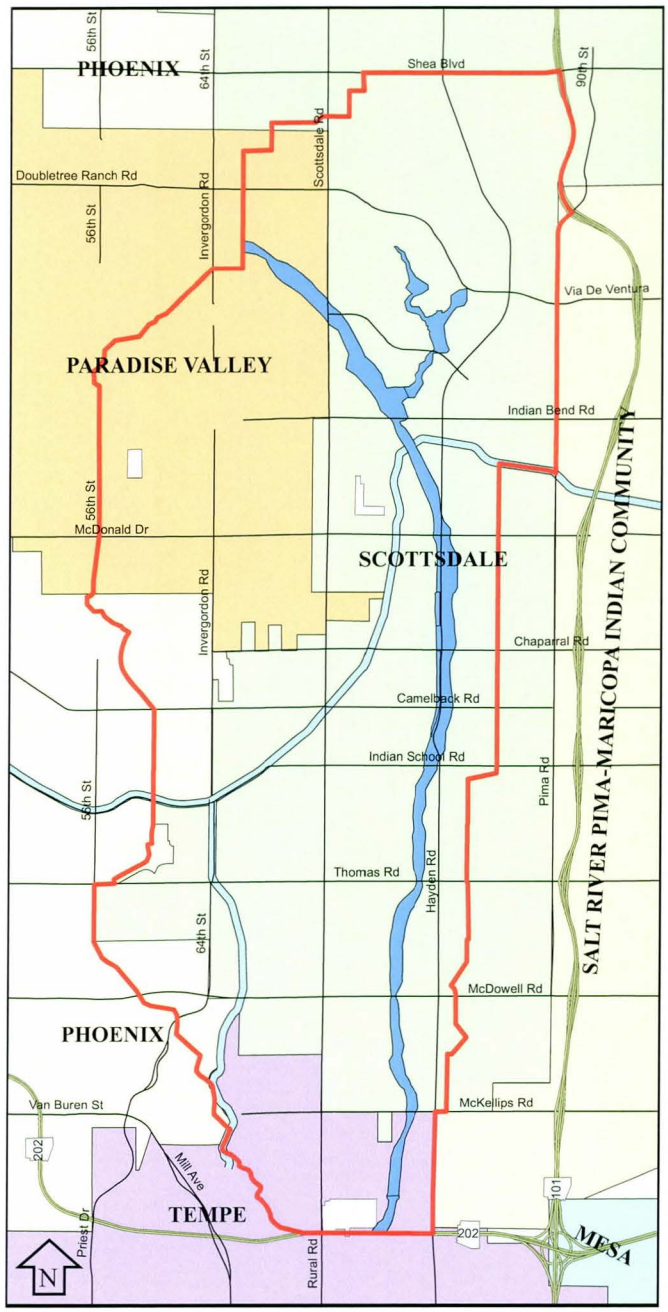


Figure-1: Study Area Map

1.4 SCOPE OF DATA COLLECTION EFFORT

The scope of work for the data collection effort includes the following:

- Research inventory and review existing studies, land data and City ordinances including topographic mapping, land use plans, drainage studies, FEMA studies & flood maps, landscape inventory data, recreation master plans and AZPDES storm sewer ordinances.
- Collect and review flooding complaints on file with the Cities
- Research and document photographs of past flooding events
- Obtain as-built plans of existing storm drains and use them to construct a GIS database that can be used to create SWMM models of the storm drain system.

2.0 TOPOGRAPHIC AND AERIAL MAPPING

The aerial topographic mapping for the LIBW ADMS/P was provided by the Flood Control District of Maricopa County (FCDMC). The topographic mapping is on the North American Vertical Datum (NAVD 88) and consists of two-foot contours. The mapping covers the area approximately bounded by the Loop 202 to the south, the Loop 101 to the east, Shea Boulevard to the north and Tatum Boulevard/56th Street to the west. The flight date for the aerial mapping was November 2nd, 2007.

3.0 FEMA MAPS AND DOCUMENTS

As part of the data collection effort for the LIBW ADMS/P, the latest (Revised September 30, 2005) Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMS) were obtained and reviewed. Letters of map amendment/revision (LOMA & LOMR) were also obtained to determine the FIRM changes that have occurred since the effective map date of September 30th, 2005.

3.1 FLOOD INSURANCE RATE MAPS (FIRMS)

The 29 square mile LIBW study area is spread across eight different flood insurance rate maps. The eight maps, FIRM panel numbers 04013C – 1680H, 1685F, 1690G, 1695H, 2155G, 2160H, 2165H & 02170G, show the study area has 5 separate floodplains plus areas of moderate to low risk flooding potential (shaded and unshaded Zone X). Refer to appendix B for an exhibit that shows all of the floodplains and floodways in the study area.

Indian Bend Wash Floodplain and Floodway

Indian Bend Wash (IBW) is the primary drainage way within the LIBW study area. It dissects the study area in two by flowing from north-to-south; entering the study area near the intersection of Doubletree Ranch Road and Invergordon Road in Paradise Valley and flowing into the Salt River (Tempe Town Lake) at the Red Mountain Freeway (Loop 202) and Miller Road. The effective floodplain delineation study of IBW was performed by Simons, Li & Associates, Inc in 1997, under contract to the FCDMC. This study resulted in a Letter of Map Revision (LOMR) for IBW. The detailed hydraulic analysis established the 100-year flood elevations and mapped the regulatory floodplain and floodway boundaries along the entire length of the wash within the LIBW study area. The study however did not include a new hydrologic model for the 100-year peak discharges. Instead, the peak discharges from the original IBW floodplain delineation study were used. The origin of the effective 100-year flood flows is unclear, but they appear to be based on the original design flows for IBW, which were developed by the U.S. Army of Corps of Engineers in the 1970's. The entire length of Indian Bend Wash is delineated as Zone AE (zone with determined base flood elevations). Since the latest FEMA map revision in 2005, no new LOMR has been developed for IBW.

McCormick Ranch Lakes West & East Branch Floodplain and Floodway

Both branches of the McCormick Ranch Lakes system are located within the McCormick Ranch subdivision and flow in a southwesterly direction to their confluence with IBW just north of Indian Bend Road. The floodplain delineation reports for the lakes system were not found. However, the FEMA FIRM indicates that the McCormick Ranch Lakes West and East Branch floodplain and floodway are delineated as a Zone AE.

Interceptor Channel Floodplain

The Interceptor Channel runs along the north side of the Arizona Canal between Pima Road and Indian Bend Wash. The channel was designed to accommodate the flows that enter the City of Scottsdale from the Salt River Pima-Maricopa Indian Community. A detailed floodplain delineation study for the Interceptor Channel was not performed. From the effective FIRM maps it was found that the floodplain is delineated as an approximate Zone A (zone with no determined base flood elevations). The approximate floodplain delineation only incorporates the channel and does not affect any adjacent properties.

Arizona Canal Floodplain

The Arizona Canal west of Indian Bend Wash has elevated banks along most of its length within the LIBW study area. Depending on the bank elevations, most of the area upstream of the canal is defined as an approximate Zone A floodplain. There are two exceptions; the first is the area between Goldwater Boulevard and 64th Street. A detailed study was performed in 2003 and a Zone AH (zone with determined base flood elevations and flooding depths of 1 to 3 feet) floodplain was delineated. The second exception is the new development upstream of the Arizona Canal between Chaparral Road and Thornwood Avenue. A Letter of Map Revision based on Fill was obtained in 2008 effectively removing the Arizona Canal floodplain from the associated buildings, but the LOMR did not remove the Zone A floodplain from the surrounding older buildings.

4.0 KNOWN FLOODING

One of the impetuses behind the LIBW ADMS/P is the fact that several areas within the study area have historically experienced flooding during storm events. Since much of the study area, such as old town Scottsdale, was developed before the Grading and Drainage Ordinances of the 1970's, flooding issues are to be expected. Over the past couple of decades, a significant effort has been undertaken by the municipalities, the FCDMC, the Arizona Department of Transportation (ADOT), and the US Army Corps of Engineers (USACE) to alleviate flooding concerns in the area by building an extensive drainage network consisting of storm drains, channels and retention basins. However, even with all of these improvements, flooding problems still exist in the study area.

4.1 FLOODING COMPLAINTS

The following paragraphs summarize the drainage/flooding complaints within the study area as documented by the municipalities.

City of Scottsdale:

Drainage complaints were obtained from the City's Stormwater Management Division. The drainage complaints are recorded in a GIS shapefile that includes the type, location and a brief description of the flooding problem. There were a total of 242 complaints within the LIBW study area. These flooding complaints were separated into different categories or types, including: *Structural Flooding, Yard Flooding, Street Flooding, Overwatering, Pool Discharge, Gutter Ponding and Parking Lot Flooding.* There were 10 entries under the structural flooding category,

45 for yard flooding, and 39 under street flooding, 22 for overwater, 66 for pool discharge, 9 for gutter ponding and 10 for parking lot flooding. All of the drainage complaints were read and evaluated for their relevance to the regional Area Drainage Master Plan, but most were found to not pertain. For example, street flooding that was a result of overwatering was eliminated for further investigation. Similarly, flooding complaints that are associated with local depressions in the gutter that result in ponding water after storm events were also eliminated from further consideration. All of the structural flooding and yard flooding complaints were carefully analyzed and some were excluded because improvements such as paving solutions or storm drains have already been constructed by the City to alleviate the problem. Using this procedure, the 242 flooding complaints were narrowed down to just 11 complaints that were further investigated. Refer to appendix C for a detailed description of all 11 drainage complaints from the City of Scottsdale.

City of Phoenix:

The drainage complaints for the City of Phoenix were obtained from the Street Transportation Department. There were only 3 drainage complaints on file within the LIBW study area. However, only one (4700 N. 64th Street) of the 3 drainage complaints was further evaluated and included as part of this Data Collection Report. Refer to appendix C for a detailed description of the sole drainage complaint from the City of Phoenix.

Of the two drainage complaints that were excluded from further investigation, one revolved around concerns that some residents had regarding 'new' street improvements and the other concerned flooding at/around 6207 E. Calle Redonda in 2001. For the latter complaint, City of Phoenix prioritization ranking score was low which prompted no action. Moreover, since 2001 there has been no follow-up complaint, which indicates that it is a relatively minor drainage problem that does not require further investigation.

City of Tempe:

The City of Tempe does not have a formal drainage complaint database on file. However, information about flooding issues within the LIBW study area was provided by Mike Golden (City of Tempe Staff). In an email he stated that he believes there are flooding issues in the county island (bound by Scottsdale Road, IBW, Curry Road and the LOOP 202 Freeway) and that there were discussions to address drainage issues with the widening of the Loop 202 freeway; but he did not know if any drainage improvements were actually made.

The review of the hydrology analysis, which will be part of the LIBW ADMS, will include the county island. This detailed review of the results will indicate whether there are any significant drainage issues in the area that have not yet been addressed. Refer to Figure-1 for the location of the county island.

Town of Paradise Valley:

Similar to the City of Tempe, the Town of Paradise Valley does not have a formal drainage complaint database. However during the scoping meeting for the LIBW ADMS/P, the Paradise Valley Town Engineer, Bill Mead, described flooding issues associated with Berneil Ditch. His statements, which are also summarized in the *Scottsdale Road Corridor Drainage Master Plan: Technical Section – Volume 2: Hydraulic Analysis Final Report,* indicate that the south bank of Berneil Ditch has overtopped in multiple locations during his tenure as the Town Engineer. In the mid-1990's, Berneil Ditch overtopped its bank along the Mountain View Road alignment causing homes to flood south of the ditch. The ditch also overtopped its southern bank at the outside bend, at about 68th Street, where it turns from flowing north-south to east-west. This overtopping occurred in the mid 1990's and caused flood damage to homes downstream. As a result, the Town constructed a 200 foot long masonry brick wall that is about 18-inches high along the outer bank in order to prevent future breakout flows. Bill Mead also described flooding issues at the northwest corner of Lincoln Drive and Scottsdale Road. He said that in 1994 the bank located at the northwest corner of this intersection was flooded.

4.2 FLOODING PHOTOGRAPHS

In addition to collecting the flooding complaints from the municipalities, an effort was made to collect flooding photographs within the LIBW study area. However, only the City of Scottsdale and FCDMC keep flooding pictures on file. In addition to those pictures, photographs taken by Gavan & Barker during a storm event in September 2012 were included as part of the photographs below.

69th Place and Avalon Drive:

The area at 69th Place and Avalon Drive has experienced significant flooding problems over the years. As can be seen from the pictures below, the floodwaters have overtopped the curb and flooded at least one residence (6925 E. Avalon Drive) in the area. The primary reason for the flooding is that the intersection is the concentration point of a relatively large watershed and since the streets (both Avalon Drive and 69th Place) are relatively flat, runoff tends to pond

instead of being conveyed downstream. In the spring of 2012, drainage improvements consisting of new storm drain laterals and inlets throughout the contributing watershed improved the flooding situation at the intersection. However, during major storm events, flooding at this location can still be expected.

1999 - Floodwaters overtopping the top of curb
@ 69th Place and Avalon Drive

1999 - Floodwaters at the threshold
@ 69th Place and Avalon Drive

Undated - Street flooding
@ 69th Place and Avalon Drive

Undated - Street flooding
@ 69th Place and Avalon Drive

2010 - Floodwaters at home foundation
@ 69th Place and Avalon Drive

2010 - Floodwaters in front yard
@ 69th Place and Avalon Drive

2012 - No flooding problems with new Catch Basin
@ 69th Place and Avalon Drive

2012 - Floodwaters are intercepted in new Catch Basin upstream @ 68th Street and Avalon Drive

67th Place and Earll Drive

The intersection of 67th Place and Earll Drive experiences significant street flooding during storm events. As can be seen from the pictures below, both 67th Place and Earll Drive tend to pond to levels that overtop the curb. There is no formal flooding complaint on file with the City of Scottsdale and hence there is no indication whether homes have been flooded. 67th Place has a slight positive slope north towards Cheery Lynn Road. However, the street does not have sufficient capacity to convey the flood waters north during larger storm events, resulting in significant ponding at Earll Drive. To date no drainage improvements have been constructed for this drainage problem. However, as part of the *Avalon Drive Drainage Phase II Improvements*, there are plans for the Cheery Lynn Road storm drain to be extended to the intersection of 67th Place and Cherry Lynn Road. Prior to the construction of *Phase II,* this drainage issue should be evaluated with the LIBW hydrologic model and the *Phase II* plans updated, if necessary, to

either include a shallow storm drain extension or a paving solution that would alleviate the flooding problems at 67th Place and Earll Drive.

2012 - Intersection flooded during storm event
@ 67th Place and Earll Drive

2012 - Ponding after storm event
@ 67th Place and Earll Drive

2012 - No positive outfall for ponded water
@ 67th Place and Earll Drive

2012 - Note the depth of ponding in the street
@ 67th Place and Earll Drive

69th Street and Lafayette Boulevard (ADW Neighborhood):

The area near 69th and Lafayette Boulevard is located just north of the Arizona Canal and has experienced flooding problems in the past. As can be seen from the pictures below, runoff from the ADW neighborhood ponds behind a flood irrigation berm at the terminus of Lafayette Boulevard to a depth of approximately one-foot before being overtopped. In 2002/2003, drainage improvements consisting of a storm drain lateral with 3 new catch basins at the intersection of 69th Street and Lafayette Boulevard were connected to the Arizona Canal side drain system. The improvements have significantly improved the drainage situation for the residences around the intersection. However, the improvements were only designed to intercept flow from a 5-10 year storm event; therefore during major storm events flooding at this location can still be expected.

1999 - Flooding at Lafayette Blvd. dead end
@ 69th Street and Lafayette Boulevard

1999 - Ponding upstream of dead end
@ 69th Street and Lafayette Boulevard

1999 - Note depth of poinding ~6-9 Inches
@ 69th Street and Lafayette Boulevard

1999 - Water overtopping the top of curb
@ 69th Street and Lafayette Boulevard

Indian Bend Wash & Other Locations within the LIBW Study Area:

The FCDMC has a vast compilation of flooding pictures within the LIBW study area. The historic flooding photographs date back to the 1950's, before most of the drainage improvements in the study area were constructed. Over time, significant drainage improvements (Indian Bend Wash channelization, side drain construction, Interceptor channel construction, etc…) have been made, which greatly reduce potential flooding. Most of these pictures are "historic" flooding photographs; taken before the aforementioned drainage improvements. The historic flooding photographs are not intended to show that the study area currently can experience similar flooding problems; instead they are intended to show that the LIBW study area has a history of flooding problems which have been addressed, but not necessarily eliminated. One of the primary goals of the LIBW ADMS/P is to determine areas that are still susceptible to flooding.

1954 - Looking south along Indian Bend Wash from Camelback Road

1966 - Arizona Canal south bank 25-foot break just west of Pima Road

1972 - Looking southeast along Indian Bend Wash from Oak Street

1972 - Looking east along Indian School Road towards Indian Bend Wash

1972 - Looking northeast from McDonald Drive west of the Arizona Canal

1972 - Looking south along 68th Street towards the Arizona Canal/Indian School Road

1972 - Looking east along Camelback Road towards Arizona Canal/Scottsdale Road

1972 - Looking south along Scottsdale Road from Camelback Road

1972 - Looking east along Thomas Road (from 76th Street) towards Indian Bend Wash

1980 - Looking southeast at Indian Bend Wash north of McDowell Road

5.0 PREVIOUS LIBW DRAINAGE INVESTIGATIONS

Over the last 50 years, there have been numerous drainage studies performed within the LIBW study area. Portions of the LIBW study area have been analyzed in large scale drainage master plans/studies (e.g. *STP Papago: Regional Flood Control Project*) as well as numerous hydrology/hydraulic reports (e.g. *Osborn Road Storm Drain and Oak Street Storm Drain*) that were intended to analyze more localized drainage problems. Peak discharges from these drainage investigations will be used for comparison purposes, comparing the LIBW FLO-2D results to previous results that were obtained with HEC-1 models, in order to help assess the reasonableness of the FLO-2D hydrologic results. The goal of the LIBW ADMS is to provide a comprehensive drainage analysis for the study area, incorporating the drainage infrastructure that has been constructed and determine where additional drainage improvements are needed to prevent future flooding problems.

5.1 LARGE SCALE DRAINAGE STUDIES

Over the years, there have been several large scale drainage studies that cover portions of the LIBW study area. The following paragraphs briefly summarize these drainage studies:

STP Papago: Regional Flood Control Project (Completed in 1997):
The purpose of the STP (Scottsdale, Tempe & Phoenix) Papago project was to identify and quantify the extents of drainage issues within the study area which was bound by the Arizona Canal/Camelback Road to the north, Indian Bend Wash to the east, 56th Street to the west and Roosevelt Street/McKellips Road to the south. The most significant outcome of the project was the recommendation, and subsequent construction of the Osborn Road and Oak Street Storm Drains. No new hydrology was performed as part of the project, the City of Scottsdale's Stormwater Master Plan 10-year, 6-hour hydrology model was slightly modified and used for the hydrologic analysis.

PVSP Drainage Study (Completed in 1978):
The purpose of the PVSP (Paradise Valley, Scottsdale & Phoenix) drainage study was to serve as a comprehensive planning study that included hydrology and hydraulics for all of the 'future' regional drainage infrastructure within its boundary which extended from the CAP Canal to the north, Pima Road to the east, 56th Street to the west and Berneil Ditch/Indian Bend Wash to the south. Some of the more prominent drainage features that have been constructed as a result of the PVSP study are the Sandpiper, Mescal and Cactus Park detention basins. However, since the completion of the drainage study in the late 1970s, the watershed has experienced significant development and most of the results/conclusions from the study have been superseded by subsequent, more localized drainage studies that are associated with new development projects.

Scottsdale Road Corridor Drainage Master Plan (Completed in 2002):
Even though the study area for the Scottsdale Road Corridor project falls outside of the LIBW study area, the two projects share Berneil Ditch as a common boundary. Therefore, the Scottsdale Road Corridor project was included in order to compare the peak discharge for Berneil Ditch between the two projects. The purpose of the Scottsdale Road Corridor project was to assess the magnitude, frequency and extent of regional flooding that occurs along Scottsdale Road, the 71st Street Channel and the Berneil Ditch. The study area includes the entire contributing drainage area for the 71st Street Channel and the Berneil Ditch which extends from the Central Arizona Project (CAP) Canal to the north, the Scottsdale Airpark/Miller Road to the

east, 64th Street to the west and the Berneil Ditch/Indian Bend Wash to the south. A new HEC-1 hydrology model was developed for the master plan and according to the model results the total 100-year, 6-hour peak discharge for the Berneil Ditch at its confluence with Indian Bend Wash is 2981 cfs. The total 100-year, 6-hour peak discharge for the 71st Street Channel at its confluence with the Berneil Ditch is 1703 cfs and the peak discharge that bypasses the Berneil Ditch and surface flows south along Scottsdale Road is 336 cfs. This is flow that bypasses the Berneil Ditch and enters the study area for the LIBW ADMS.

5.2 LOCAL DRAINAGE STUDIES

In addition to the larger scale drainage studies that were done in the LIBW study area; there are numerous local/small scale drainage studies that have been completed in order to identify localized drainage problems. Some of the most prominent drainage studies that have been performed within the study area are:

- *Avalon Drive Drainage Study;*
- *Cross Cut Canal to 69th Place;*
- *Final 68th Street and Arcadia Flooding Investigation;*
- *Osborn Road Storm Drain;*
- *Updated Hydrology Analysis: Arizona Canal Drainage Channel Pima Freeway Via Linda to Arizona Canal;*
- *Final Hydrology Report Outer Loop Highway: Camelback Walk Channel to the Arizona Canal*;
- D*rainage Design Report Shea Boulevard: Scottsdale Road to Pima Road;*

A brief summary of these drainage studies, as well as all of the other reports that were collected, can be found in appendix D. The conclusions from these localized drainage studies will be used to point us to drainage problem areas within the study area and evaluate them in greater detail with the LIBW FLO-2D model results.

5.3 DRAINAGE INFRASTRUCTURE DESIGN REPORTS

As part of the data collection effort, the available design reports for the constructed drainage infrastructure (channels, storm drains, detention basins, etc…) within the study area were collected. Some of the most prominent drainage design reports are:

- *Final Design Report: Osborn Road Storm Drain;*
- *Drainage Report for Oak Street Storm Drain: 58th Street to Indian Bend Wash;*
- *Report on Hydraulic Analysis of Indian Bend Wash Greenbelt Interceptor Channel,*
- *The US Army Corps of Engineers memorandums concerning the design of IBW*

A brief summary of these reports, along with numerous other reports, can also be found in appendix D.

5.4 MASTER PLAN COMMUNITY DRAINAGE REPORTS

The two master planned (private) communities, McCormick Ranch and Gainey Ranch are located within the LIBW study area. Both were developed in the 1970's and 1980's, after the introduction of Scottsdale's grading and drainage ordinance, but the drainage reports associated with these two communities are no longer on file with the City.

6.0 EXISTING STORM DRAIN AS-BUILT PLAN COLLECTION

6.1 PURPOSE

The most significant part of the LIBW ADMS/P data collection effort is the storm drain as-built plan collection. The storm drain as-built plans will serve as the foundation to the ADMS's Storm Water Management Model (SWMM), which will be integrated with the FLO-2D hydrology model to evaluate the existing storm drain systems in the study area. It is important to consider the storm drain infrastructure because a "surface" only hydrology/hydraulics model would not account for storm drain improvements, which are significant, and therefore would not in turn accurately reflect flooding conditions in the study area. In previous studies, the capacity of the existing storm drains was calculated and diverted out of the surface flows. The drawback to this approach is that it assumes that the inlet capacity for the existing storm drains is sufficient to fully utilize the capacity of the storm drain trunk line. For the 2-year storm drains this approach might be appropriate, but the LIBW study area consists of fairly large storm drains that have been designed for the 10 and 100-year storm events. Therefore it is important to consider all of the inlets associated with the storm drains and determine whether the inlets have sufficient interception capacity to fully utilize the storm drain capacity. To achieve this level of modeling detail, an extensive search and collection effort was performed to obtain as many of the storm drain as-built plans as possible. As discussed in further detail in the following sections, the as-built plans will be used to create a GIS database of the storm drain network within the study area. This GIS data will in turn be used to create input files for SWMM before combining it with the FLO-2D model to create an overall drainage model that accounts for flow being intercepted by individual storm drain inlets.

6.2 AS-BUILT PLAN RESEARCH AND COLLECTION

The storm drain as-built plans research and collection effort covered information from all of the municipalities within the study area as well as the FCDMC. Early on in the collection effort it was found that the City of Phoenix and the Town of Paradise Valley did not have any significant storm drain infrastructure (i.e. storm drains larger than 30-inches) within the LIBW study area. In contrast, the Cities of Tempe and Scottsdale had significant infrastructure within the study area. In addition to obtaining as-built plans from the Cities, the FCDMC's records were searched for the USACE side-drain as-built plans as well as FCDMC's sponsored storm drains.

The most extensive library of storm drain as-built plans was found in the City of Scottsdale. The search consisted of 3 separate requests for as-built plans as well as a visit to the City's *One Stop Shop*. The first request for as-built plans consisted of as-built call numbers that were obtained from the *Stormwater Master Plan*. All of the as-built plans that were obtained with the first request were used in the storm drain GIS construction. The second request consisted of as-built call numbers (which were not collected with the first request) that were obtained from the City's as-built GIS shapefile. These as-built call numbers were first separated based on their type (i.e. "Storm Water, Drainage, etc…) and then further narrowed down based on the as-built name. Roughly 80% of all the as-built plans that were requested were useful in the construction of the GIS storm drain database.

From the first two requests, patterns/gaps in the study area storm drain coverage were appearing for which there was substantial evidence that storm drains existed but for which no as-built plans were (yet) found. The idea was that these storm drains were constructed/as-built as part of a paving project. Therefore the third request of as-built plans, which was similar to the second request, separated all of the City's as-built plans based on their "Paving" designation. From there, the list was further narrowed down based on the name of the as-built and the number of pages found in the as-built set (the idea was that a set of paving plans that only had a few pages would not include any significant storm drain information). Approximately 30% of the as-built plans obtained from the third request were useful in the construction of the GIS storm drain layer. After incorporating the as-built files that were obtained with the third request, it was realized that not all of the gaps in the storm drain GIS layer were filled. In order to find those missing storm drain as-built plans, an in-person as-built search was performed at the City's *One*

Stop Shop. However, only a couple of additional as-built plans were obtained using this method, still leaving significant gaps and storm drain as-built plans missing from the LIBW study area.

The City of Tempe storm drain as-built files were obtained in a similar manner. A request to the City's Engineering Division was made for all of their storm drain as-built files for the area north of Tempe Town Lake/Salt River. Even though all of the recorded as-built plans available from the City have been obtained, there are still missing storm drains (i.e. there are known storm drains for which as-built plans are not available). Since all of the available as-built plans have been collected, the remaining missing storm drains within the City of Tempe will have to be field located/measured.

In addition to Scottsdale and Tempe, the FCDMC's library was searched for agencies' sponsored storm drains. The two FCDMC sponsored storm drains that were obtained are the Oak Street Storm Drain (from 58th Street to Indian Bend Wash) and the Osborn Road Storm Drain (61st Place to Indian Bend Wash). In addition to these two files, the Corp's side drain system plans were also obtained from the FCDMC library.

6.3 AS-BUILT PLANS INVENTORY AND NOMENCLATURE

The storm drain as-built plan data collection process was very successful; however, even with the extensive effort, not all of the as-built plans were found. As a result, there are known storm drains that have been identified as part of this data collection effort, but for which no data is available. Data for these storm drains will be collected during future work assignments.

As part of this data collection effort, a total of approximately 130 storm drain as-built plans were collected, catalogued and used to construct the GIS database that will be used to construct the SWMM input files. The oldest storm drain that was included in the GIS data was built in 1967 and the most recent storm drain was built in the spring of 2012. The as-built files were separated based on their outlet location within Indian Bend Wash, the Interceptor Channel or the Salt River. Upon separating all of the storm drains based on their outlet location, the plans were named based on the year, street and extent of the storm drain. For example, the Scottsdale Road storm drain between Earll Drive and Thomas Road which was constructed in 1990 was placed in the *West Thomas Road Storm Drain* folder (i.e. the folder containing the as-built plans of all storm drains that ultimately discharge to the Thomas Road storm drain on the west side of Indian Bend Wash) and named: *1990 – Scottsdale Road SD (Earll Dr. to Thomas Rd)*. One special note

to be made is that the same set of as-built plans can be found in multiple folders. This occurred for the above example, where the 1990 Scottsdale Road improvements consisted of storm drain laterals between Earll Drive and McDowell Road that connected to multiple existing storm drain trunk lines; including trunk lines in Thomas Road, Oak Street and McDowell Road. So, for example, in the *West Oak Street Storm Drain* folder, there is a file labeled *1990 – Scottsdale Road SD (Thomas Rd to Oak St)*. The two files are identical, even though they are in different folders and have different names. The reason one as-built plan was copied into different folders was to keep the notion that all of the as-built plans that outlet to a certain outfall location will be found in that folder. This convention made it easy to keep track of as-built plans during the construction of the GIS storm drain data. Refer to appendix E for a table summarizing all of the storm drain as-built files that have been obtained as part of this data collection report and that have been used to construct the storm drain GIS database.

7.0 STORM DRAIN GIS CONSTRUCTION

As previously discussed, storm drain as-built plans will serve as the primary source of data that will be used to create the storm drain GIS database. Secondary sources will be the City of Scottsdale's Stormwater Master Plan (SWMP) and field visit/survey measurements. The database will consist of various GIS shapefiles which will include data on pipes (both storm drains and connector pipes), junctions (manholes and pipe junctions) and inlets. The GIS shapefiles will be populated in a manner to satisfy the following three objectives:

1) Construct necessary shapefiles and corresponding data that is required to create the SWMM input file
2) Construct necessary shapefiles and corresponding data that is required to link the FLO-2D hydrology model to the SWMM storm drain model
3) Provide a reference for the data within the shapefiles so that it can be easily found by others

7.1 PURPOSE OF GIS CONSTRUCTION

The primary purpose of the GIS construction effort is to create a digital comprehensive geo-database for the entire storm drain network within the LIBW study area. The storm drain GIS shapefiles will be constructed with the help of storm drain as-built plans, the City's SWMP and field visits/surveys. Once the storm drain network has been converted to a digital format (GIS shapefile), then it can be readily used to create the input file for the SWMM model. This is a

vital step in order to achieve one of the LIBW's primary study objectives; analysis of the study area with a combined FLO-2D/SWMM hydrology/hydraulics model.

7.2 GIS DATABASE STRUCTURE

As previously mentioned, three objectives need to be satisfied with the GIS shapefile construction. The first objective is to incorporate all of the data into the shapefiles that is essential in creating a working SWMM model. The second objective is to create a shapefile that will be used to link the SWMM model to the FLO-2D model, and the third objective is to provide reference information for all the data found in the shapefiles. Providing a reference for the data in the shapefiles is vital, due to the large number of as-built plans and the secondary data sources that were used, in order to be able to quickly access/back-check the data with the original files.

To satisfy the first objective, the storm drain data was organized in three shapefiles. The **Conduits** shapefile consists of all the data associated with the storm drain pipes, the **Junctions** shapefile contains the data associated with the storm drain manhole and pipe junctions (NOTE: the **Junctions** shapefile will be created by merging the *Pipe_Junctions* and *Manhole_Junctions* shapefiles) and the **Inlets** shapefile includes the data associated with the storm drain catch basins. These three shapefiles are essential in creating the SWMM model. To satisfy the second objective, the **Sub-Catchments** shapefile was created in order to provide a link between SWMM and the FLO-2D model. Figure 2 shows the structure of the GIS storm drain database, including the four different shapefiles along with their input data. Most of the input data shown in Figure 2 are either directly or indirectly required for the SWMM model creation using inpPINS or for the linkage between SWMM and FLO-2D.

To satisfy the third objective, input data that reference the original as-built plans to the GIS data are the *"AB_FILE_NAME", "AB_START_NO* " and *"AB_END_NO"*. The *AB_FILE_NAME* refers to the name of the as-built plan that was discussed in Section 6.3 of this report. The *AB_START_NO* and *AB_END_NO* in the conduit shapefile refers to the starting and ending as-built plan numbers used by the Cities of Scottsdale and Tempe, and the FCDMC. By knowing the as-built plan numbers, the plans could be readily obtained from the Cities or the FCDMC.

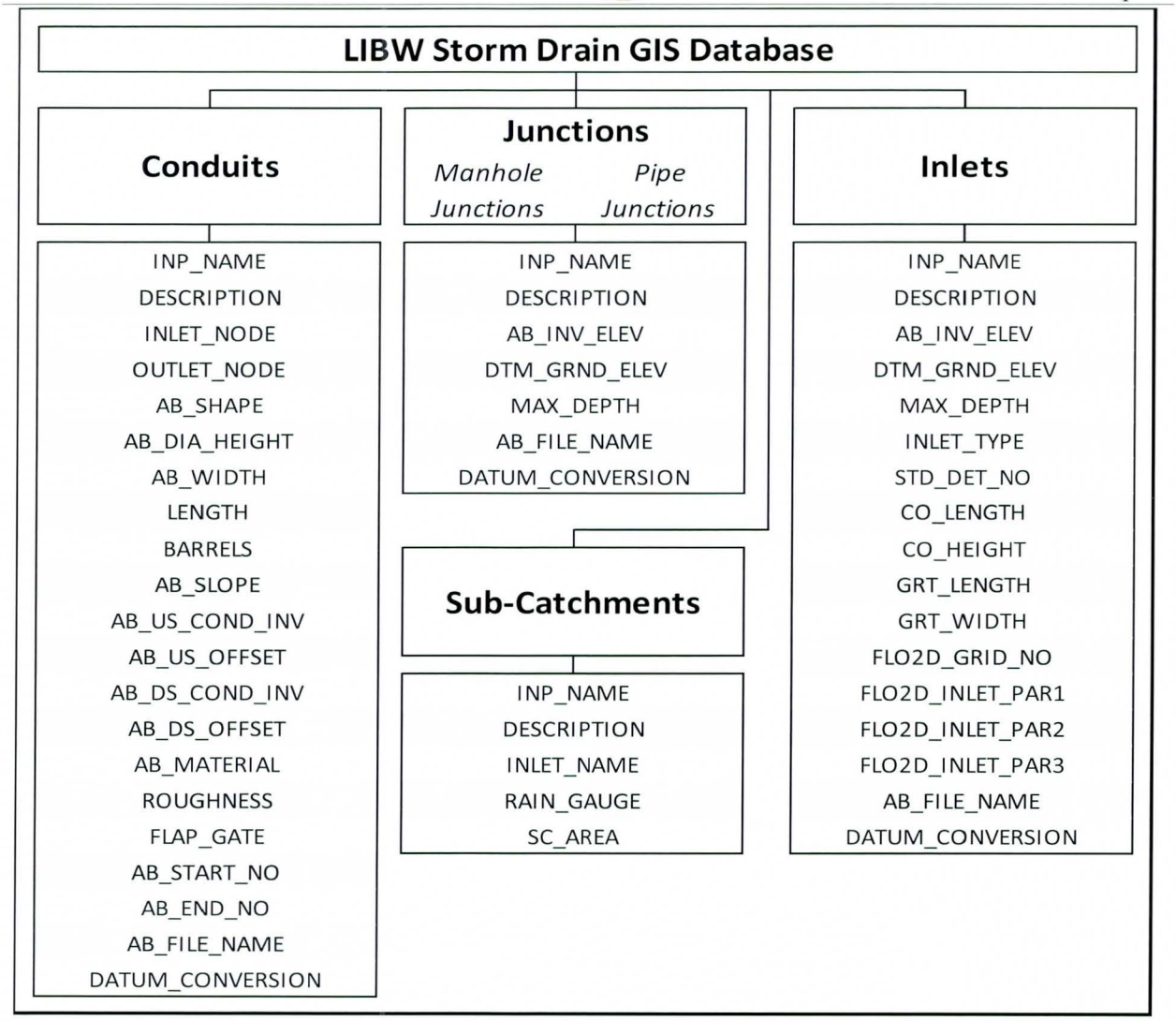


Figure-2: Storm Drain GIS Database Shapefiles and Input Data

7.3 GIS AS-BUILT DATA INPUT PROCEDURE

As can be seen from the figure above, the storm drain database is separated into 4 components; Conduits, Junctions, Inlets and Sub-Catchments. Individual shapefiles were created for conduits (trunkline and connector pipes), inlets (grates, curb openings, headwalls, etc…) and sub-catchments. The junction data however was separated into two shapefiles, one consisting of manhole junctions and the other consisting of pipe junctions. As the names imply, manhole junctions are junctions at which manholes are found and pipe junctions are all other junctions where storm drain pipes join, bend or change pipe sizes. The input data/attribute names are defined in appendix F.

The first step in the GIS data input procedure was to create the Conduit, Inlet, Manhole and Pipe junction shapefiles with the data fields that are listed in Figure 2. These shapefiles were then constructed by using aerial photography and the previously discussed as-built plan data. The shapefiles were populated starting with the most downstream set of as-built plans and then progressively moving upstream. The following briefly describes the general procedure that was followed to digitize the as-built plans to the GIS shapefiles.

1) Digitize and populate the data for the as-built manholes using the position of the manhole covers that are visible in the aerial photography
2) Digitize and populate the data for all of the remaining as-built manholes that are not visible in aerial photography based on pipe length offsets or other identifying marks such as nearby street intersections. The primary reason why manholes do not appear in aerial photography is because they have been paved over.
3) Connect all of the manholes with conduits (trunkline). At the same time, populate the as-built conduit data such as invert elevation, pipe size and geometry. The as-built pipe lengths were not input, instead the pipe lengths were calculated using the distance between manholes.
4) Digitize and populate the data for all of the inlets, using the position from aerial photography and by placing them at the gutter (flowline) and connecting them with conduits to the trunkline.
5) The trunkline was then split at each connector pipe. Pipe junctions were inserted at these splits and the pipe upstream/downstream invert elevations were calculated accordingly.
6) Once all of the storm drain as-built plans were digitized and populated, each conduit, inlet and junction was named based on the procedure that will be discussed in Section 7.4

The ground surface elevations (*"DTM_GRND_ELEV"*) field associated with the junctions and inlets are populated using the topographic mapping digital terrain model. The as-built invert elevations (*"AB_INV_ELEV"*) are subtracted from the ground surface elevations to obtain the maximum depth (*"MAX_DEPTH"*) of flow at the inlet/junction. However, at the time of this writing the digital terrain model for the LIBW study area is unavailable so those fields have been left blank. The digital terrain data will be available by the start of the next work assignment. Similarly, the *"AB_US_OFFSET"* (upstream offset) and *"AB_DS_OFFSET"* (downstream offset) in the conduit shapefile are calculated from the difference between the conduit's invert

elevations at the junction. This procedure will be followed during the next work assignment before the GIS shapefiles are used to create the SWMM input file. Refer to appendix G for exhibits of the GIS shapefiles that show the storm drains for which data has been obtained.

The final step in the GIS data input procedure was to create the Sub-Catchment shapefile. This shapefile plays an important part in the FLO-2D and SWMM integration by acting as the data transfer link. The sub-catchment polygon shapefile was created by "buffering" the inlet nodes for an arbitrary radius of 3 feet. The only physical data that is required is the sub-catchment area, or area of the polygon, which is only used as a placeholder and has no impact on the results that are generated by either FLO-2D or SWMM.

7.4 GIS NAMING CONVENTION

As one of the SWMM requirements, all of the GIS input components (conduits, junctions, etc…) need to have a unique name (identifier). Since SWMM is not a location based model, the unique name is used to specify what nodes (junctions and inlets) are at the upstream/downstream end of the link (conduits). As part of the data collection effort, all of the junctions and inlets were given a unique name. In addition to a unique name, the conduits shapefile has two additional fields specifying the name of the upstream (inlet) and downstream (outlet) node for each storm drain segment. Using the names, inpPINS will associate each conduit to the corresponding node and build a SWMM input file.

With well over 900 inlets, 1500 junctions (manhole and pipe junctions) and 2400 conduits (main and connector pipes), a procedure had to be developed in order to avoid repeating names. The naming convention that was developed consisted of three main parts, the component name (C = Conduit, CP = Connector Pipe, I = Inlet, MJ = Manhole Junction, PJ = Pipe Junction), the outlet storm drain name (WTR = West Thomas Road, WOS = West Oak Street, EISR = East Indian School Road, etc…) and the name of the major storm drain lateral (SRL = Scottsdale Road Lateral, GBL = Goldwater Boulevard Lateral, 64STL = 64th Street Lateral, etc…). Since Indian Bend Wash (IBW) runs north-south through the study area and serves as the outfall for the majority of the storm drains, the outlet storm drains were separated as being either "West" or "East" of IBW (i.e. West Thomas Road = the storm drain within Thomas Road, west of IBW). A sequential numbering system starting at the downstream end of the storm drain was also used to provide a unique name for each component. The first step of the naming procedure consisted of

naming all of the main storm drain (trunk line) conduits based on their ultimate outlet location before progressively moving upstream. The second step of the procedure consisted of naming all of the connector pipes, inlets and junctions based on the name of the trunk line conduits. The names of the inlets, junctions and connector pipes are based on the name of the **downstream** conduit that they are associated with. This naming procedure is illustrated with Figure 3 and the examples in Table 1.

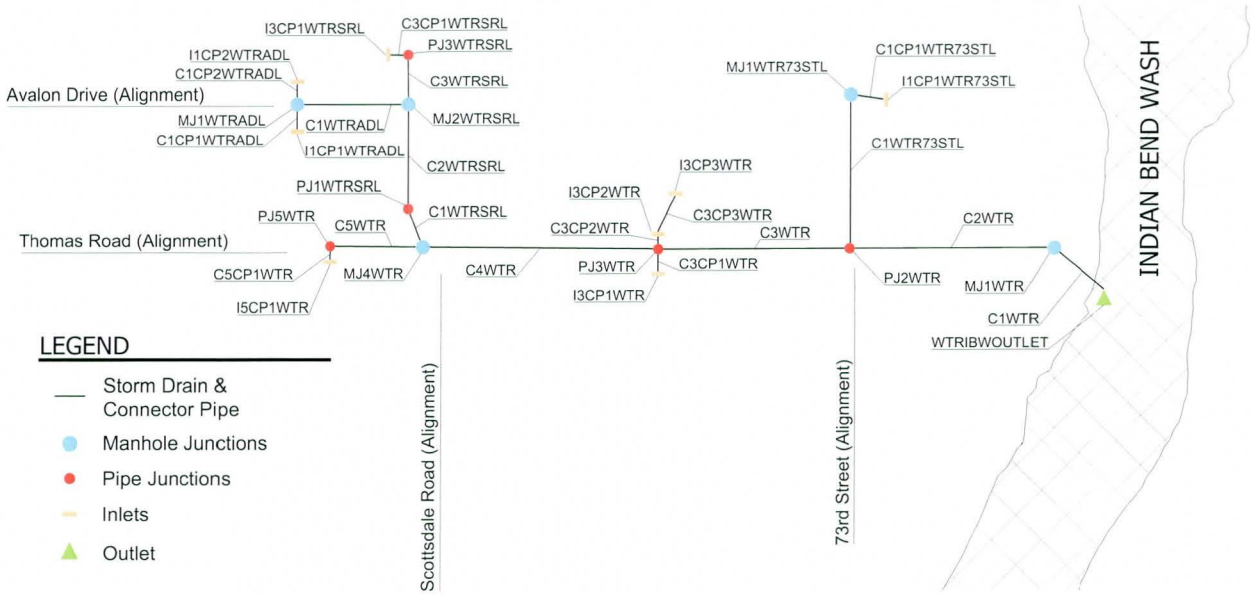


Figure-3: Naming Convention Example Layout

Unique Name	Long Name / Description
C1WTR	1st conduit {C1} on the West Thomas Road {WTR} storm drain
C34WTR	34th conduit {C34} on the West Thomas Road {WTR} storm drain
C17CP1WTR	1st connector pipe{CP1} discharging to the 17th conduit {C17} on the West Thomas Road {WTR} storm drain
C1WTRSRL	1st conduit {C1} on the Scottsdale Road Lateral {SRL} eventually discharging to the West Thomas Road {WTR} storm drain
C12CP2WTRADL	2nd connector pipe {CP2} discharging to the 12th conduit {C12} on the Avalon Drive lateral {ADL} eventually discharging to the West Thomas Road {WTR} storm drain
I12CP2WTRADL	Inlet {I} associated with the 2nd connector pipe {CP2} discharging to the 12th conduit {12} on the Avalon Drive lateral {ADL} discharging to the West Thomas Road {WTR} storm drain
MJ4ECHR	Manhole junction {MJ} associated with the 4th conduit {4} on the East Chaparral Road {ECHR} storm drain
PJ9WCR68STL	Pipe junction {PJ} associated with the 9th conduit {9} on the 68th Street lateral {68STL} eventually discharging to the West Camelback Road {WCR} storm drain
C4CP3W2STGBL	3rd connector pipe {CP3} discharging to the 4th conduit {C4} on the Goldwater Boulevard lateral {GBL} eventually discharging to the West 2nd Street {W2ST} storm drain
I4CP3W2STGBL	Inlet {I} associated with the 3rd connector pipe {CP3} discharging to the 4th conduit {C4} on the Goldwater Boulevard lateral {GBL} eventually discharging to the West 2nd Street {W2ST} storm drain
EJRIBWOUTLET	The East Jackrabbit Road {EJR} storm drain outlet {OUTLET} into Indian Bend Wash {IBW}

Table-1: Naming Convention Examples

8.0 VERTICAL DATUM ADJUSTMENTS

During the storm drain as-built collection and GIS database generation it was found that there are two main vertical datums within the study area; the National Geodetic Vertical Datum of 1929 (NGVD 29), also known as "Mean Sea Level," and the North American Vertical Datum of 1988 (NAVD 88).

8.1 DESCRIPTION/NEED

The storm drain as-built plans span a 45 year period from 1967 to 2012. During that time period, some of the storm drain plans were on the NGVD 29 datum while the more recent ones are on the NAVD 88 datum. However, not all of the newer as-built plans are on the new datum, this is because some of the municipalities such as the City of Phoenix have yet to officially convert to the new datum. Since the topographic mapping and project analysis is based on the new NAVD 88 datum, the as-built elevations that are based on the old NGVD 29 datum will need to be adjusted to match the new datum.

For the most part, the as-built plans did not specifically call out the datum that the elevations are based on. Therefore, to determine which storm drains will require a datum adjustment the following steps were followed:

- Obtain 3-5 manhole rim elevations from the as-built plans and average the elevation
- For the same manhole locations obtain the ground elevation from the provided NAVD 88 topographic mapping and average to one elevation
- If the two averaged elevations were within 0.5 feet, it was deemed that the storm drain as-built plans were on the NAVD 88 datum and NO DATUM ADJUSTMENT was necessary
- If the two averaged elevations were more than 0.5 feet apart, then it was deemed that all the elevations that correspond to those as-built plans will need a DATUM ADJUSTMENT.

8.2 ADJUSTMENT PROCEDURE

The datum adjustment was performed using the National Geodetic Survey VERTCON datum conversion calculator. The storm drains within the LIBW study area were separated into 3 segments, the upper, middle and lower segment. The lower segment extends from the south study boundary up to Thomas Road, the middle segment encompasses the area between Indian Bend Road and Thomas Road and the upper segment includes everything north of Indian Bend Road. For each of the segments, a VERTCON established datum conversion height was used to adjust the storm drain elevations within that segment. Separating the study area in three segments provides a more accurate conversion factor, compared to using only one conversion for the entire study area.

8.3 DATUM CONVERSION

The datum conversion was performed on all of the elevations for the storm drains that were deemed to be on the 1929 datum. From VERTCON it was found that for the upper segment of the study area, a height conversion factor of 1.57 feet needs to be added to the elevations in order to convert them to NAVD 88 datum. For the middle and lower segments a height conversion factor of 1.82 feet and 2.01 feet, respectively needs to be added to the storm drain elevations in order to bring them up to the NAVD 88 datum.

9.0 AS-BUILT VERIFICATION

As part of the storm drain data collection effort and GIS database construction, the storm drain as-built plans were verified for their current applicability. For example, the Indian School Road storm drain between IBW and Drinkwater Boulevard was constructed in 1992, however most of the inlets that were built with the storm drain have been replaced with bigger/more efficient inlets as part of the 2009 Indian School Road improvements. The discrepancy between the original as-built plans and current conditions was easily identified and corrected once the newer as-built plans were found. However, there also were multiple locations where the original street did not get widened but instead driveways were put at locations where the original catch basins were located. The following two methods were used to identify locations such as these.

9.1 MICROSOFT BING STREETSIDE EXPLORER

The Microsoft Streetside Explorer is a tool, similar to Google's StreetView, which shows 360 degree street level images of streets and surrounding areas. All public roads within the LIBW study area contain these high resolution street images which were taken in March 2012. From the Streetside explorer it was relatively easy to see street catch basins and storm drain manhole covers. It was a heavily utilized tool and a constant companion during the GIS database construction to verify the applicability of the as-built plans. Another benefit of the Explorer was that it was relatively easy to identify the length of the curb opening catch basins and compare it to the as-built plans. For example, the as-built plans would call out a 20-foot long inlet, where in fact a 37-foot long inlet was constructed. Changes like these were noted in the *Descriptions* field of the GIS layer.

In addition to as-built verification, the Streetside Explorer was used to identify inlets/manholes in the streets where no as-built plans were available. These missing inlets and storm drains were noted in a separate GIS layer labeled "Missing_SD" and "Missing_Inlets." The data for these storm drains will be obtained during subsequent LIBW Work Assignments.

9.2 SITE INVESTIGATION/FIELD VISITS

In addition to using the Microsoft Streetside Explorer, traditional field visits and site investigations were made to identify discrepancies between the as-built plans and current conditions. One of the primary reasons for field visits was to identify and measure inlet sizes that were not visible in the Streetside Explorer imagery (such as headwall inlets behind the curb and

inlets in parking lots and on private drives). Field visits were also performed to identify the location of storm drain outfalls into IBW. This was necessary since some of the storm drains, such as the Roosevelt Street storm drain, were built before the roadway improvements at IBW. With the roadway improvements, some of the original as-built storm drain outlet structures were re-constructed and/or relocated. Field visits were used to determine the new location and characteristics of the outlets.

10.0 SUPPLEMENTAL STORM DRAIN DATA COLLECTION

In addition to collecting all of the available storm drain as-built plans from the Municipalities and the FCDMC; known storm drains for which no as-built data was found were also identified and will require further investigation with subsequent work assignments. This supplemental storm drain data collection effort will be primarily centered on obtaining field measurements for known existing storm drains and inlets.

10.1 METHODOLOGY OF DETERMINING FURTHER NEEDS

There were several ways that existing storm drains were identified as missing from the as-built data collection effort. Initially missing storm drains were identified by looking at available as-built plans which called out connections to storm drains for which no plans were available. Missing storm drains within the City of Scottsdale were also identified by comparing the collected as-built plans to the City's SWMP, GIS storm drain shapefiles as well as the Municipal Separate Storm Sewer System (MS4) Permit Inventory shapefile (from the Drainage Inspection database). Once discrepancies between these three sources and the collected as-built data were found, the Streetside Explorer was used to verify that the storm drain actually exists. In addition, some of the missing storm drains were identified from old hydrology/hydraulics reports. Since some of the storm drains in the old reports were called out as 'proposed', they were checked to see if they actually were constructed. The SWMP includes storm drain trunkline information (pipe inverts, pipe sizes, etc…), which was used to populate some of the missing storm drains, however since the SWMP does not include any inlet information, field measurements will still need to be performed in order to obtain their properties (location, type, size, etc…). Finally several missing storm drains were identified by City staff and by our own prior working knowledge within the study area. The missing storm drains are identified in appendix H.

10.2 SUPPLEMENTAL DATA COLLECTION PROCEDURE

The identified missing storm drain data will be collected in subsequent work assignments as part of the LIBW ADMP. Missing storm drain properties will be collected through field surveys. The field surveys will consist of measuring the inlet properties (type, size, depth to connector pipe invert, etc…) and storm drain manhole properties (depth from rim to invert, storm drain pipe size, etc…).

11.0 AZPDES STORM SEWER PERMITS

The four municipalities within the study area (Paradise Valley, Phoenix, Scottsdale and Tempe) all have MS4 permits issued by the Arizona Department of Environmental Quality (ADEQ). The Town of Paradise Valley is regulated under Arizona's Small MS4 General Permit while the others operate under individual MS4 permits. The Arizona Department of Transportation (ADOT) also has an individual MS4 permit issued by the ADEQ.

These MS4 permits authorize the municipalities and ADOT to discharge storm water to the Waters of United States. The permits require the municipalities to implement and maintain a Storm Water Management Program designed to reduce, to the maximum extent practicable, pollutant discharges from the MS4. The Storm Water Management Programs are tailored specifically for each municipality, but generally include public education and outreach, public involvement, illicit discharge detection and elimination, a program for operation and maintenance of municipal facilities (including storm drains), measures to monitor and control pollutants from industrial and commercial facilities, control of pollutants from construction activities, best management practices for new construction, and water quality monitoring programs.

As part of developing the ADMP, it will be important to review the proposed elements of the ADMP versus the Municipality's Storm Water Management Program to make sure that all necessary best management practices are incorporated into the proposed flood control measures.

12.0 LANDSCAPE AND RESOURCE CONTEXT

The LIBW ADMS/P study area covers an established portion of the metropolitan area, including four municipal jurisdictions, that contains a spectrum of landscape characters and land uses.

The LIBW ADMS data collection effort included the FCDMC's Landscape Inventory and Analysis (LIA) data, which is used for the Context Sensitive Flood Hazard Mitigation Process (CSFHM). The CSFHM data inventory process is a means of recording the cultural, scenic and recreational resources, and it provides information needed for judging landscape resource values and predicting the visual impacts of flood hazard mitigation. The landscape analysis provides a systematic approach in developing comprehensive information about the land and its resources as they relate to flood protection alternatives. The purpose of this analysis is to develop useful, site development planning information prior to the decision-making process regarding proposed drainage and flood hazard mitigation measures. This is accomplished primarily by identifying landscape resource opportunities and constraints relative to flood hazard mitigation strategies.

In addition to the review of the FCDMC's county-wide LIA data, community context information has been gathered specifically for the study area from the cities of Phoenix, Scottsdale, Tempe, and the Town of Paradise Valley. This information includes plans, guidelines, and policies that could impact location, or influence design of flood hazard mitigation alternatives. This information is used along with stakeholder and public input to gauge the level of acceptance for various flood protection solutions.

Depending on the outcome of hydrology analysis, the flooding context, and potential solutions, forthcoming phases of the LIBW study may analyze this information based on the FCDMC's CSFHM Planning and Design Model, with the goal of finding the ideal solutions to the combination of land and resource context, community context, and the flood hazard context. The ideal solutions are those that are effective in providing public safety, are compatible with the landscape resources, and are acceptable to the community.

12.1 REVIEW OF LIA

The LIA, provided by the FCDMC, is a study of the existing characteristics that identify, describe and delineate the extent of the landscape character units within Maricopa County. The report is a planning tool which breaks the County into a hierarchical system of land classification based on visual, physical, and land use, including character types, subtypes, and physical units.

A review of the LIA mapping indicates that the study area falls within one character type, three character subtypes, and is comprised of 31 character units. The Sonoran Desert Character Type covers approximately 86 percent of the County and is associated with the long views across the

desert and desert mountains. Subtypes of the study area include the Sonoran Mountain Lands, Sonoran Valley Lands, and the Sonoran River Lands.

The majority (43%) of the study area is made up of the Suburban Valley Plains Landscape Character Unit under the Sonoran Valley Landscape Character Subtype. The next largest character unit is the Urban Valley Plains Unit (19%), which is comprised of urban land uses located primarily along major roadway corridors. The remaining character units are comprised of various suburban, rural, industrial, and natural units based on physical, cultural, and visual settings.

The following sections describe the inventory data from the LIA including physical and cultural settings, landscape character units, open space, park and recreation resources, and the compatibility of flood hazard mitigation structural types and methods relative to the inventoried data. (For more information on the District's Flood Protection Structural Type and Methods, see the Flood Control District of Maricopa County web page: http://www.fcd.maricopa.gov/Projects/PPM/landArch.aspx).

The LIA provides mapping data for both existing conditions as well as future conditions which includes planned changes anticipated for the area. A comparison was made between the existing and future mapping, but due to the established character of the study area there were only minimal differences; including some growth of the urban area and more definition of the physical setting and character units. Therefore, for the purpose of this data summary, only the future data was used in the following Exhibits.

a. Physical Setting

(See Exhibit 8.a) The physical setting for the majority of the study area is categorized as Valley Plains, but there are also Mountain and Bajada areas on Camelback Mountain, Mummy Mountain and the Papago Buttes, and a Valley Wash category along the Arizona Canal and along Indian Bend Wash. These physical settings help to identify the effectiveness of structure types and concern for visibility, as well as the structural methods or aesthetic treatment that may be required.

b. Cultural Setting

(See Exhibit 8.b) As a reflection of land use, the landscape cultural settings identified in the exhibit represent a spectrum of landscapes that vary in degree of dominance of either natural or human-made features.

c. ***Landscape Character Units***
(See Exhibit 8.c) The landscape character units created from the physical and cultural settings.

d. ***Open Space & Parks and Recreation Resources***
(See Exhibit 8.d) Open Space including public and private lands, and parks.

e. ***Combined Structural Types Compatibility***
(See Exhibit 8.e) The Combined Structural Types Compatibility Map has been developed using a compilation of the landscape character units, open space, and recreational resources. The map identifies compatibility with the commonly used structures used for flood protection, including natural structure, underground pipe, channel levee, conveyance channel, storage basin, and dam. In addition to the three compatibility classes shown on Exhibit 8.e, the LIA contains a more defined map which breaks down the three classes into sizes of structures (S, M, & L) that would be compatible. If alternatives are identified that include above ground structures, the more defined LIA mapping should be reviewed.

f. ***Combined Structural Methods Compatibility***
(See Exhibit 8.f) The Combined Structural Methods Compatibility Map has been developed using a compilation of the landscape character, open space, and recreational resources. The map identifies compatibility with various flood hazard mitigation methods applied to structures, including natural, soft structural, semi-soft structural, enhanced hard structural, semi-hard structural, and hard structural.

12.2 COMMUNITY CONTEXT

The community context element of the FCDMC's CSFHM process consists of gathering input from the stakeholders and the public, and sensing the range of acceptable solutions for flood protection and control. As part of the data collection effort, information has been collected to help identify the community context of the study area. This includes city planning documents that relate to landscape character, scenic and recreational resources. This information will assist in the evaluation of flood protection alternatives and influence the how the alternatives or final solutions are developed. Exhibit 8.g provides a summary of the information. During the development of alternative solutions, this map should be referenced, as a start, to identify possible opportunities or constraints in terms of community context. Further investigation will be required into the specifics of the planning documents if alternative solutions fall within or near specific planning areas or study area features.

Exhibit 8.g illustrates particular planning areas or features for the four municipalities in the study area. These include:

City of Scottsdale: The City has a high level of sensitivity to the valued characteristics of the City's natural and man-made landscape. Numerous City codes, ordinances, and planning and design guidelines address the importance of preserving the unique landscape character and the value of open space. Most particularly, in the case of above ground flood control structures, the landscape character and open space will play a key role in the evaluation and development of alternatives for flood hazard mitigation. In addition to the City's General Plan, other pertinent planning documents for the Study area include:

- *City-Wide Design Guidelines.* The guidelines outline the City's expectations regarding design and the planning of developments, with the premise that every project should achieve its full potential in design, response to site conditions, contextual settings, and design influences associated with the region.
- *Local Area Character Plans.* These plans are working guides designed to assist city staff and property owners to make sure that infrastructure and city service needs can be met in areas of the city with large numbers of smaller individually owned properties. The Character Plans in the study area include the Shea Area Character Plan, the Downtown Area Character Plan, and the Southern Scottsdale Character Area Plan.
- *Growth areas:* Areas where future development is focused – mixed uses and multi-modal transportation are most appropriate in these areas.
- *Activity Areas:* Areas where development is concentrated, but to a lesser degree than the Growth Areas.

City of Phoenix: In addition to the General Plan, the LIBW study area contains two specific planning areas:

- *Camelback East Village:* Camelback East has two primary cores: the 24th Street and Camelback Road core and the 44th Street and Van Buren Avenue core. The village offers a range of housing diversity and neighborhood types with a major portion of the housing stock built between 1950 and 1970. Several prominent Valley landmarks, including the 914-acre Papago Park with an 18-hole golf course and Papago Baseball Facility, Squaw Peak Mountain Park, the Phoenix Zoo and the Desert Botanical Gardens bring visitors from all over the state. Camelback East is also home to three five-star resorts that provide the ambience of housing and resort living in a planned community setting while offering extensive recreational opportunities.
- *Arcadia Camelback Special Planning District:* This special planning district falls within the Camelback East Village, it is a policy document for the purpose of providing a consistent and ongoing planning program. The overall goal of the Special District Plan is to provide policies and preservation measures to sustain the residential character of this

area. This Special Planning District has a rich history and has historically been an area where residents have been active in preserving what is good about their neighborhood.

City of Tempe: In review of the City's General Plan information, of particular interest to the LIBW study area are two potentially eligible historic properties.

- *Historic properties:* Tempe is one of the oldest incorporated cities in the valley and enjoys a rich multi-cultural heritage evident through its historic buildings, open spaces, neighborhoods, and structures. Less visible, but equally important to the City, are the archaeological resources of Tempe's past, including the remains of several Hohokam villages. Protection and enhancement of heritage is critical to the City in preserving the unique identity of the community. Within the LIBW study area there are two subdivisions on Tempe's list for properties potentially eligible for historic designation: Papago Parkway1954~1960, and Cavalier Hills1960~1960.

Town of Paradise Valley: The Town of Paradise Valley has three Development Areas. Each Development Area has distinct characteristics based on the role it plays within the surrounding community and its context within the Town.

The three *Development Areas* are:

- 56th Street and Lincoln Drive Development Area is comprised of approximately 35 acres which includes the former Mountain Shadows Resort. This former resort property was closed in 2004 and contains a number of deteriorating structures.
- East Lincoln Drive North Development Area is comprised of approximately 110 acres of undeveloped land approved and platted as the Paradise Valley Ritz Carlton Special Use Permit property, but it has not been constructed.
- East Lincoln Drive South Development Area is comprised of approximately 55 acres including Smoke Tree Resort and Bungalows, Cottonwoods Resort, Lincoln Medical Complex, and the Applewood Pet Resort. The Development Area's close proximity to the City of Scottsdale also promotes reinvestment.

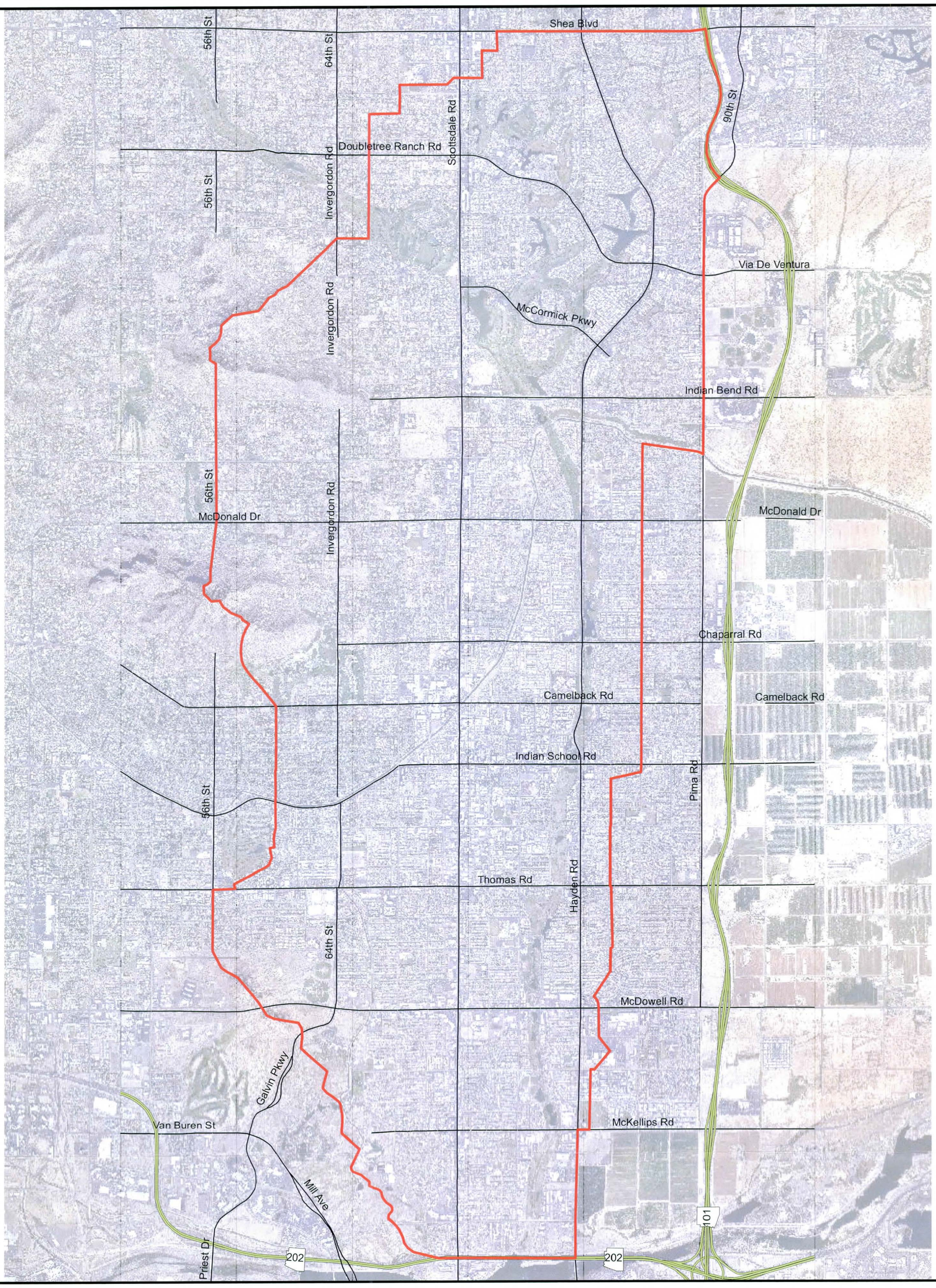
Parks/Open Space: Flood control improvements are very often compatible with recreational uses, such as soccer fields located within detention basins. The recreational aspects of possible flood control design alternatives will take into account the existing and proposed recreational land uses. The parks and open space shown on Exhibit 8.g were derived from District's LIA Open Space Resources, and Parks and Recreational Resources Maps, and supplemented with information from the municipal general plans.

12.3 HISTORIC DISTRICTS

As part of the data collection effort, designated historical districts within the LIBW study area were identified. In addition to the historical districts, the study area includes several historic landmarks/buildings. Therefore, the historic building registers will have to be reviewed if any of the proposed flood control measures impact individual buildings.

There were three historical districts identified within the City of Scottsdale; *Villa Monterey Units 1-7, Town & Country* and *Village Grove 1-6*. In addition, there are two subdivisions within the City of Tempe that are potentially eligible for historic designation; *Papago Parkway* and *Cavalier Hills*. Finally, the City of Phoenix identified *Papago Park* as a historic nonresidential district. Refer to appendix J for an exhibit showing the location of the aforementioned districts in relation to the LIBW study area boundary.

Appendix A: Topographic and Aerial Maps



Legend

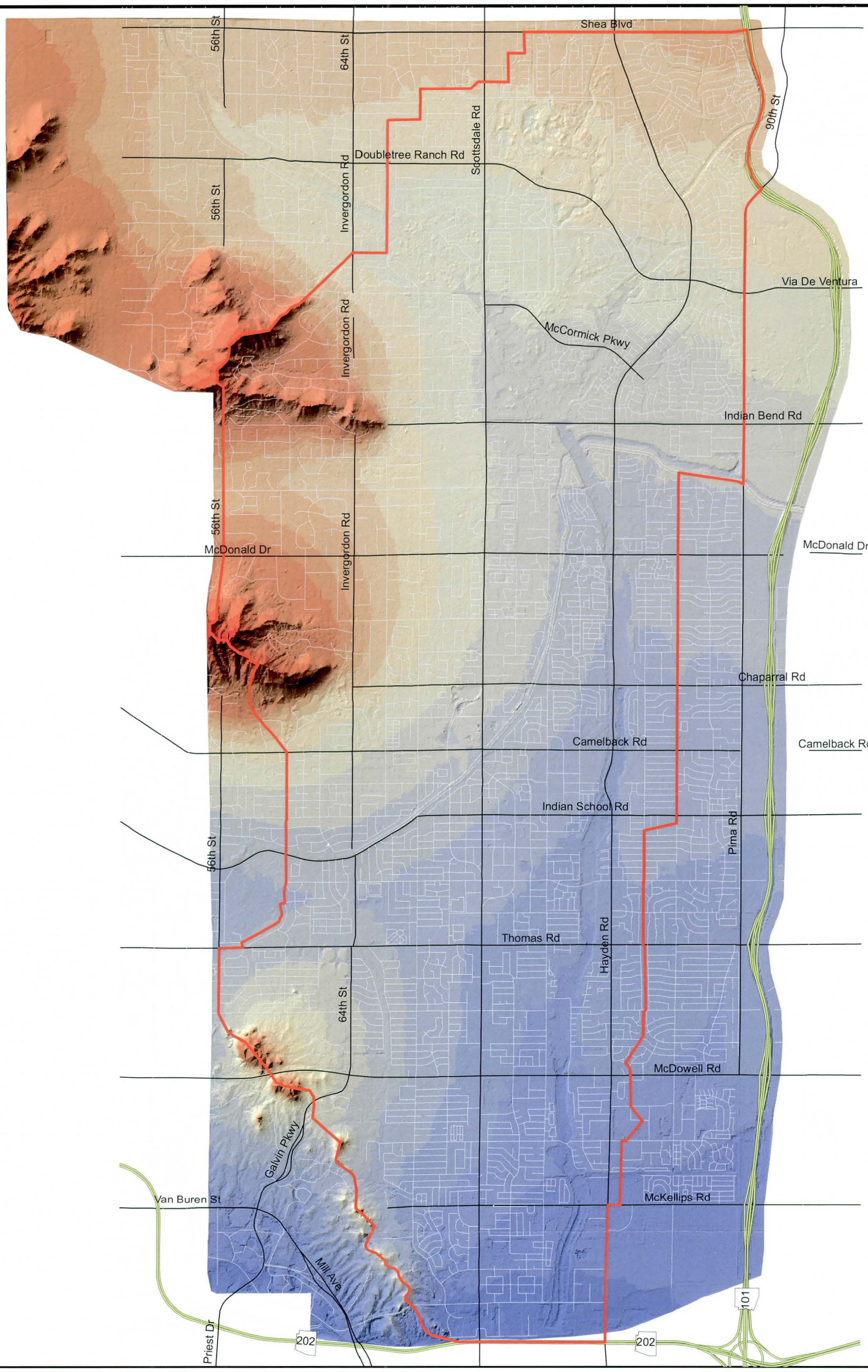
Study Boundary Area

Lower Indian Bend Wash ADMS
Aerial Map (FY 2011-2012)
Appendix A

4,100 0 4,100 Feet
1 inch = 4,167 feet

Flood Control District of Maricopa County

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture



Legend

2300 - 2670	1300 - 1320	Study Area Boundary
2000 - 2300	1280 - 1300	
1700 - 2000	1260 - 1280	
1400 - 1700	1240 - 1260	
1380 - 1400	1220 - 1240	
1360 - 1380	1200 - 1220	
1340 - 1360	1180 - 1200	
1320 - 1340	1150 - 1180	

4,100 0 4,100 Feet

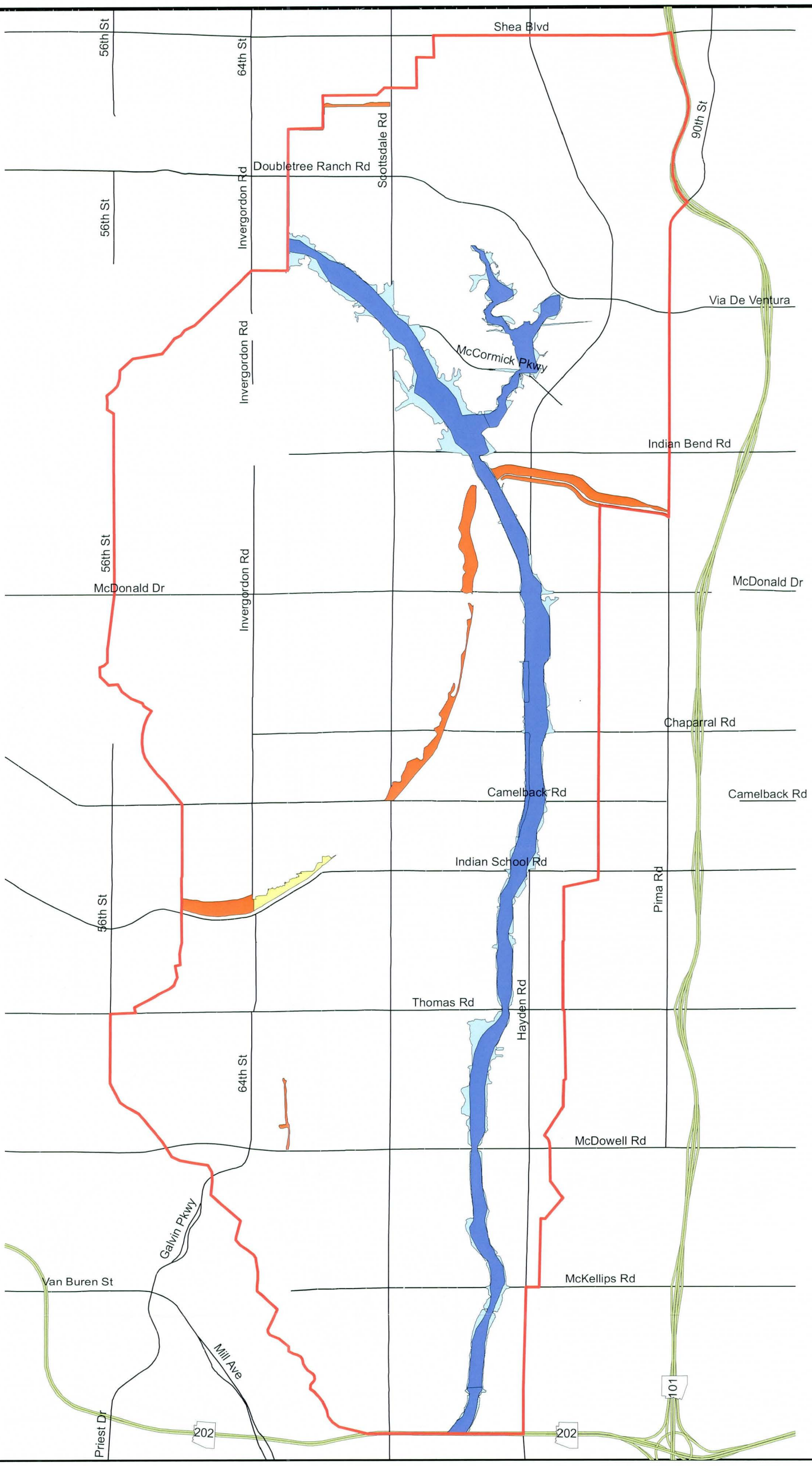
1 inch = 4,167 feet

Lower Indian Bend Wash ADMS Topography Map Appendix A

Flood Control District of Maricopa County

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

Appendix B: FEMA Floodplain Maps



Legend

- Study Area Boundary
- Floodplain Zone A
- Floodplain Zone AH
- Floodplain Zone AE
- Floodway

4,100 0 4,100 Feet

1 inch = 4,167 feet

Lower Indian Bend Wash ADMS
FEMA Floodplain
Appendix B

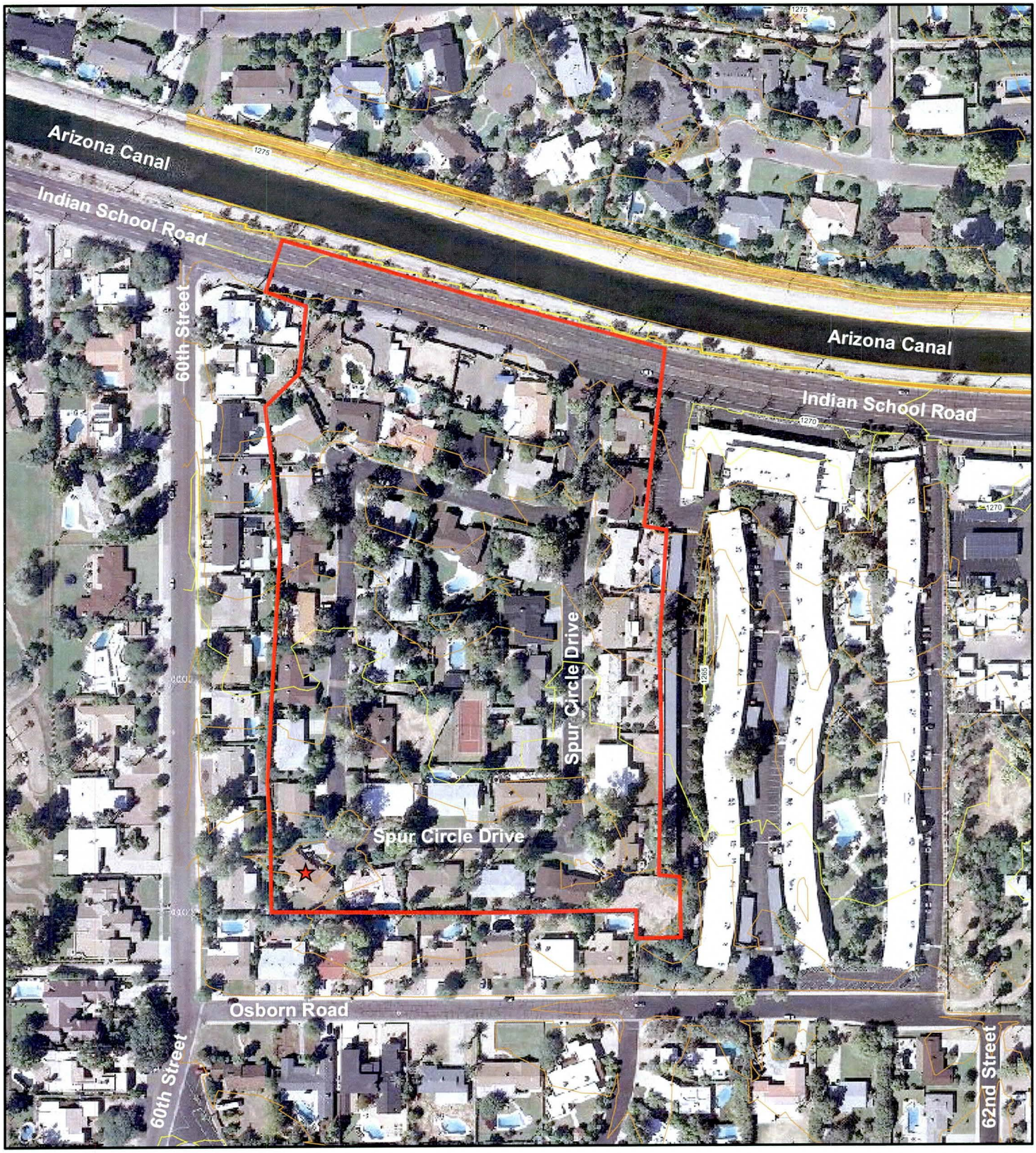
Flood Control District of Maricopa County

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

Appendix C: Flooding Complaints

Drainage Complaints

25 N. Spur Circle Drive Drainage Complaint



Legend

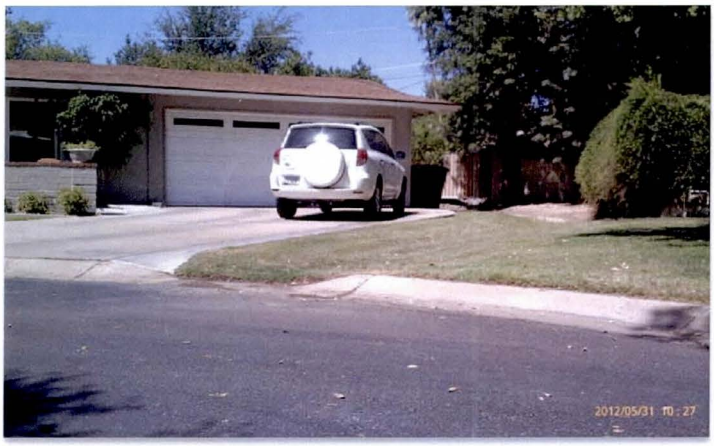
- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

25 N. Spur Circle Drive Drainage Complaint



Looking at 25 N. Spur Circle Drive
(Note: Drainage swale on north side of the property)

Close up: Drainage swale on north side of property at 25 N. Spur Circle Drive

Looking North along Spur Circle Drive

Looking East along Spur Circle Drive

Local Drainage Area: 11.9 Acres

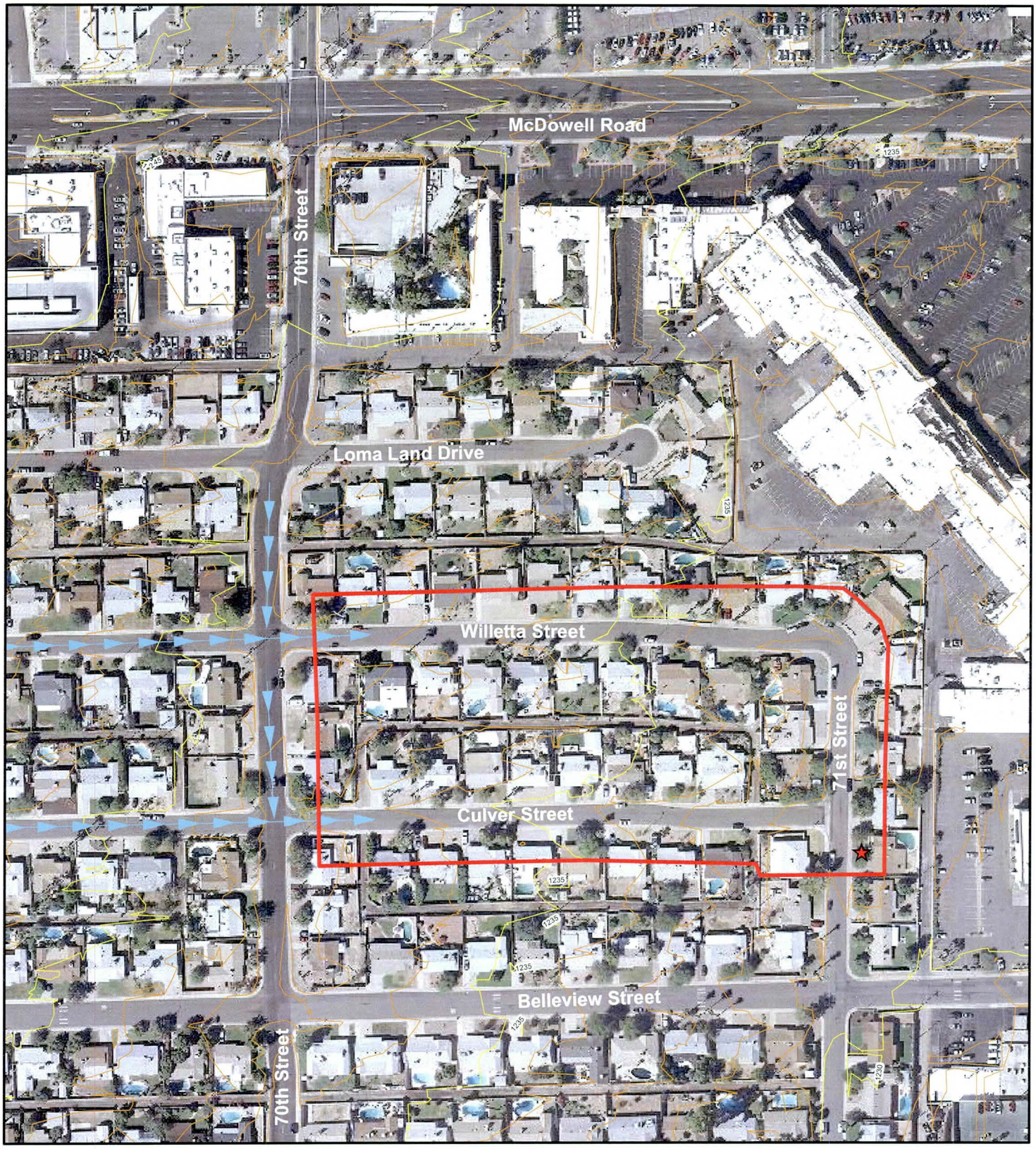
Apparent Offsite Inflow: No

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the drainage channel next to the house at 25 N. Spur Circle Drive ponds and floods the yard and street.

Field Visit Observation: The entire subdivision as well as the Indian School Road frontage to the subdivision drains to the drainage swale (6 ft wide by 1 ft deep) at 25 N. Spur Circle Drive. The swale discharges flow from the street to the property located due west and eventually out onto 60th Street. The swale is grass lined at 25 N. Spur Circle Drive, but transitions to a rock lined swale before discharging out onto 60th Street. From visual inspection, it appears that the rock lined portion of the swale is at least a few inches above the grass lined portion. The house and garage at 25 N. Spur Circle Drive are above the top of curb elevation

Conclusion/Recommendation: In order to minimize the ponding in the yard and the street, the rock lined portion of the drainage swale should be regraded to drain the grass lined portion of the swale. To verify that the swale can convey the 100-year flood without the risk of structural flooding, a detailed hydrologic/hydraulic analysis should be performed. This is a local drainage issue, but the hydrologic analysis will be able to answer the question as to the effectiveness of the swale in conveying the 100-year flood.

1313 N. 71st Street Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Offsite Inflow
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

1313 N. 71st Street Drainage Complaint

Looking Southeast at 1313 N. 71st Street

Looking South along 71st Street

Looking North along 71st Street

Looking East along Culver Street

Local Drainage Area: 7.9 Acres

Apparent Offsite Inflow: Yes (at 70th Street & Willetta Street & at 70th Street & Culver Street)

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the property at 1313 N 71st Street, as well as the property immediately to the north at 1319 N. 71st Street, both experienced water entering their residences during a storm event.

Field Visit Observation: From visual inspection, it appears that the house at 1313 N. 71st Street is located below the top of roll curb that is fronting the property. The property is located at the downstream end of a relatively small local watershed, however, from field inspection it was found that there are two major offsite inflow locations along 70th Street; one at Willetta Street and the other at Culver Street. The watershed for these flows appears to extend all the way to 68th Street. Due to its relatively flat nature, water that flows down Willetta and Culver Street is unable to be conveyed in 71st Street.

Conclusion/Recommendation: During the site investigation, it was found that very recently, 10 new 20-foot curb opening inlets were constructed immediately upstream of the property at 1313 N. 71st Street. Two are located on Willetta Street, just west of 71st Street, four are located on 71st Street, north of Culver Street and an additional four are located on Culver Street just west of 71st Street. The construction of the inlets will intercept a significant amount of flow and prevent it from reaching the flood prone properties on 71st Street. The effectiveness of the new inlets will be analyzed as part of the hydrologic analysis.

1841 N. 66th Street Drainage Complaint

Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Offsite Inflow
- Elevation Contour (1' Interval)

0 N 500

1 in = 250 ft

1841 N. 66th Street Drainage Complaint

Looking Southeast at 1841 N. 66th Street

Looking North along 66th Street

Looking South along 66th Street

Looking Northeast from Detention Basin
(Note: 1841 N. 66th Street Property in Background)

Local Drainage Area: 50.5 Acres

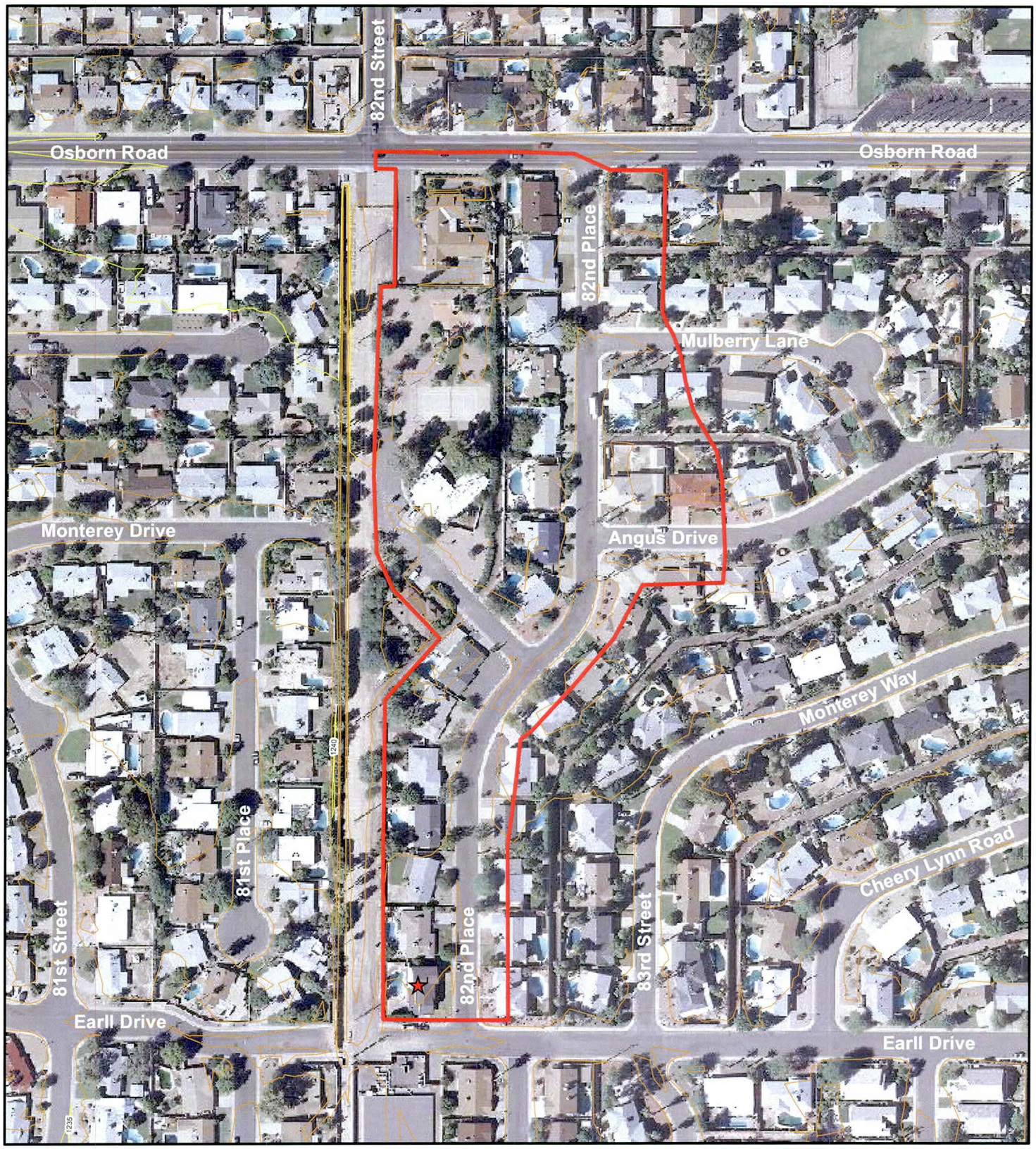
Apparent Offsite Inflow: Yes (at Oak Street & 66th Street)

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the property at 1841 N. 66th Street has been flooded once since 1992, and that was when the City of Phoenix Papago Park Baseball Facility dike broke in 1994.

Field Visit Observation: From visual inspection of the property it clearly appears that the residence is significantly higher than that top of roll curb elevation on 66th Street. Just south of the property is a detention basin that discharges to a large diameter storm drain which runs in 66th Street, north to the Oak Street storm drain. In addition to the detention basin, there are a multitude of grated inlets that are picking up flows before they arrive at the detention basin. There is one offsite inflow location located at Oak Street and 66th Street, however there are inlets along Oak Street that pick up small flows from flowing down 66th Street, however, larger flows might exceed the inlet capacity and turn the corner and discharge down 66th Street.

Conclusion/Recommendation: The existing drainage infrastructure including the storm drain inlets and connection to the detention basin was added after the 1994 flooding event. These improvements were part of the Oak Street Storm Drain project which was build in 1999. It was designed to provide 100-yr flood protection for the properties along the Cross-Cut Canal, therefore this flooding complaint has been resolved.

3126 N. 82nd Place Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Elevation Contour (1' Interval)

0 N 400

1 in = 200 ft

3126 N. 82nd Place Drainage Complaint

Looking Northwest at 82nd Place and Earll Drive Intersection
(Note: 3126 N. 82nd Place Property in Background)

Looking East along Earll Drive

Looking West along Earll Drive

Looking North 82nd Place

Local Drainage Area: 9.9 Acres

Apparent Offsite Inflow: No

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the resident complained that when it rains water ponds in front of the home's driveway and on the street corner, eventually spilling over the top of curb and into the front yard.

Field Visit Observation: From visual field inspection, it appears that the house at 3126 N. 82nd Place is only slightly above the top of curb (TOC) elevation on Earll Drive, however the garage appears to be below the TOC elevation with the driveway sloping towards the house. It appears that the northwest corner of 82nd Place and Earll Drive is in a sump, which causes water to pond at the corner and in front of the residence's driveway. Once the ponded water gets to a high enough elevation to spill over the crown of 82nd Street, it flows easterly down Earll Drive. From visual inspection, it appears that the sump is about 4 to 6 inches deep and there is clear evidence of the ponding with significant degradation to the asphalt and concrete curb.

Conclusion/Recommendation: It appears that there is a potential for the ponding to exceed the top of curb elevation, which could cause flooding problems for the front yard and possibly the garage. This is a local issue that can be improved with a concrete valley gutter across 82nd Street to eliminate the local sump on the northwest corner of 82nd Street and Earll Drive.

4700 N. 64th Street Drainage Complaint

Legend

- ★ Drainage Complaint Location
- Drainage Flow Path
- Elevation Contour (1' Interval)

0 N 500

1 in = 250 ft

4700 N. 64th Street Drainage Complaint

Looking Northeast at 4700 N. 64th Street
(Note: Dip in 64th Street at Golf Course Entrance)

Looking North along 64th Street
(Note: Depressed Curb and Sidewalk)

Looking North along 64th Street

Looking at Storm Drain Inlet South of Golf Course at Camelback Road

Local Drainage Area: Not Applicable (Major offsite contributing drainage area)

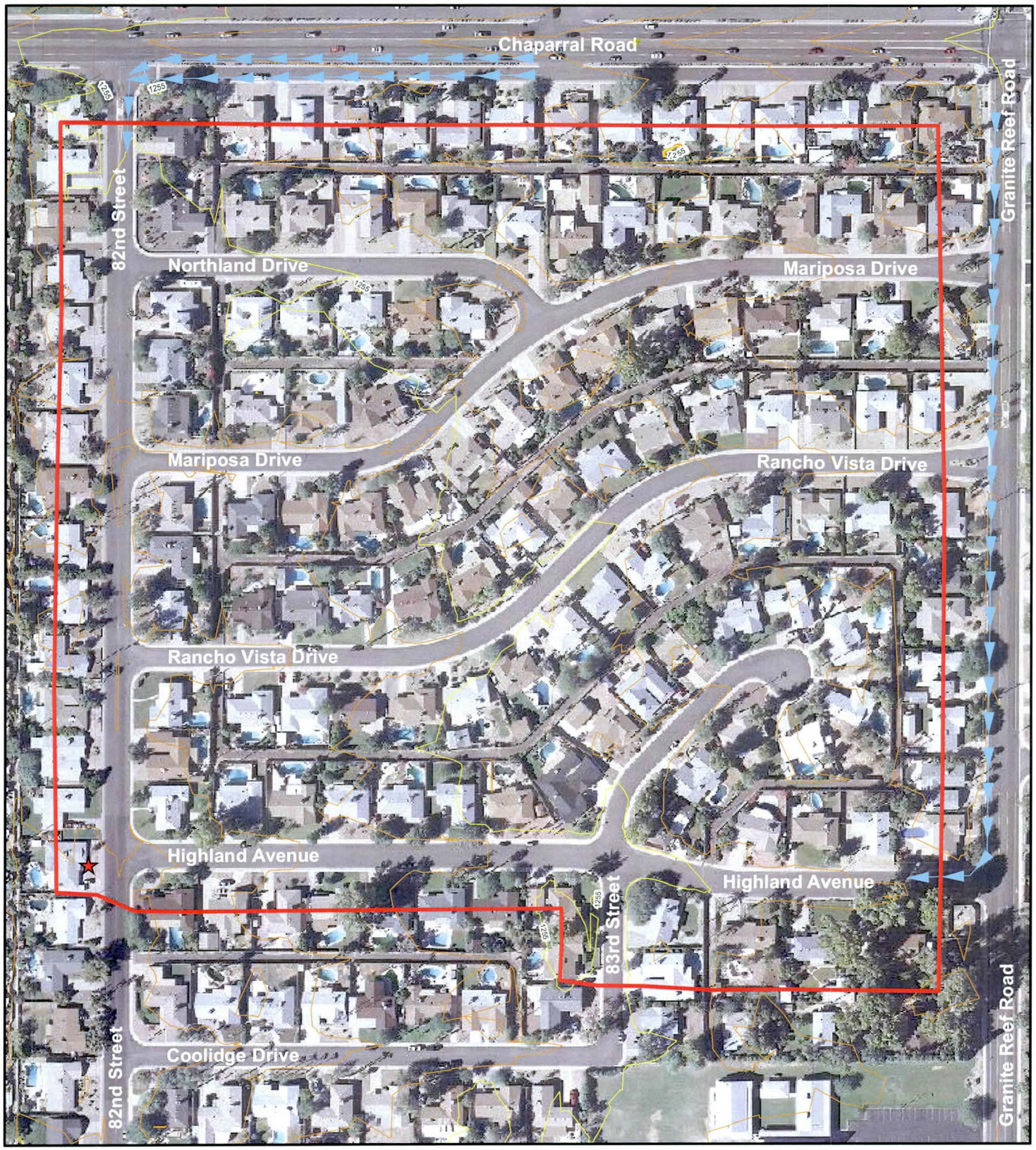
Drainage Flow Path: Enters the Phoenician Golf Course from 64th Street and exits at Camelback Road

Flood Complaint Description: According to the drainage complaint on file with the City of Phoenix; flood waters enter the Phoenician golf course from 64th Street and causes damage to the golf course.

Field Visit Observation: From the field inspection it was found that there is a significant dip section in 64th Street, just south of Phoenician Boulevard. Water flowing down 64th Street enters the Phoenician golf course at the dip section through a depressed curb/sidewalk and the entrance drive. Within the golf course, the water flows in a southeasterly direction through the fairway and into a lake system north of Camelback Road. Once the lakes fill up, the water flows out south towards a grated inlet that is connected to the Camelback Road storm drain.

Conclusion/Recommendation: The dip in 64th Street, the depressed curb/sidewalk and the large grated inlet north of Camelback Road indicate that the golf course was designed to accept offsite runoff from 64th Street and convey it to the Camelback Road storm drain. This flooding issue will be furher reviewd with the hydrologic analysis.

4726 N. 82nd Street Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Offsite Inflow
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

4726 N. 82nd Street Drainage Complaint

Looking West at 82nd Street and Highland Avenue Intersection
(Note: 4726 N. 82nd Street Property in Background)

Looking North along 8f2nd Street (From Highland Avenue)

Looking East along Highland Avenue

Looking North along 82nd Street (From Coolidge Drive)

Local Drainage Area: 36.3 Acres

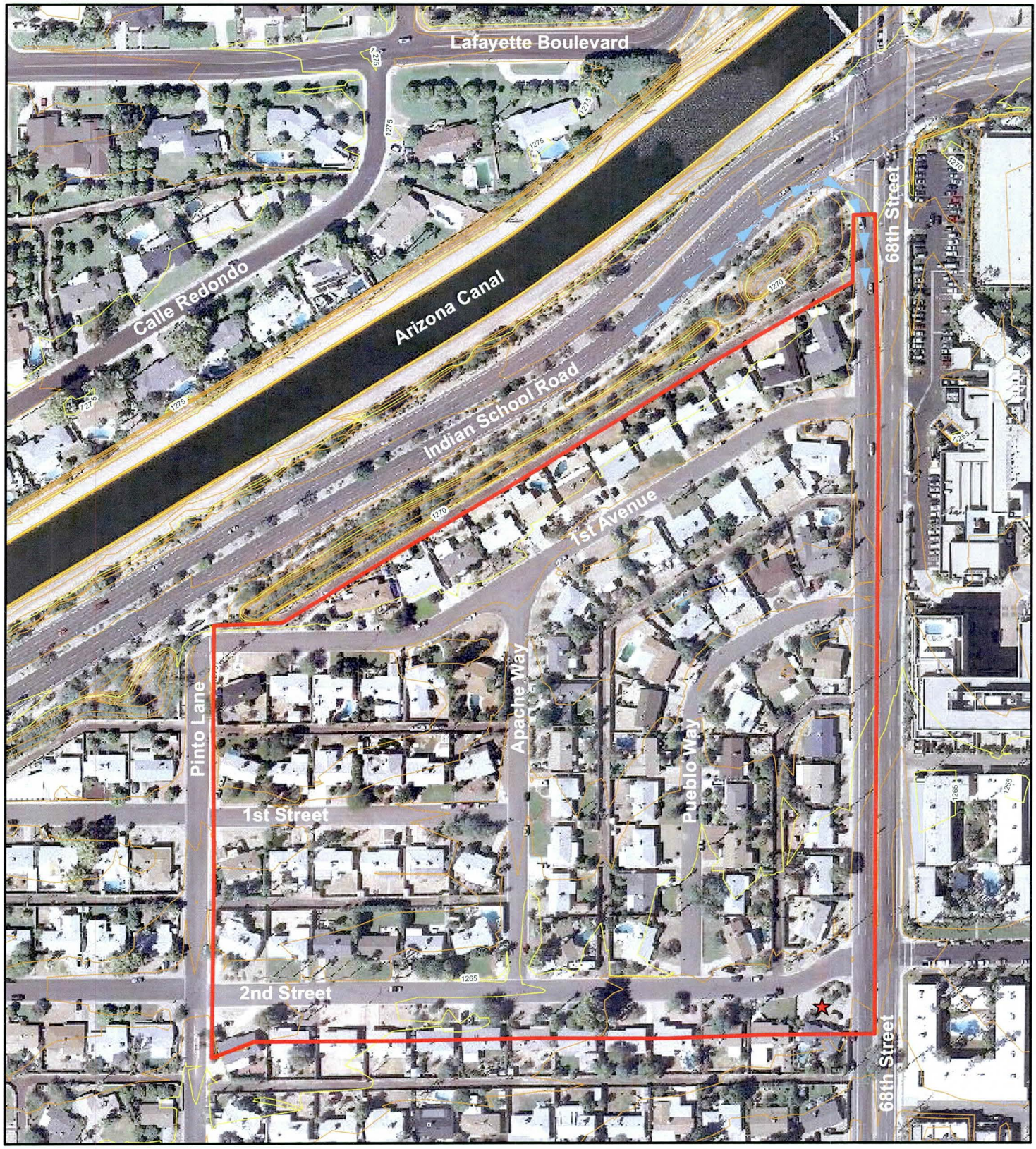
Apparent Offsite Inflow: Yes (at 82nd Street and Chaparral Road & at Granite Reef Road and Highland Avenue)

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; flow from 82nd Street and Highland Avenue combines in front of the property at 4726 N 82nd Street and flows through the driveway to the backyard and into the pool. Reportedly the entire backyard gets flooded.

Field Visit Observation: From visual field inspection it appears that the property is significantly lower than the top of roll curb elevation along 82nd Street. The driveway slopes from the street towards the carport. When water in 82nd Street overtops the top of curb, it flows down the driveway, through the carport and into the backyard. The home's finished floor elevation is above the carport slab but flood waters could enter the home in the event of a major storm. It appears that street improvements have been constructed in order to help mitigate the flooding problem. 82nd Street has been regraded/repaved from Highland Avenue to Coolidge Drive with an inverted centerline crown. This has increased the conveyance capacity of 82nd Street, but with only a small grated catch basin at Coolidge Drive, the improvements may not have completely solved the problem.

Conclusion/Recommendation: The intersection of 82nd Street and Highland Avenue is the concentration point of a relatively large, developed watershed with additional offsite flow entering the watershed at two locations during larger storm events. This drainage issue will be reviewed as part of the hydrologic analysis.

6737 E. 2nd Street Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Offsite Inflow
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

6737 E. 2nd Street Drainage Complaint

Looking Southeast at 6737 E. 2nd Street

Looking South along 68th Street

Looking West along 2nd Street

Looking North along 68th Street

Local Drainage Area: 19.3 Acres

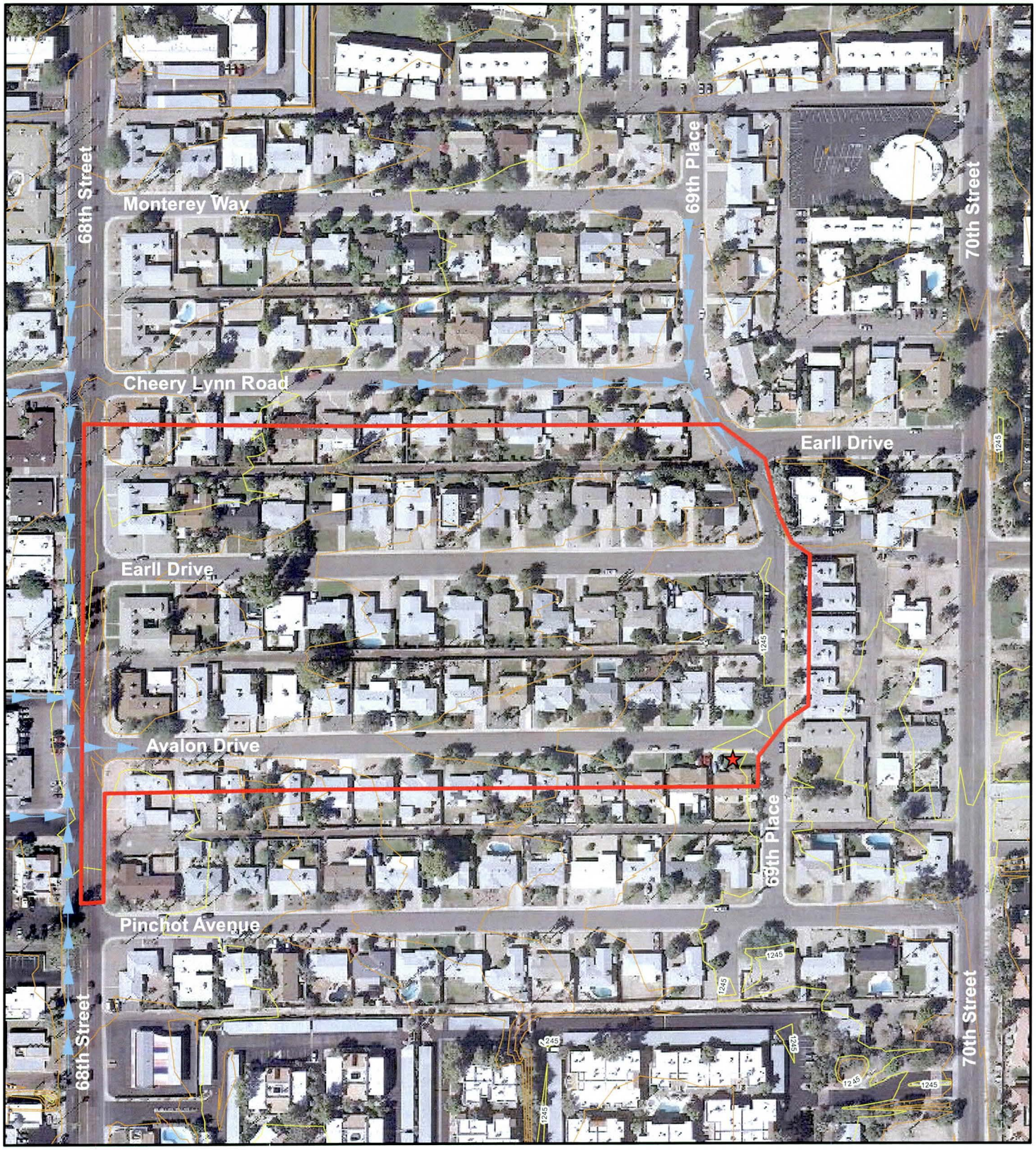
Apparent Offsite Inflow: Yes (at 68th Street and Indian School Road)

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the garage and front yard of the property at 6737 E. 2nd Street were flooded with flood waters entering from both 68th Street to the east and 2nd Street from the north.

Field Visit Observation: The property in question is located at the southwest corner of 68th Street and 2nd Street, with the garage being located off of 68th Street. From visual field inspection it appears that the garage is below the top of roll curb elevation on 68th Street. When flood waters exceed the capacity of the 68th Street, they spill into the garage. On 2nd Street, there is a noticeable low spot in the gutter in front of the driveway entrance. This low spot causes runoff to pond in the gutter, limits the capacity of the gutter, and contributes to the front yard flooding problem.

Conclusion/Recommendation: The intersection of 68th Street and 2nd Street is the concentration point of a relatively large local watershed with offsite inflows contributes during larger storm events. The drainage issue along 2nd Street can be mitigated by rebuilding portions of the existing curb and gutter. The drainage issue along 68th Street can be improved by increasing the conveyance capacity in 68th Street either by adding a storm drain or repaving to improve its surface flow capacity.

6925 E. Avalon Drive Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Local Drainage Area Boundary
- Offsite Inflow
- Elevation Contour (1' Interval)

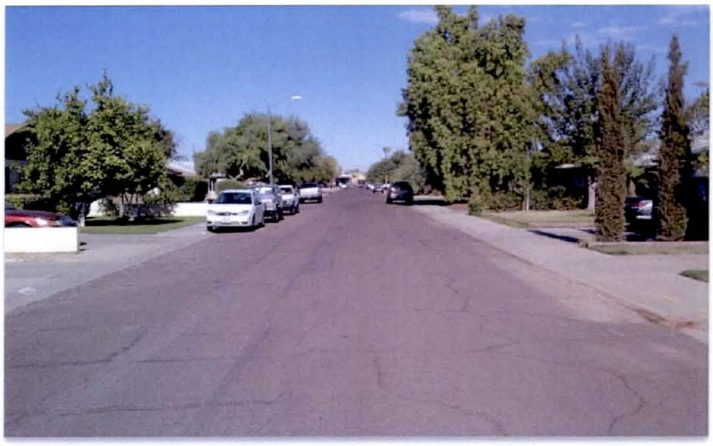
N

0 400

1 in = 200 ft

6925 E. Avalon Drive Drainage Complaint

Looking Southwest at 69th Place and Avalon Drive Intersection
(Note: 6925 E. Avalon Drive Property in Background)



Looking West along Avalon Drive

Looking South along 69th Place

Looking North along 69th Place

Local Drainage Area: 13.0 Acres

Apparent Offsite Inflow: Yes (at 68th Street & Avalon Drive and 69th Place & Earll Drive)

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the storm event that occurred on July 31st 2010 caused the intersection of 69th Place and Avalon Drive to flood and the property at 6925 E. Avalon Drive to experience yard flooding, with water threatening to enter the residence. From talking to property owner and neighbors, this was not an isolated occurrence, the flooding problem has existed for years.

Field Visit Observation: From the field inspection, it appears that the finished floor elevation of the property at 6925 E. Avalon Drive is below the top of curb (roll curb) elevation. There are two existing grated inlets at the intersection, once the inlets and the capacity of the street are exceeded water will spill into the front yard, potentially flooding the residence.

Conclusion/Recommendation: As part of a recent City of Scottsdale drainage improvement project, this drainage issue has been significantly improved. The project included catch basins along Avalon Drive, 68th Street and 69th Place to intercept flood waters before they arrive at the intersection of 69th Place and Avalon Drive. However, only a portion of the improvements has been built to date, Phase Two of the project will be built when funds become available. Once Phase Two is constructed, the area should have a 10-year level of flood protection. The level of flood protection will be reviewed as part of the hydrologic analysis.

7100 N. Pima Road Drainage Complaint

Legend

- ★ Drainage Complaint Location
- Drainage Flow Path
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

7100 N. Pima Road Drainage Complaint

Looking North along Pima Road

Looking South along Pima Road

Looking South along Pima Road

Looking North along Pima Road

Local Drainage Area: Not Applicable (Major offsite contributing drainage area)

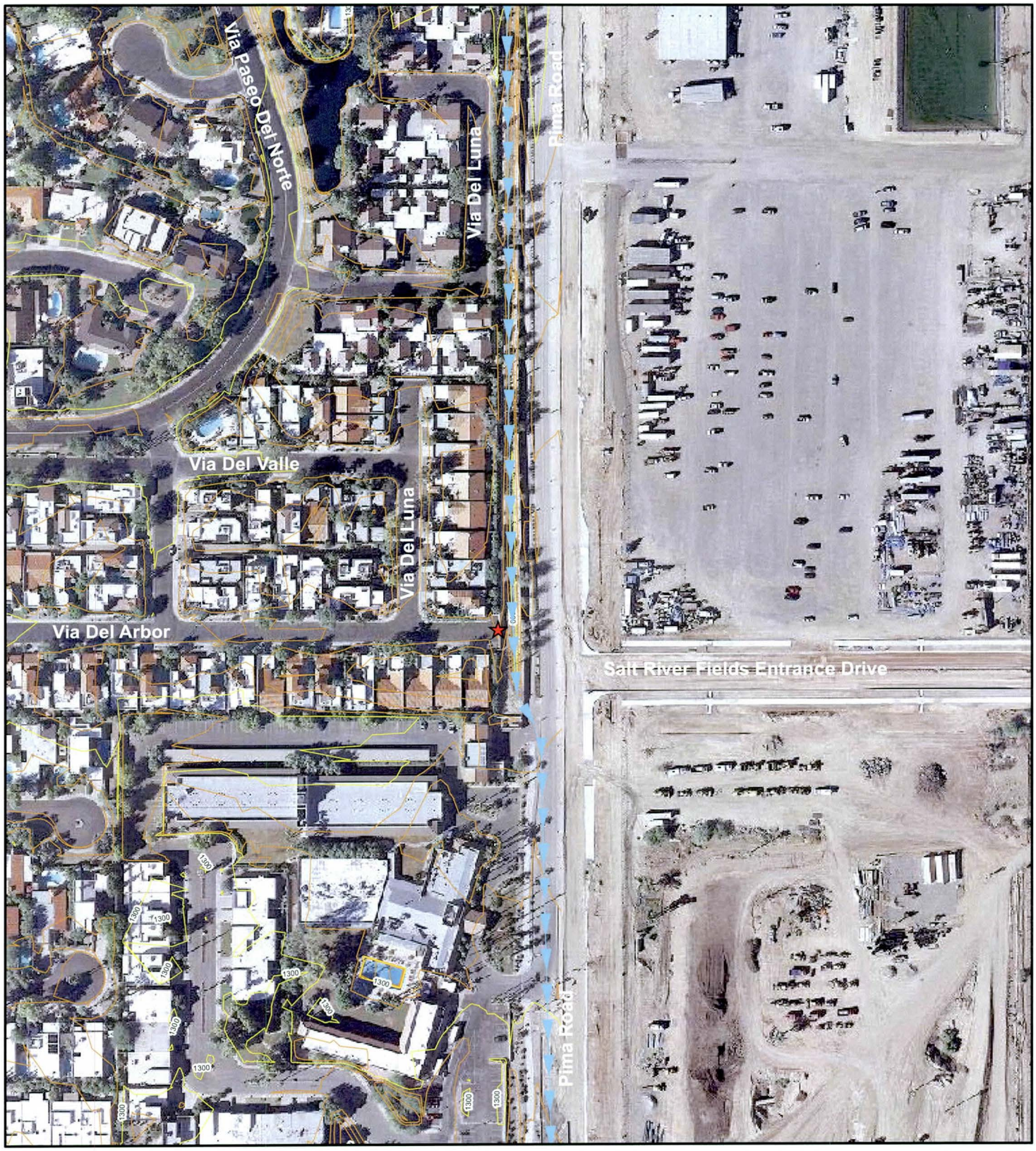
Drainage Flow Path: Flow is from north to south along Pima Road

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; Pima Road just north of Indian Bend Road was flooded with standing water and cars stranded in the street.

Field Visit Observation: From field inspection and aerial mapping review, it is evident that Pima Road has been improved within the past few years (Note: The aerial in this exhibit shows Pima Road under construction). As part of the roadway improvements, Pima Road was widened from a two lane road with curb and gutter on the west side to a 4-lane roadway with curb and gutter and a landscaped median that continuously slopes north to south. In addition to the roadway improvements, the newly developed *Pavilions at Talking Stick* shopping center has cut off a significant portion of the offsite flow that used to drain to this part of Pima Road. There are curb opening inlets along the west side of Pima Road.

Conclusion/Recommendation: With the construction of the *Pavilions at Talking Stick* and the Pima Road improvements, it appears that the potential of Pima Road flooding has been significantly reduced. No further action seems to be required.

7500 N. Pima Road Drainage Complaint



Legend

- ★ Drainage Complaint Location
- Drainage Flow Path
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

7500 N. Pima Road Drainage Complaint

Looking Southeast at the Drainage Channel Outfall
(Note: Maintenance Access gate and Pima Road in the Background)

Looking South along Pima Road
(Note: Maintenace Access gate on the right)

Looking South along Drainage Channel

Looking at Dead-End in Via Del Arbor
(Note: No Wall Openings in Privacy Wall)

Local Drainage Area: Not Applicable (Major offsite contributing drainage area)

Drainage Flow Path: Flow is from north to south in a drainage channel along the west side of Pima Road (behind the sound wall); the channel discharges to Pima Road

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; the drainage channel that is located west of Pima Road between the Pima Road sound wall and the communities privacy wall ponded water and spilled into the community through openings in the privacy wall.

Field Visit Observation: From field inspection it was found that the drainage channel drains north to south and discharges to a headwall inlet that connects to the Pima Road storm drain. It appears that flows in excess of the capacity of the inlet will pond and spill out onto Pima Road through the maintenance access gate that is located just south of the inlet. Water spilled into the adjacent community through the privacy wall at the end of Via Del Arbor. However, upon inspection of the privacy wall no openings were found that would allow water to spill into the community.

Conclusion/Recommendation: It appears that since the time that the drainage complained was filed, the openings in the privacy wall at the end of Via Del Arbor have been blocked off. From the brief visual field inspection, the intended flow path for excess flow in the drainage channel appears to spill out through the maintenance gate and onto Pima Road. Therefore, blocking the wall openings on Via Del Arbor has the effect of forcing the water to pond and spill out onto Pima Road instead Via Del Arbor. It appears that the problem has been resolved and no further action is apparently needed.

7600 & 7800 E. McCormick Parkway Drainage Complaint

Legend

- Drainage Complaint Location
- Drainage Flow Path
- Elevation Contour (1' Interval)

N

0 800

1 in = 400 ft

7600 & 7800 E. McCormick Parkway Drainage Complaint

Looking East towards 18-inch Culvert at 7600 E. McCormick Parkway
(Note: McCormick Parkway is on the right)

18-inch Culvert at 7600 E. McCormick Parkway

Looking West along McCormick Parkway at 7800 E. McCormick Parkway

Looking at Golf Lake North of 7800 E. McCormick Parkway

Local Drainage Area: Not Applicable (Major offsite contributing drainage area)

Drainage Flow Path: Flow is along McCormick Parkway from west to east

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; McCormick Parkway was flooded on both sides of a relatively large housing development. The only access to and from the development was to drive through the floodwaters along McCormick Parkway.

Field Visit Observation: From field and contour inspection, it was found that water within the McCormick Ranch Golf Course flows south towards McCormick Parkway. On the west side of the development (7600 E. McCormick Parkway) water flows to a low spot where it discharges in a 18-inch pipe underneath McCormick Parkway. When the capacity of the pipe culvert is exceeded, water spills into the west bound lanes of McCormick Parkway and flows east until it crosses the street at 7800 E. McCormick Parkway and flows south into the golf course lake. In addition to the water in the street, water from the lakes north of McCormick Parkway discharge across the street at this same location.

Conclusion/Recommendation: It appears that the east section of McCormick Parkway (7800 E. McCormick Parkway) was designed as a weir spill over location for flows coming through the golf course lake system. However, at the west section (7600 E.) it appears that the existing 18-inch pipe culvert is inadequate. Therefore, the existing 18-inch pipe culvert should probably be upsized as to prevent flows from spilling into McCormick Parkway. The adequacy of the exiting culvert will be reviewed with the hydrologic analysis.

8200 E. Via Paseo Del Sur Drainage Complaint

Legend

- Drainage Complaint Location
- Drainage Flow Path
- Elevation Contour (1' Interval)

N

0 400

1 in = 200 ft

8200 Via Paseo Del Sur Drainage Complaint

Looking South along Drainage Channel towards Via Paseo Del Sur

Upstream side of Culverts at Via Paseo Del Sur

Downstream side of Culverts at Via Paseo Del Sur

Upstream side of Grated Culvert at Indian Bend Road

Local Drainage Area: Not Applicable (Major offsite contributing drainage area)

Drainage Flow Path: Flow is from north to south along the grass/concrete lined channel

Flood Complaint Description: According to the drainage complaint on file with the City of Scottsdale; two residents of the area have complained that during rain events the drain grates at the box culvert are not adequately sized and cause the water to back up in the channel.

Field Visit Observation: From field inspection it was found that the culverts at Via Paseo Del Sur do not have grates. The only culvert that is equipped with a grate is the downstream culvert at Indian Bend Road. The grass lined channel drains south to four culverts underneath Via Paseo Del Sur. If the capacity of the culverts is exceeded, runoff will weir flow across the street and into the downstream, concrete lined portion of the channel (Note: an existing planter significantly reduces the weir capacity on the downstream side of Via Paseo Del Sur). All the homes in the area are elevated and should not be susceptible to flooding. The grate on the culvert at Indian Ben Road is susceptible to clogging, which can reduce its interception capacity.

Conclusion/Recommendation: This appears to be a local drainage issue. To improve the water from backing up in the channel (and potentially spilling over the grate inlet and into Indian Bend Road), the exiting grate could be replaced with a new grate that is less susceptible to clogging.

Appendix D: Drainage Report Summary Table

Drainage Report Summary Table

Name	Agency	Prepared By	Date
Final Drainage Report: PCX-1 GAC Treatment Facility	City of Scottsdale	Water Works Engineers, LCC	March 12, 2012
	Summary/Description: The report provides drainage calculations for the new water treatment facility located on the southeast corner of McDonald Drive and Cattle Tracks Road. The report only includes onsite requred retention volume calculations for the 100-year, 2-hour storm event.		
Final Drainage Report: Camelback Golf Club	Marriott Corporation	Erie & Associates, Inc.	March 12, 2012
	Summary/Description: The report provides the drainage analysis for the golf course re-design, which will include modifications to the course layout, re-grading/re-contouring of the holes within the IBW 100-year floodplain as well as low-flow golf cart bridge construction.		
Avalon Drive Drainage Study: Crosscut Canal to 69th Place	City of Scottsdale	Gavan & Barker Inc.	July 25, 2011
	Summary/Description: The report provides hydrologic and hydraulic analysis for the flooding problems at the intersection of 69th Place and Avalon Drive as well as the low spot on 66th Street just north of Earll Drive.		
Final Drainage Report for Model Railroad Building: McCormick Railroad Park	City of Scottsdale	Erie & Associates, Inc.	January 20, 2010
	Summary/Description: The report documents the hydrologic and hydraulic calculations for the McCormick Railroad Park improvements on the Southeast corner of Indian Bend Road and Scottsdale Road. The report calculated an existing 100-year, 6-hour peak discharge at the Scottsdale Road and Indian Bend Road is 1082 cfs with the future condition peak discharge (with the empty lot developed and channelized) will be 1964 cfs.		
Master Drainage Report Supplement for 7000 E Lincoln Drive: Temporary Outfall Channel	City of Scottsdale	Erie & Associates, Inc.	April 27, 2009
	Summary/Description: The report documents the hydrologic and hydraulic calculations for an temporary channel along Indian Bend Road from Scottsdale Road to IBW in order to alleviate the drainage issue stemming from the empty lot east of Scottsdale Road (between Indian Bend Road and Lincoln Drive). The report has a 100-year, 6-hour peak discharge for the main wash that enters the empty lot on Mockingbird Road of 1853 cfs. The peak discharge at the intersection of Lincoln Drive and Scottsdale Road was calculated to be 992 cfs and the channel (Mummy Mountain Wash) north of Indian Bend Road at Scottsdale Road was found to have a peak discharge of 731 cfs.		
Letter of Map Revision Based on Fill: Reach 4 of the Side Channel System	City of Scottsdale	Arroyo Engineering, LLC	July 30, 2008
	Summary/Description: The LOMR-F that was submitted to FEMA for review and approval for the Arizona Canal floodplain from Chaparral Road to Thornwood Drive. The LOMR-F is the subsequent submittal to the above CLOMR-F.		
Final Drainage Report Indian Bend Road Improvements: Scottsdale Road to Hayden Road (Volume 1 of 2)	City of Scottsdale	URS	June 29, 2007
	Summary/Description: Volume 1 of the drainage report documents on-site and off-site drainage improvements that were done as part of the Indian Bend Road improvements. Some of the off-site drainage improvements include the Seville Channel, culverts and storm drains in McCormick-Stillman Railroad Park, new inlets on Scottsdale Road and Rocking Road and a bridge structure (multi-barrel arch culvert) at Indian Bend Wash.		
Final Drainage Report Indian Bend Road Improvements: Scottsdale Road to Hayden Road (Volume 2 of 2)	City of Scottsdale	URS	June 29, 2007
	Summary/Description: Volume 2 of the drainage report includes hydraulic model printouts (Seville Channel, Indian Bend Wash, etc... HEC-RAS results).		
Conditional Letter of Map Revision Based on Fill: Reach 4 of the Side Channel System	City of Scottsdale	Arroyo Engineering, LLC	November 20, 2006
	Summary/Description: The CLOMR-F includes a detailed hydrologic and hydraulic analysis of the Arizona Canal floodplain from Chaparral Road to Thornwood Drive. The intent of the CLOMR-F was to remove the floodplain designation from the new *Reflections on the Canal* condominiums.		

Name	Agency	Prepared By	Date
Request for Letter of Map Revision: Arizona Canal Scottsdale, Arizona	City of Scottsdale	EEC, Inc.	January 9, 2003
	Summary/Description: The LOMR includes a detailed hydrologic and hydraulic analysis of the Arizona Canal floodplain from 64th Street to Goldwater Boulevard. The analysis showed that the 100-year water surface elevation was 1.5 feet below the top of the bank elevation, removing the designated floodplain from 76 homes.		
Storm Drain Design Report for ADW Neighborhood	City of Scottsdale	EEC, Inc.	May 3, 2002
	Summary/Description: The design report includes hydrologic and hydraulic calculations for a storm drain extension from the existing Arizona Canal storm drain to 69th Street and Lafayette Boulevard. The storm drain was designed for a local watershed with an approximate capacity of only 29 cfs.		
Scottsdale Road Corridor Drainage Master Plan (Multiple Reports)	Flood Control District	Stanley Consultants Inc.	January 1, 2002
	Summary/Description: The purpose of the Scottsdale Road Corridor Drainage Master Plan is to asses the magnitude, frequency and extent of regional flooding that occurs along Scottsdale Road, the 71st Street Channel and the Berneil Ditch. According to the master plan, the 100-year, 6-hour peak discharge in Berneil Ditch at its confluence with IBW is 2981 cfs. The peak discharge for the 71st Street Channel at its confluence with the Berneil Ditch is 1703 cfs. The calculated peak discharge that bypasses the Berneil Ditch and surface flows south within Scottsdale Road was calculated to be 336 cfs.		
Candidate Assessment Report: Upper Camelback Walk Wash	Flood Control District	Willdan	March 12, 2001
	Summary/Description: The purpose of the report was to asses the need for a detailed study of the Upper Camelback Walk Wash. The report includes a collection of existing hydrology reports, but no new hydrology was performed.		
Final Design Report: Osborn Road Storm Drain	Flood Control District	Parsons Brinckerhoff	March 31, 2000
	Summary/Description: The report documents the hydrologic and hydraulic calculations that were done for the Osborn Road Storm Drain. The storm drain trunk line was designed for the 10-year, 6-hour storm. The Osborn Road storm drain provided lateral stub-outs at intersection streets (Navajo Trail, Pinto Lane, 68th Street, Supai Way, 70th Street, Civic Center Boulevard, 75th Street and Miler Road). According to the report, to utilize the entire capacity of the storm drain those stub-outs have to be extended into the neighborhoods to the north in order to intercept the entire design flows. The current Osborn Road storm drain, does not have sufficient inlet capacity to capture the entire 10-year peak discharge.		
Final 68th Street and Arcadia Flooding Investigation: Osborn Road Storm Drain	Flood Control District	Parsons Brinckerhoff	April13, 2000
	Summary/Description: The purpose of this report was to perform an analysis of the drainage conditions at the intersection of 68th Street and Calle Redondo (north of the Arizona Canal) for the 100-year storm. The investigation focused on recommending improvements to the existing drainage infrastructure in order to remove the 100-year floodplain from the north side of the Arizona Canal In the Arcadia subdivision.		
Final Alternative Analysis Report: Osborn Road Storm Drain	Flood Control District	Parsons Brinckerhoff	June 30, 1999
	Summary/Description: The purpose of the alternative analysis report is to determine the most efficient and least disruptive alignment for the Osborn Road storm drain between Paiute Park Basin and Indian Bend Wash.		

Name	Agency	Prepared By	Date
Drainage Report for Oak Street Storm Drain: 58th Street to Indian Bend Wash	Flood Control District	EEC/MKE	December 31, 1998
	Summary/Description: The report documents the hydrologic and hydraulic calculations that were done for the Oak Street Storm Drain. The storm drain was designed to capture the 100-year peak discharge upstream of the Cross Cut Canal, downstream of the canal the storm drain was designed to capture the 10-year peak discharge. The report states that the provided 42-inch stub out in 74th Street is to be extended up to Virginia Avenue. This lateral extension (which has not been constructed) was intended to capture the flows at the 74th Street and Virginia Avenue intersection, before they spill over the curb and flow through the residential/school properties.		
Hydraulic Analysis: Pima Outfall Channel / Arizona Canal Outfall Channel	SRPMIC	Robert L. Ward, P.E.	October 19, 1998
	Summary/Description: Primary goal of the analysis was to determine whether the runoff captured by the drainage infrastructure east of Pima Road exceeds the design discharge of the IBW Interceptor Channel. (Note: Pima Outfall Channel is from Pima Road to Loop 101 and the Arizona Canal Outfall Channel is from Loop 101 to 96th Street) The total flow in the Pima Outfall Channel and the Arizona Canal that is allowed to pass west underneath Pima Road is 8000 cfs. The total flow that is allowed in the Interceptor Channel, west of the Arizona Canal side-spillway (side-spillway is just west of Pima Road, on the north bank) is 5500 cfs.		
Indian Bend Wash Floodplain Delineation Study: Hydraulics Report Volume 1 of 2	Flood Control District	Simons, Li & Associates, Inc.	November 3, 1997
	Summary/Description: Re-delineation of the Indian Bend Wash floodplain between the Salt River and 40th Street. Documentation and hydraulic analysis in support of a Request for Letter of Map Revision.		
Indian Bend Wash Floodplain Delineation Study: Hydraulics Report Volume 2 of 2	Flood Control District	Simons, Li & Associates, Inc.	November 3, 1997
	Summary/Description: Re-delineation of the Indian Bend Wash floodplain between the Salt River and 40th Street. Documentation and hydraulic analysis in support of a Request for Letter of Map Revision.		
STP Papago: Regional Flood Control Project (Multiple Reports)	Flood Control District	Kimley-Horn and Associates, Inc.	January 1, 1997
	Summary/Description: The purpose of the STP Papago Regional Flood Control Project was to identify and quantify the extents of drainage issues within the study area which is bound by the Arizona Canal and Camelback Road to the north, Indian Bend Wash to the east, 56th Street to the west and Roosevelt Street/McKellips Road to the south. The two primary recommendations identified in this report are the construction of the Osborn Road and Oak Street Storm Drains. The 10-year, 6-hour hydrologic model for this study was based on the City of Scottsdale Stormwater Master Plan.		
Updated Hydrology Analysis: Arizona Canal Drainage Channel Pima Freeway Via Linda to Arizona Canal	SRPMIC	Robert L. Ward, P.E.	August 20, 1996
	Summary/Description: The purpose of this report is to update the hydrology model for the Pima Freeway (Loop 101) between Via Linda Drive and the Arizona Canal. The update incorporated the upstream urbanization/channelization as well as the Scottsdale Ranch detention basin. Further modifications were performed at the CAP Canal over chutes, where actual stage-storage-discharge rating curves were used, instead of just a peak discharge with an assumed hydrograph shape. The updated hydrology model showed that the Pima Freeway drainage channel between Via Linda Drive and Arizona Canal will not exceed the allowable peak discharge at Pima Road and the Arizona Canal (combined capacity of the Pima Road Outfall Channel and the Arizona Canal) of 8,000 cfs.		
Report on Hydraulic Analysis of Indian Bend Wash Greenbelt Interceptor Channel	City of Scottsdale	KVL Consultants, Inc.	May 2, 1995
	Summary/Description: The study analyzed the impacts of the improvements to the Interceptor Channel from Hayden Road to Pima Road on the previously established (by the US Army Corps of Engineers) water surface elevations and channel velocities.		

Name	Agency	Prepared By	Date
Draft Indian Bend Wash Flood Insurance Study: Data Collection Report	Flood Control District	Simons, Li & Associates, Inc.	June 9, 1994
	Summary/Description: The report summarizes the data collection effort performed as part of the Indian Bend Wash Floodplain Re-delineation. The data includes previous hydrology studies, as well as historical flooding information and drainage infrastructure construction and as-built plans.		
Final Drainage Study: Indian Bend Wash Multi-Use Path Site 1: Camelback Road to Chaparral Road	City of Scottsdale	CRSS Civil Engineers, Inc.	June 3, 1994
	Summary/Description: The drainage report provides hydraulic calculations for the Indian Bend Wash multi-use pathway widening between Camelback Road and Chaparral Road. The 2 foot widening does not reduce the 4000 cfs capacity of the IBW low-flow channel.		
Final Drainage Report: Osborn Road Storm Drain - Scottsdale Road to the Indian Bend Wash	City of Scottsdale	Greiner, Inc.	March 1, 1993
	Summary/Description: The drainage report documents the hydrologic and hydraulic calculations for the Osborn Road Storm Drain between Drinkwater Boulevard and IBW. The report includes storm drain and catch basin sizing calculations.		
96th Street Storm Drain and Arizona Canal Outfall Channel Engineering Design Calculations	SRPMIC	Evans, Kuhn & Associates, Inc.	May 11, 1992
	Summary/Description: The report documents the design criteria and hydraulic analysis performed for the 96th Street storm drain and the Arizona Canal Outfall Channel. The outfall channel parallels the Arizona Canal from the Pima Freeway (Loop 101) to 96th Street.		
Concept Design Memorandum Pima Freeway Drainage System North of the Arizona Canal	ADOT/ Parsons De Leuw, Inc.	Robert L Ward, P.E.	April27, 1992
	Summary/Description: Memorandum addressing the design of the concrete lined channel that extends approximately 2400 feet east of Pima Road along the north side of the Arizona Canal. It accounts for the majority of the inflow into the Interceptor Channel.		
Preliminary Design Report Landscaped Channel Concept: Outer Loop Highway Via Linda to the Arizona Canal	ADOT/ De Leuw, Cather & Company	Robert L Ward, P.E.	March 19, 1990
	Summary/Description: The report only includes Appendices A, C, and D, which are the HEC-1 and HEC-2 computer models for the landscaped channel along the Pima Freeway (Loop 101) from Via Linda to the Arizona Canal.		
Drainage Report for Scottsdale Road Improvements	City of Scottsdale	Brooks, Hersey and Associates, Inc.	December 1, 1989
	Summary/Description: Design data report for Scottsdale Road Improvements between McDowell Road and Earll Drive. The report includes hydrologic and hydraulic calculations, including storm drain and catch basin sizing calculations.		
Final Hydrology Report Outer Loop Highway: Camelback Walk Channel to the Arizona Canal	ADOT/ De Leuw, Cather & Company	Simons, Li & Associates, Inc.	May 18, 1989
	Summary/Description: Report includes offsite hydrologic calculations for the Pima Freeway (Loop 101) from Camelback Walk to the Arizona Canal. The report also includes recommendations and hydraulic calculations for intercepting the offsite flows and diverting them to the Interceptor Channel.		
Drainage Study for Paradise Valley/Scottsdale Lincoln Drive to Cheney Drive	City of Scottsdale	Erie & Associates, Inc.	October 1, 1988
	Summary/Description: This study evaluated the flooding problems along Scottsdale Road between Lincoln Drive and Cheney Drive. It calculated a 100-year peak discharge at Lincoln Drive and Scottsdale Road of 603 cfs and 1654 cfs at a point 1500 feet north of the intersection.		
Drainage Design Report Shea Boulevard: Scottsdale Road to Pima Road	City of Scottsdale / ADOT	A-N West, INC.	March 3, 1988
	Summary/Description: Drainage design report for the Shea Boulevard roadway improvements between Scottsdale Road and Pima Road. Major 100-yr peak discharges crossing Shea Blvd.: 8'x2' CBC 700 ft East of Scottsdale Road = 93 cfs, 10'x3' CBC West of 75th Place = 169 cfs, 10'x2' CBC East of Sundown Drive = 146 cfs, 2-12'x3.5' CBC East of 77th Place = 700 cfs, 6-6'x4' CBC West of Hayden Road = 1300-1500 cfs, 8'x2' CBC East of Hayden Road = 116 cfs, 2-12'x3' CBC West of 82nd Place = 358 cfs, 12'x3' CBC East of Pima Road = 185 cfs.		

Name	Agency	Prepared By	Date
Addendum to Drainage Design Report Shea Boulevard: Scottsdale Road to Pima Road	City of Scottsdale / ADOT	A-N West, INC.	January 13, 1988
	Summary/Description: This report presents the design calculations of the concrete channel along the west side of 82nd Place. The concrete channel was designed for a 100-yr peak discharge of 240 cfs, however improvements to the upstream segment of the channel were recommended in order to capture the entire 240 cfs at the upstream end.		
Addendum to Shea - Scottsdale Master Drainage Plan for Area West of Scottsdale Road	City of Scottsdale	Collar, Williams, & White Eng., Inc.	April 6, 1987
	Summary/Description: The addendum completes the Shea-Scottsdale Master Drainage Plan by finalizing the hydrology and hydraulics of the 71st Street Channel. The 71st Street channel design was delayed due to the design/construction of the Gary Basin (present day Mescal Park Basin).		
Hydrologic Study for Scottsdale Lakes Golf Club: Inlet & Interceptor Channels Indian Bend Wash	Dahlberg Industries	Erie & Associates, Inc.	January 30, 1987
	Summary/Description: The study report documents the design effort of the golf course within the Interceptor Channel and IBW from Indian Bend Road to McDonald Road. The primary objective of the report was to design the golf course as not to raise the water surface elevations.		
Appendix B: TR-20 Output Data: Drainage Study for Paradise Valley/Scottsdale Lincoln Drive to Cheney Drive	City of Scottsdale	Erie & Associates, Inc.	October 1, 1986
	Summary/Description: This report includes the hydrologic TR-20 Output file for the drainage study that evaluated the flooding problems along Scottsdale Road between Lincoln Drive and Cheney Drive.		
Storm Drainage System for McDowell Road Improvements 64th Street to IBW (Part 2 - Hydraulic Design Report)	City of Scottsdale	Cella Barr Associates	June 25, 1986
	Summary/Description: Hydraulic calculations for the storm drain and roadway improvements for McDowell Road from 64th Street to Indian Bend Wash. The purpose of this report is to document the catch basin sizes, storm drain sizes and roadway capacity calculations.		
Strom Drainage System for McDowell Road Improvements 64th Street to IBW (Part 1 - Hydrology & Concept Design)	City of Scottsdale	Cella Barr Associates	April25, 1986
	Summary/Description: Hydrologic calculations for the storm drain and roadway improvements for McDowell Road from 64th Street to Indian Bend Wash. The combination of the roadway improvements and new storm drain system was intended to provide a 100-year level of protection.		
Master Drainage Report and Plan: Shea - Scottsdale Master Plan	Herberger Enterprises, Inc.	Collar, Williams, & White Eng., Inc.	October 8, 1985
	Summary/Description: Master drainage study for the intersection of Shea Boulevard and Scottsdale Road. The report includes hydrologic and hydraulic calculations for various channels and drainage crossings within the study area.		
Drainage Report for Scottsdale Road from McDowell Road to Osborn Road	City of Scottsdale	Ellis-Murphy, Inc.	October 3, 1985
	Summary/Description: Design report for the Scottsdale Road improvements between McDowell Road and Osborn Road. The hydrologic analysis incorporates the area bounded by Osborn Road, Scottsdale Road, McDowell Road and the Arizona Cross-Cut Canal.		
Drainage Report: Indian Bend Wash at Scottsdale Road	City of Scottsdale	Unknown	May 1, 1985
	Summary/Description: Drainage design report for the Scottsdale Road overpass at Indian Bend Wash. An 8 barrel 10'x8' box culvert was proposed, however there is an existing birdge in its place. This would indicate that this report was not used for the Scottsdale Road overpass at IBW.		
Indian Bend Wash Original FEMA Study	Flood Control District	PRC Engineering	March 29, 1984
	Summary/Description: The original Indian Bend Wash floodplain delineation. The report only includes the HEC-2 model printout with no accompanying text.		

Name	Agency	Prepared By	Date
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 5 Feature Design for Side Channel System Project Design for Indian Bend Wash	Flood Control District	US Army Corps of Engineers	July 1, 1981
	Summary/Description: The purpose of this report is to provide a basis of design for the Indian Bend Wash Side Channel System. Similar to the interceptor channel, the side channel system consists of channels and storm drains along the Arizona Canal west of Indian Bend Wash. As previously summarized in Design Memorandum No. 1: Supplementary Report on the Side Channels System the side channel system was separated into 4 reaches, each of which was designed for either a 50-year or 25-year storm event. Incorporating the capacity of the Arizona Canal, the system provides 100-year flood protection to the properties downstream of the Arizona Canal. The primary intent of the side channels is to convey water from behind the west bank of the Arizona Canal to Indian Bend Wash. Improvements along the Arizona Canal (channels and storm drains) convey flows to McDonald Drive, Chaparral Road and Camelback Road, from where flows are conveyed in storm drains to Indian Bend Wash.		
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 4 Feature Design for Interceptor Channel Project Design for Indian Bend Wash	Flood Control District	US Army Corps of Engineers	January 1, 1980
	Summary/Description: The purpose of this report is to provide a basis of design for the Indian Bend Wash Interceptor channel. The interceptor channel, along the north side of the Arizona Canal between Indian Bend Wash and Pima Road is an integral part of the Indian Bend Wash flood protection system. The interceptor channel provides flood protection for the 100-year peak discharge of 8,000 cfs concentration at Pima Road and the Arizona Canal. The channel was designed for 5,500 cfs, 4,600 cfs of which will be conveyed along the Arizona Canal east of Pima Road, and 900 cfs of overland flow across Pima Road. In the event of the 100-year storm, an assumption was made that the Arizona Canal will be empty of irrigation water and will be allowed to accept flood flows. The capacity of the Arizona Canal between Pima Road and IBW was found to be 2,500 cfs. Therefore, the combined interceptor channel and Arizona Canal capacity is the 100-year peak discharge of 8,000 cfs.		
Hydraulic Analysis at Chaparral Road Bridge	Flood Control District	B. R. Jolly, P.E.	April26, 1979
	Summary/Description: Design report for the new low-flow bridge over Indian Bend Wash at Chaparral Road. The design discharge for the bridge was 3,300 cfs. All subsequent bridges and the low-flow channel downstream of Chaparral Road are designed for a discharge of 4,000 cfs.		
PVSP Drainage Study: Phase III, Addendum	Flood Control District	Collar, Williams, & White Eng., Inc.	November 1, 1978
	Summary/Description: The addendum to the PVSP Phase III Hydraulics and Hydrology report further clarifies and answers questions about the recommended drainage improvements that were raised by the PVSP Committee after the final reports were submitted.		
PVSP Drainage Study: Phase III, Volume I Hydraulics	Flood Control District	Collar, Williams, & White Eng., Inc.	July 15, 1978
	Summary/Description: The report summarizes the PVSP master drainage study hydraulic analysis. The report also proposes various drainage improvements within the study boundary (roughly extending from 56th Street to Scottsdale Road and from Indian Bend Wash to the CAP Canal). In addition to proposing new storm drains and channels, the study recommends the construction of multiple detention basins, including Sereno Park Basin, Cactus Road Basin and the Gary Basin (Mescal Park Basin).		
PVSP Drainage Study: Phase III, Volume II Hydrology	Flood Control District	Collar, Williams, & White Eng., Inc.	July 15, 1978
	Summary/Description: The report summarizes the PVSP master drainage study hydrologic analysis. It provides design discharges for the proposed drainage infrastructure improvements throughout the watershed that have been proposed in Volume I - Hydraulics.		
Indian Bend Wash Inlet Channel Design: Valley Vista Drainage Structures	City of Scottsdale	B. R. Jolly, P.E.	April21, 1978
	Summary/Description: Hydraulic design calculations for the Valley Vista drainage inlets north of McDonald Road.		

Name	Agency	Prepared By	Date
Final Report: Lateral Drainage of Indian Bend Wash Project	Flood Control District	Sullivan & Masson Consulting Engineers	March 7, 1978
	Summary/Description: The report provides 100-year peak discharge calculations for several locations (Intersection of Scottsdale Road with Indian Bend Road and Hayden Road, north of Valley Vista Lane and just south of the Arizona Canal) along Indian Bend Wash. The study provides alternative methods of conveying these peak discharges to Indian Bend Wash.		
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 3 Feature Design for Inlet Channel Project Design for Indian Bend Wash	Flood Control District	US Army Corps of Engineers	January 1, 1978
	Summary/Description: The purpose of this report is to provide a basis of design for the Indian Bend Wash upstream of the outfall channel (upstream of McKellips Road). The report includes design considerations for the Arizona Canal siphon and wasteway at IBW. A review and update of the hydraulic analysis that was previously presented is also included. It analyzes the floodways capacity of safely conveying the 100-year project design flood of 30,000 cfs without significant damage to any 'existing' development.		
Greenbelt	City of Scottsdale	Unknown	December 5, 1977
	Summary/Description: HEC-2 hydraulic analysis of the Indian Bend Wash greenbelt channel.		
Town of Paradise Valley Indian Bend Wash Improvements	Town of Paradise Valley	Coe & Van Loo	July 23, 1976
	Summary/Description: The report gives construction recommendations for the portion of Indian Bend Wash within the Town of Paradise Valley. The 100-year peak discharge that was used for the hydraulic analysis was 22,000 cfs.		
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 1 General Design Memorandum - Phase 2 Project Design for Indian Bend Wash	Flood Control District	US Army Corps of Engineers	May 1, 1975
	Summary/Description: The primary purpose of this report is to present a detailed project cost estimate for the recommended Indian Bend Wash improvements. In addition to the cost analysis, the report includes hydraulic design of the Indian Bend Wash outfall channel (the portion of IBW between 1200 ft north of McKellips Road to the Salt River). The Indian Bend Wash outfall channel was designed for the 100-year peak discharge of 30,000 cfs, with the low-flow channel capable of conveying 4,000 cfs. At various street crossings (McKellips Road, Curry Road, etc...) bridges will be designed in order to convey the capacity of the low flow channel, with the 100-year peak discharge spilling over the roadway with the flows being contained within the Indian Bend Wash floodplain.		
Master Drainage Study: Indian Bend Wash	City of Phoenix	Yost and Gardner Engineers	April 1, 1975
	Summary/Description: Evaluation of four alternatives for handling the 100-year flows in the portion of Indian Bend Wash that is within the City of Phoenix. The study also performed hydrologic and hydraulic analysis on tributary channels, along with conceptual designs for each of them.		
Hydraulic Report Oak Street Storm Drain in Scottsdale, Arizona	City of Scottsdale	Hook, Rockwell and Associates	March 21, 1975
	Summary/Description: Hydrologic and hydraulic design report for the old Oak Street storm drain that extends from 71st Street to Indian Bend Wash.		
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 1 General Design Memorandum - Phase 1 Plan Formulation for Indian Bend Wash	Flood Control District	US Army Corps of Engineers	November 1, 1973
	Summary/Description: The purpose of the memorandum was to review the authorized Indian Bend Wash improvements (authorized in 1965) and reaffirm the plan of improvement or reformulate and develop a plan that is more suitable under existing conditions. The original plan of improvements for Indian Bend Wash called for the construction of a concrete-lined trapezoidal channel about 7 miles long starting at the Arizona Canal and extending southward to the Salt River. The plan calls for the Arizona Canal to be siphoned underneath IBW. Upstream of the siphon, a side gate will connect the canal to Indian Bend Wash, so that in case of an emergency the water from the canal can be discharged into Indian Bend Wash. The report also discusses recreational and open space improvements along the extent of the IBW improvements.		

Name	Agency	Prepared By	Date
Gila River Basin, Arizona Indian Bend Wash Design Memorandum No. 1 General Design Memorandum - Phase 1 Plan Formulation for Indian Bend Wash Supplementary Report on Side Channels System	Flood Control District	US Army Corps of Engineers	November 1, 1973
	Summary/Description: The purpose of this report is to document justification of the side channels system as well as to determine what level of protection can realistically be provided with the system. The side channel system were separated into 4 reaches, each intended to convey water from behind the Arizona Canal to IBW. Reach 1: Consists of a collector channel on the west side of the Arizona Canal from Lincoln Drive north to Indian Bend Wash. The channel was designed to intercept and convey the 50-year peak discharge of 2000 cfs. Reach 2: The side drain system within McDonald Drive consists of a trapezoidal channel and storm drains capable of conveying the 25-year peak discharge of 650 cfs to Indian Bend Wash. Reach 3: The side drain system within Chaparral Road consist of a trapezoidal channel and storm drains capable of conveying 25-year peak discharge of 610 cfs to Indian Bend Wash. Reach 4: Side drain system within Camelback Road consists of storm drains capable of conveying the total 25-year peak discharge of 1100 cfs to Indian Bend Wash.		
Flood Insurance Study: Scottsdale, Arizona	Federal Insurance Administration	US Army Corps of Engineers	June 1, 1972
	Summary/Description: The study developed flood frequency data from discharge-frequency relationships of historical data (flood flow frequency analysis). Water surface profiles were calculated for the portion of Indian Bend Wash within the City limits.		
Study of Arcadia - Arizona Canal Storm Drain Channel 64th Street to 56th Street	City of Phoenix	Coe & Van Loo	July 30, 1971
	Summary/Description: Design report for the low-flow channel north of the Arizona Canal from 64th Street to 56th Street. The channel has a design capacity in the range of 130-150 cfs at 64th Street and increasing to 300 cfs west of 60th Street.		
Flood-Plain Information Study for Maricopa County, Arizona Indian Bend Wash Report	Flood Control District	US Army Corps of Engineers	June 1, 1964
	Summary/Description: The report contains a flood hazard evaluation of Indian Bend Wash between Indian Bend Road and Greenway Road. The hydrologic analysis that was performed takes into account the contributing drainage area north of the CAP Canal.		

Appendix E: Storm Drain As-Built Plan Inventory

Storm Drain As-Built Plan Inventory

Year	Name	Location	Start As-Built No.	End As-Built No.
East Avalon Drive Storm Drain				
1977	Avalon Dr SD	Hayden Road to Indian Bend Wash	2331	2334
1986	Hayden Rd SD	Thomas Road to Earll Drive	15989	16022
East Camelback Road Storm Drain				
1978	Camelback Rd SD	86th Street to Indian Bend Wash	13248	13260
East Chaparral Road Storm Drain				
1973	Chaparral Rd Improvements	82nd Street to Hayden Road	5654	5661
1989	Chaparral Rd SD	Pima Road to Indian Bend Wash	17627	17643
East Indian Bend Road Strom Drain				
1973	Hayden Rd SD	Indian Bend Road to Via De La Extrada	1175	1177
1981	Indian Bend Rd Improvements	Scottsdale Road to Hayden Road	16109	16140
1982	Indian Bend Rd SD	78th Place to Hayden Road	15919	15923
East Indian School Road Storm Drain				
1984	Indian School Rd SD	Pima Road to Indian Bend Wash	15924	15942
2004	Hayden Rd SD Inlet Addition	Hayden Road and Indian School Road	47596	47606
2009	Indian School Rd Improvements	Hayden Road to Pima Road	64558	64678
East Jackrabbit Road Storm Drain				
1985	Jackrabbit Rd SD	86th Street to Indian Bend Wash	15866	15883
East Malcomb Drive Storm Drain				
1978	Hayden Rd SD	Lincoln Drive to Malcomb Drive	2846	2851
East McDonald Drive Storm Drain				
1965	Hayden Rd SD	Valley Vista Lane to McDonald Drive	3306	3317
1974	McDonald Dr SD	79th Street to Indian Bend Wash	5890	5905
2005	McDonald Dr SD	82nd Street to Indian Bend Wash	56212	56337
2007	Valley Vista Dr SD Extension	82nd Street to Hayden Road	61745	61762
East McDowell Road Storm Drain				
1973	McDowell Rd SD	Hayden Road to Indian Bend Wash	5879	5889
1986	Hayden Rd SD	Virginia Avenue to McDowell Road	17436	17510-A
East McKellips Road Storm Drain				
1967	McKellips Rd Improvements	McKellips Road and Hayden Road	3455	3471
1986	Hayden Rd SD	McKellips Road to Hayden Road	17369	17435
2003	Garfield St SD	81st Street to Hayden Road	46230	46232
East Thomas Road Storm Drain				
1975	Thomas Rd SD	Hayden Road to Indian Bend Wash	16484	16508

Year	Name	Location	Start As-Built No.	End As-Built No.
		East Valley Vista Drive Storm Drain		
1993	Hayden Rd SD	Rose Lane to Valley Vista Drive	22459	22460
		Arizona Canal Outfall Channel Discharging Storm Drains		
1993	83rd Street Inlet	83rd Street and Cactus Wren	23603	23618
1998	Indian Bend Rd SD	Granite Reef Road to Via De La Sendero	39474	39509
		West 2nd Street Storm Drain		
1973	Civic Center Plaza SD	Main Street to 2nd Street	10958	10960
1974	Brown Ave SD	Main Street to 2nd Street	13237	13240
1975	Scottsdale Rd SD	Indian School Road to 2nd Street	5957	5995
1975	Scottsdale Rd SD	Indian School Road to 2nd Street (Second Duplicate Set)	10759	10794
1982	Scottsdale Rd SD	3rd Avenue to Indian School Road	5814	5817
1983	Indian School Rd SD	NW Corner of Indian School Road and Scottsdale Road	6057	6058
1985	2nd St SD	Wells Fargo Avenue to Indian Bend Wash	12270	12287
1987	Goldwater Blvd SD	Arizona Canal to 3rd Avenue	17511-A	17565
1990	2nd St Inlet Addition	2nd Street Cul-De-Sac	27481	27482
1991	Goldwater Blvd SD	Indian School Road to 2nd Street	20735	20739
1992	Goldwater Blvd SD	3rd Avenue to Indian School Road	22930	22996
1992	2nd St SD	69th Street to Wells Fargo Avenue	21505	21517
1992	Main St SD	Scottsdale Road to Brown Avenue	22747	22819
1992	Civic Center Library SD	Civic Center Library	36918	37089
1994	Goldwater Blvd SD	Indian School Road to 2nd Street	38701	38830
1995	2nd St SD Inlet Addition	2nd Street and Miller Road	27288	27289
1995	5th Ave SD	Arizona Canal to Indian School Road	27505	27510
1997	Indian School Rd SD	68th Street to 69th Place	46242	46383
1998	Indian School Rd SD	69th Place to Goldwater Boulevard & Marshall Way to Scottsdale Road	36802	36917
1998	Civic Center Plaza SD	Civic Center Plaza	36556	36657
2004	69th St SD	Main Street to 2nd Street	51939	51941
2005	70th St SD	Arizona Canal to 5th Avenue	53007	53020
2008	Arizona Canal SD Extension	5th Avenue and Goldwater Boulevard	60749	60786

Year	Name	Location	Start As-Built No.	End As-Built No.
West Camelback Road Storm Drain				
1968	68th St Improvements	Arizona Canal to Camelback Road	13493	13514
1974	Chaparral Rd SD	Woodmare Fairway to Arizona Canal	5684	5690
1974	Camelback Rd SD	68th Street to Scottsdale Road	13186	13199
1974	Camelback Rd Improvements	68th Street to Scottsdale Road	10347	10396
1980	Camelback Rd SD Inlet Addition	Goldwater Boulevard and Camelback Road	15942	15942
1983	Camelback Rd Side Drain	Arizona Canal to Indian Bend Wash	FCD Drawer #14	
1986	Camelback Rd Side Drain Extensions	Camelback Road & Lafayette Boulevard: 64th Street to 68th Street	15813	15854
1986	Fashion Square Mall SD	Camelback Road to Parking Areas	13519	13523
1986	Fashion Square Mall SD Extension	Parking Area Extension	13888	13890
1987	Goldwater Blvd SD	Montecito Way to Arizona Canal	17511-A	17565
1988	Fashion Square Mall SD	Scottsdale Road and Camelback Road	19399	19405
1988	Fashion Square Mall SD Extension	Scottsdale Road and Camelback Road	32156	32157
1990	Camelback Rd Inlet Addition	Goldwater Boulevard and Camelback Road	21020	21022
1991	Fashion Square Mall SD Modification	Scottsdale Road and Camelback Road	21014	21016
1991	Camelback Rd SD Inlet Addition	Scottsdale Road and Camelback Road	22629	22647
1992	Goldwater Blvd SD	Camelback Road to Montecito Way	22930	22996
1993	Camelback Rd Improvements	68th Street to Goldwater Boulevard	28938	28973
2003	Camelback Rd Side Drain Inlet Addition	69th Street and Lafayette Boulevard	46227	46229
2004	Camelback Rd Side Drain Addition	Camelback Road and Scottsdale Road	53436	53470
2005	Highland Ave SD	Goldwater Boulevard to Scottsdale Road	61000	61029
2007	Arizona Canal SD	Chaparral Road to Camelback Road	FCD Plan Check Set	
West Chaparral Road Storm Drain				
1982	Chaparral Rd Side Drain	Arizona Canal to Indian Bend Wash	FCD Drawer #14	
1991	Chaparral Rd Side Drain Inlet Addition	Chaparral Road and Miller Road	21717	21717
West Earll Drive Storm Drain				
1970	Monterey Way SD	63rd Place to 64th Street	13206	13207
1989	Thomas Road Improvements	60th Street and Thomas Road	19642	19645
1999	64th St SD	Thomas Road to Indian School Road	40775	40857
2000	Osborn Rd SD	61st Place to Indian Bend Wash	FCD Drawer #35	
West Eastwood Lane Storm Drain				
1977	Eastwood Lane SD	Fairview Lane to "The Lakes"	1649	1650
1980	Vaquero Dr SD	Doubletree Ranch Road to "The Lakes"	6806	6811
1983	Doubltree Ranch Rd SD	Scottsdale Road to Gainy Center Drive	6746	6778
1987	Gainy Center Dr SD	Doubletree Ranch Road SD Extension	14425	14431

Year	Name	Location	Start As-Built No.	End As-Built No.
West Heatherbrae Street Storm Drain				
1993	Heatherbrae St SD	79th Street to Indian Bend Wash	23224	23227
West Indian Bend Road Storm Drain				
1981	Indian Bend Road Improvements	Scottsdale Road to Hayden Road	16109	16140
1992	Scottsdale Road Improvements	Lincoln Drive to Indian Bend Road	22648	22679
2001	Indian Bend Road SD Extension	Scottsdale Road and Indian Bend Road	40161	40168
West Indian School Road Storm Drain				
1990	Drinkwater Blvd SD	5th Avenue to Indian School Road	20753	20786
1990	Drinkwater Blvd SD	Stetson Drive to 6th Avenue	43081	43118
1992	Indian School Rd SD	Scottsdale Road to Indian Bend Wash	23228	23283
1992	Indian School Rd SD Inlet Addition	75th Street and Indian School Road	22444	22454
1998	Indian School Rd SD	Marshall Way to Scottsdale Road	36802	36917
2004	Indian School Rd SD Inlet Addition	Miller Road and Indian School Road	49321	49324
2009	Indian School Rd SD Improvements	Drinkwater Boulevard to Hayden Road	64458	64557
West Lincoln Drive Storm Drain				
1980	Scottsdale Rd Improvements	North of Lincoln Drive and Scottsdale Road	7978	7984
1983	Lincoln Dr SD Inlet Addition	Lincoln Drive and Scottsdale Road	16286	16286
1991	Lincoln Dr SD	Scottsdale Road to Side Channel	20845	20854
1992	Scottsdale Rd Improvements	Lincoln Drive to Indian Bend Road	22648	22679
1993	Scottsdale Rd Improvements	Lincoln Drive to Indian Bend Road	22720	22746
1996	Scottsdale Rd Improvements	Scottsdale Road north of Lincoln Drive	32668	32681
West McCormick Parkway Storm Drain				
1976	McCormick Pkwy SD	At Scottsdale Conference Center	11557	11567
1985	McCormick Pkwy SD Inlet Addition	Royal Palm Road and McCormick Parkway	11739	11747
1997	McCormick Pkwy SD Inlet Addition	Via Camello Del Sur and McCormick Parkway	43335	43336
West McDonald Drive Storm Drain				
1980	McDonald Dr SD	Scottsdale Road to 74th Street	3756	3758
1982	McDonald Dr Side Drain	Arizona Canal to Indian Bend Wash	FCD Drawer #14	

Year	Name	Location	Start As-Built No.	End As-Built No.
West McDowell Road Storm Drain				
1973	McDowell Rd SD	Miller Road to Indian Bend Wash	5879	5889
1974	Scottsdale Rd Improvements	McDowell Road to Thomas Road	1915	1948
1975	McDowell Rd SD	64th Street to 70th Street	6920	6923
1990	Scottsdale Rd SD	Oak Street to McDowell Road	20426	20541
1992	McDowell Rd SD	Scottsdale Road to Indian Bend Wash	23955	24005
West McKellips Road Storm Drain				
1983	McKellips Rd SD	Miller Road to Indian Bend Wash	19335	19348
West Murray Lane Road Storm Drain				
1977	Murray Ln SD	Miller Road to Indian Bend Wash	16547	16572
West Oak Street Storm Drain				
1977	Oak St SD	70th Street to Indian Bend Wash	13268	13281
1990	Scottsdale Rd SD	Thomas Road to Oak Street	20426	20541
1999	Oak St SD	58th Street to Indian Bend Wash	FCD Drawer #35	
West Osborn Road Storm Drain				
1978	78th St SD	Osborn Road to Thomas Road	NA	NA
1985	Osborn Rd SD Inlet Addition	Drinkwater Boulevard and Osborn Road	16285	16285
1993	Osborn Rd SD	Drinkwater Boulevard to Indian Bend Wash	24353	24379
West Palm Lane Road Storm Drain				
1977	Miller Rd SD	Holly Street to Palm Lane	16547	16572
West Roosevelt Street Storm Drain				
1968	Roosevelt St SD	70th Street & McDowell to Roosevelt Street & Indian Bend Wash	10488	10520
1970	Roosevelt St SD Outlet	Roosevelt Street Storm Drain Outlet Modification	13206	13206
2006	McDowell Rd SD Inlet Addition	McDowell Road and Hayden Road	60944	60969
West San Miguel Avenue Storm Drain				
1978	San Miguel Ave SD	78th Street to Indian Bend Wash	2693	2695

Year	Name	Location	Start As-Built No.	End As-Built No.
		West Thomas Road Storm Drain		
1973	68th St SD	Earll Drive to Avalon Drive	5730	5734
1974	Scottsdale Rd Improvements	Thomas Road to Osborn Street	1915	1948
1975	Thomas Rd SD	78th Street to Indian Bend Wash	16484	16508
1975	Scottsdale Rd SD	2nd Street to Osborn Road	5957	5995
1975	Scottsdale Rd SD	2nd Street to Osborn Road (Second Duplicate Set)	10759	10794
1975	Scottsdale Rd SD	Osborn Road to Indian Bend Wash	13156	13185
1975	Avalon Dr SD	68th Street to Scottsdale Road	13261	13266
1978	78th St SD	Osborn Road to Thomas Road	2335	2347
1982	Osborn Road SD	68th Street to Scottsdale Road	16171	16184
1990	Scottsdale Rd SD	Earll Drive to Thomas Road	20426	20541
1992	Thomas Rd SD Inlet Addition	Thomas Road and 60th Street	22467	22467
1993	Brown Ave SD	2nd Street to 4th Street	25226	25245
1993	Osborn Road SD	Brown Avenue to Scottsdale Road	24353	24379
1994	Goldwater Blvd SD	Scottsdale/Osborn Road to 2nd Street	38701	38830
1999	Avalon Dr SD	Paiute Park to 68th Street	40775	40857
2001	Scottsdale Rd SD Inlet Addition	Scottsdale Road and Osborn Road	40177	40178
2002	Brown Ave SD	3rd Street to 4th Street	41863	41871
2008	73rd St SD	Catalina Drive to Thomas Road	61997	61999
2012	66th St SD	Earll Drive to Paiute Park	Personal Files	
2012	Cheery Lynn Rd SD	67th Place to 70th Street	Personal Files	
		City of Tempe Storm Drains		
1967	Scottsdale Rd SD	Fillmore Street to Loop 202	SD 54012	
1975	College Ave SD	College Avenue and McKellips Road	P 1809	
1978	Curry Rd SD	Miller Road to Indian Bend Wash	7349	
1980	Scottsdale Rd Improvements	Curry Road to Continental Drive	SD PID135	
1980	Scottsdale Rd Improvements	Roosevelt Drive to McKellips Road	SD PID135	
1981	Gilbert Dr SD	Scottsdale Road to College Ave	80019 P ID143	
1993	Scottsdale Rd Improvements	Gilbert Drive to Weber Drive	MP 906353	
1997	Mary St SD	Henry Street to Curry Road	MP 966671B	
2006	Playa Del Norte Dr SD	Scottsdale Road to Miller Road	MP 5101241	
2008	Playa Del Norte Dr SD Extension	North Shore Condominiums	7035	

Year	Name	Location	Start As-Built No.	End As-Built No.
Additional As-Builts Collected				
1991	Hayden Rd Improvements	Shea Boulevard to Via De Ventura	23157	23223
2004	Hayden Rd Improvements	Redfield Road to Shea Boulevard	56736	56973
1986	McDowell Rd Improvements	64th Street to Cross-Cut Canal	15731	15753
1991	64th St Improvements	McDowell Road and 64th Street Intersection	19940	19959
1968	Pima Rd Improvements	Shea Boulevard to Indian Bend Road	2529	2541
1978	Pima Rd Improvements	Shea Boulevard to Via Linda	2468	2484
1998	Pima Rd SD	Inner Circle Drive to Arizona Canal Outfall Channel	37766	37835
1991	Chaparral Rd Improvements	Granite Reef Road to Pima Road	22220	22256
1983	Eastwood Lane SD	72nd Way to Scottsdale Road	7081	7092
1984	71st Street Channel	Gold Dust Avenue to Mountain View Road	15884	15915
1992	70th Street Improvements	Shea Boulevard to Mountain View Road	24132	24199
1961	Scottsdale Rd Improvements	Camelback Road to Indian School Road	9841	9848
2003	Scottsdale Rd Improvements	McCormick Parkway to Indian Bend Road	48669	48849
2003	Scottsdale Rd Improvements	Hummingbird Lane to Berniel Drive	43955	44098
2003	Scottsdale Rd Improvements	McCormick Parkway and Scottsdale Road	48850	48853
1992	Shea Boulevard Improvements	Scottsdale Road to Pima Road	22832	22869
1992	Shea Boulevard Improvements	Scottsdale Road to Pima Road	22870	22929
1982	Shea Boulevard Improvements	Scottsdale Road to Hayden Road	21658	21700
1992	Shea Boulevard Improvements	85th Place to 89th Place	22598	22606
2008	Shea Boulevard Improvements	Shea Boulevard and Hayden Road	64259	64345
1976	Thomas Road Improvements	Thomas Road Bridge at Indian Bend Wash	16525	16543
1999	McDonald Drive Improvements	Granite Reef Road to Pima Road	41069	41125

Appendix F: Storm Drain GIS Attribute/Component Descriptions

LIBW Storm Drain GIS Attribute Description

Conduits (Storm Drains and Connector Pipes)		
GIS Attribute	**Description**	**GIS Input**
INP_NAME	A unique name given to the conduit	Text
DESCRIPTION	A brief description of the conduit (if necessary)	Text
INLET_NODE	The name of the upstream junction	Text
OUTLET_NODE	The name of the downstream junction	Text
AB_SHAPE	The as-built shape of the conduit (Options: CIRCULAR, RECT_CLOSED, HORIZ_ELLIPSE, etc...)	Text
AB_DIA_HEIGHT	The as-built diameter (circular) or height (box culvert/elliptical pipe) of a conduit	Number
AB_WIDTH	The as-built width of a box culvert/elliptical pipe conduit	Number
LENGTH	The length of the conduit	Number
BARRELS	The number of barrels of the conduit	Number
AB_SLOPE	The as-built slope of the conduit	Number
AB_US_COND_INV	The as-built upstream (inlet) invert elevation	Number
AB_US_OFFSET	The upstream elevation difference between the conduit invert elevation and the junction invert elevation	Calculated
AB_DS_COND_INV	The as-built downstream (outlet) invert elevation	Number
AB_DS_OFFSET	The downstream elevation difference between the conduit invert elevation and the junction invert elevation	Calculated
AB_MATERIAL	The as-built material of the conduit	Text
ROUGHNESS	The Manning's n-value of the conduit (based on the conduit material)	Number
FLAP_GATE	Designates whether the conduit is equipped with a flap gate to prevent reverse flow (Options: YES or NO)	Text
AB_START_NO	The as-built plan set starting call number	Number
AB_END_NO	The as-built plan set ending call number	Number
AB_FILE_NAME	The as-built plan set file name	Text
DATUM_CONVERSION	Designates whether the elevations were adjusted for datum differences (Options: YES or NO)	Text

Junctions (Storm Drain Manholes)		
GIS Attribute	**Description**	**GIS Input**
INP_NAME	A unique name given to the junction	Text
DESCRIPTION	A brief description of the junction (if necessary)	Text
AB_INV_ELEV	The as-built invert elevation of the junction	Number
DTM_GRND_ELEV	The surface (DTM) ground (rim) elevation of the manholes	Auto Populate
MAX_DEPTH	The height from the invert elevation to the rim elevation	Calculated
AB_FILE_NAME	The as-built plan set file name	Text
DATUM_CONVERSION	Designates whether the elevations were adjusted for datum differences (Options: YES or NO)	Text

LIBW Storm Drain GIS Attribute Description

Junctions (Bends, Slope Changes, Connections, etc...)		
GIS Attribute	**Description**	**GIS Input**
INP_NAME	A unique name given to the junction	Text
DESCRIPTION	A brief description of the junction (if necessary)	Text
AB_INV_ELEV	The as-built invert elevation of the junction	Number
DTM_GRND_ELEV	The surface (DTM) ground elevation at the junction	Auto Populate
MAX_DEPTH	The height from the invert elevation to the ground elevation	Calculated
AB_FILE_NAME	The as-built plan set file name	Text
DATUM_CONVERSION	Designates whether the elevations were adjusted for datum differences (Options: YES or NO)	Text

Sub-Catchments (Required for FLO-2D/SWMM Integration)		
GIS Attribute	**Description**	**GIS Input**
INP_NAME	A unique name given to the sub-catchment	Text
DESCRIPTION	A brief description of the sub-catchment (if necessary)	Text
INLET_NAME	The name of the inlet that the sub-catchment is associated with	Text
RAIN_GAUGE	The name of the rain gauge that the sub-catchment is associated with (one rain gauge per model)	Text
SC_AREA	The sub-catchment surface area	Number

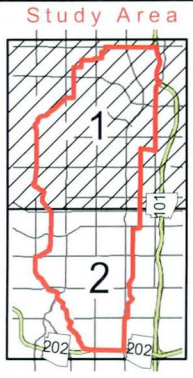
LIBW Storm Drain GIS Attribute Description

Inlets (Storm Drain Catch Basins)		
GIS Attribute	**Description**	**GIS Input**
INP_NAME	A unique name given to the inlet	Text
DESCRIPTION	A brief description of the inlet (if necessary)	Text
AB_INV_ELEV	The invert elevation of the inlet (i.e. the invert elevation of the connector pipe)	Number
DTM_GRND_ELEV	The surface (DTM) ground elevation at the inlet	Auto Populate
MAX_DEPTH	The height from the invert elevation to the ground elevation	Calculated
INLET_TYPE	The type of inlet (Options: CURB_OPENING, GRATE, COMBINATION, HEADWALL, SLOTTED_DRAIN)	Text
STD_DET_NO	The as-built standard detail call-out of the inlet (if available)	Text
CO_LENGTH	The length of a CURB_OPENING, COMBINATION and SLOTTED_DRAIN type of Inlet	Number
CO_HEIGHT	The height of a the curb opening in the CURB_OPENING and COMBINATION type of inlets	Number
GRT_LENGTH	The length of the grate in the GRATE and COMBINATION types of inlet	Number
GRT_WIDTH	The width of the grate in the GRATE and COMBINATION types of inlet	Number
FLO2D_GRID_NO	The FLO-2D grid number where the inlet is located (Required parameter for FLO-2D/SWMM model integration)	Text
FLO2D_INLET_PAR1	Required parameter for FLO-2D/SWMM model integration	Text
FLO2D_INLET_PAR2	Required parameter for FLO-2D/SWMM model integration	Text
FLO2D_INLET_PAR3	Required parameter for FLO-2D/SWMM model integration	Text
AB_FILE_NAME	The as-built plan set file name	Text
DATUM_CONVERSION	Designates whether the elevations were adjusted for datum differences (Options: YES or NO)	Text

Appendix G: Storm Drain GIS Exhibits

Shea Blvd
101
64th St
Scottsdale Rd
Hayden Rd
90th St
Doubletree Ranch Rd
Invergordon Rd
Via De Ventura
Pima Rd
Invergordon Rd
McCormick Pkwy
Indian Bend Rd
Invergordon Rd
Indian Bend Wash
McDonald Dr

Study Area



Box Culvert

27" and Smaller

30" - 45"

48" - 63"

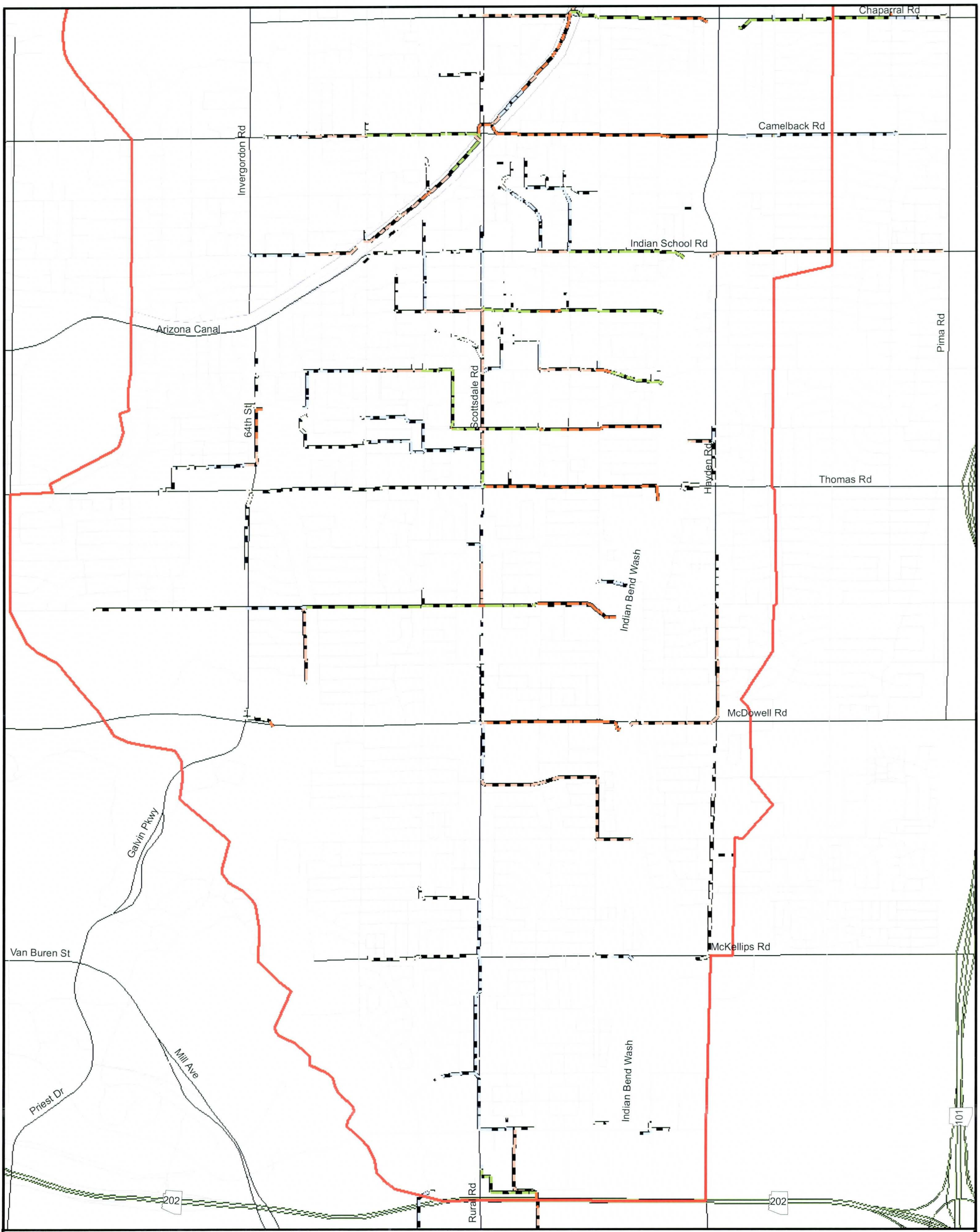
66" - 81"

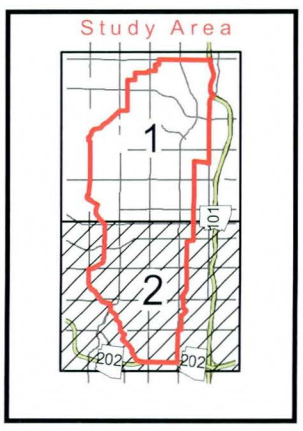
84"and Bigger

Lower Indian Bend Wash ADMS
Existing Drainage Infrastructure
Appendix G
Sheet 1 of 2

Flood Control District of Maricopa County

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture





Box Culvert

27" and Smaller

30" - 45"

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84"and Bigger

Lower Indian Bend Wash ADMS
Existing Drainage Infrastructure
Appendix G
Sheet 2 of 2

Flood Control District of Maricopa County

Gavan & Barker Inc.
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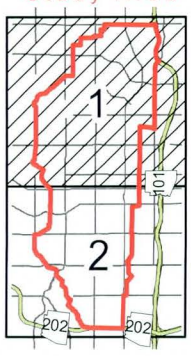
Appendix H: Missing Storm Drain GIS Exhibit

Shea Blvd
101
64th St
Scottsdale Rd
Hayden Rd
90th St
Doubletree Ranch Rd
Invergordon Rd
Via De Ventura
Pima Rd
Invergordon Rd
McCormick Pkwy
Indian Bend Rd
Invergordon Rd
Indian Bend Wash
McDonald Dr

Study Area



Inlets to Field Verify

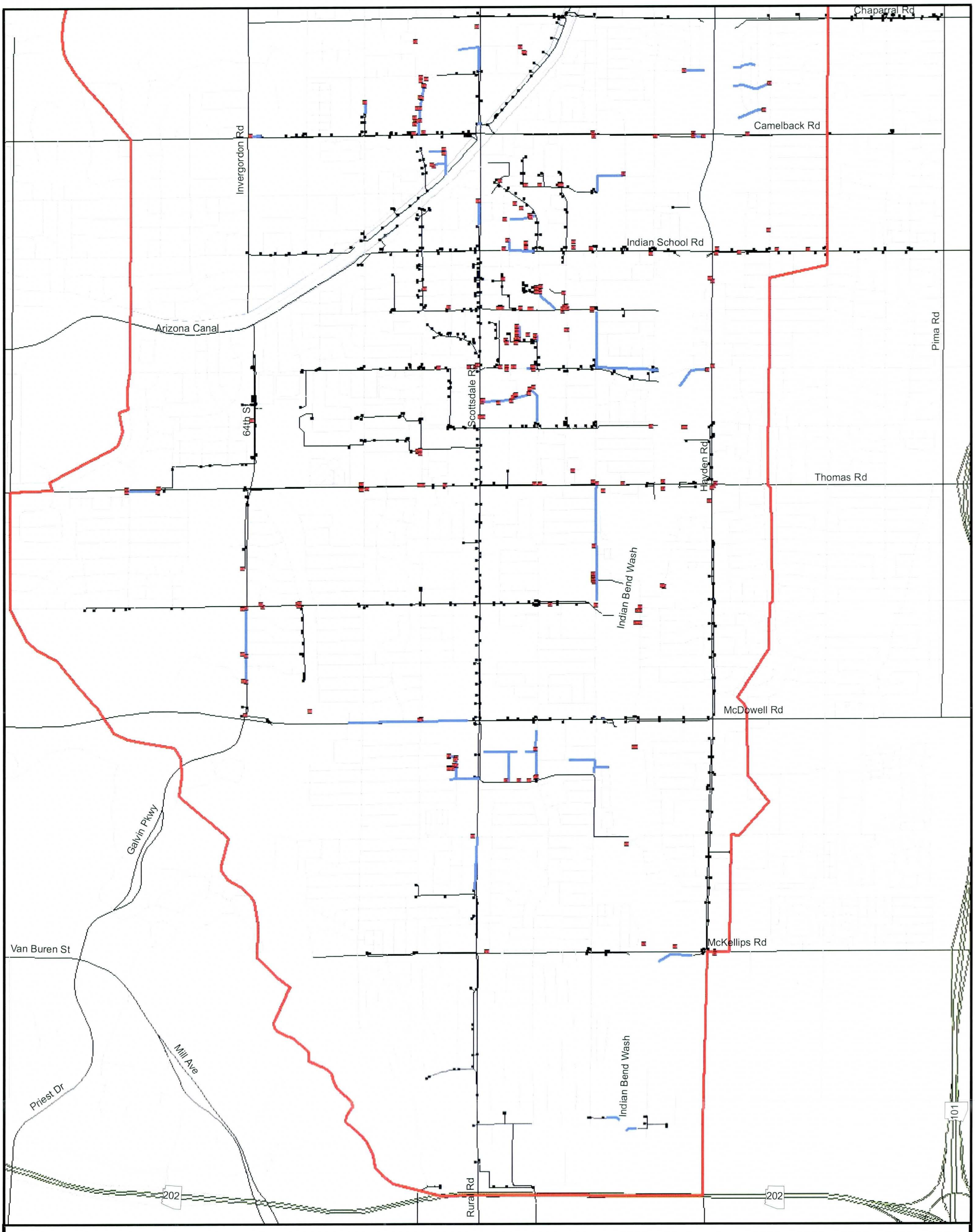
Storm Drains to Field Verify

Known Storm Drain System

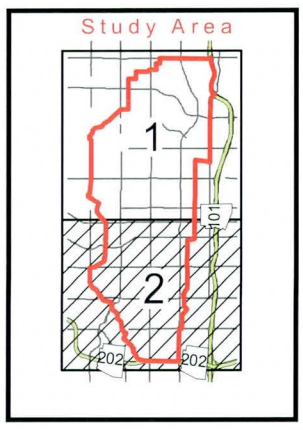
Lower Indian Bend Wash ADMS
Missing Storm Drain Infrastructure
Appendix H
Sheet 1 of 2

Flood Control District of Maricopa County

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture



Lower Indian Bend Wash ADMS
Missing Storm Drain Infrastructure
Appendix H
Sheet 2 of 2



Inlets to Field Verify

Storm Drains to Field Verify

Known Storm Drain System

Flood Control District of Maricopa County

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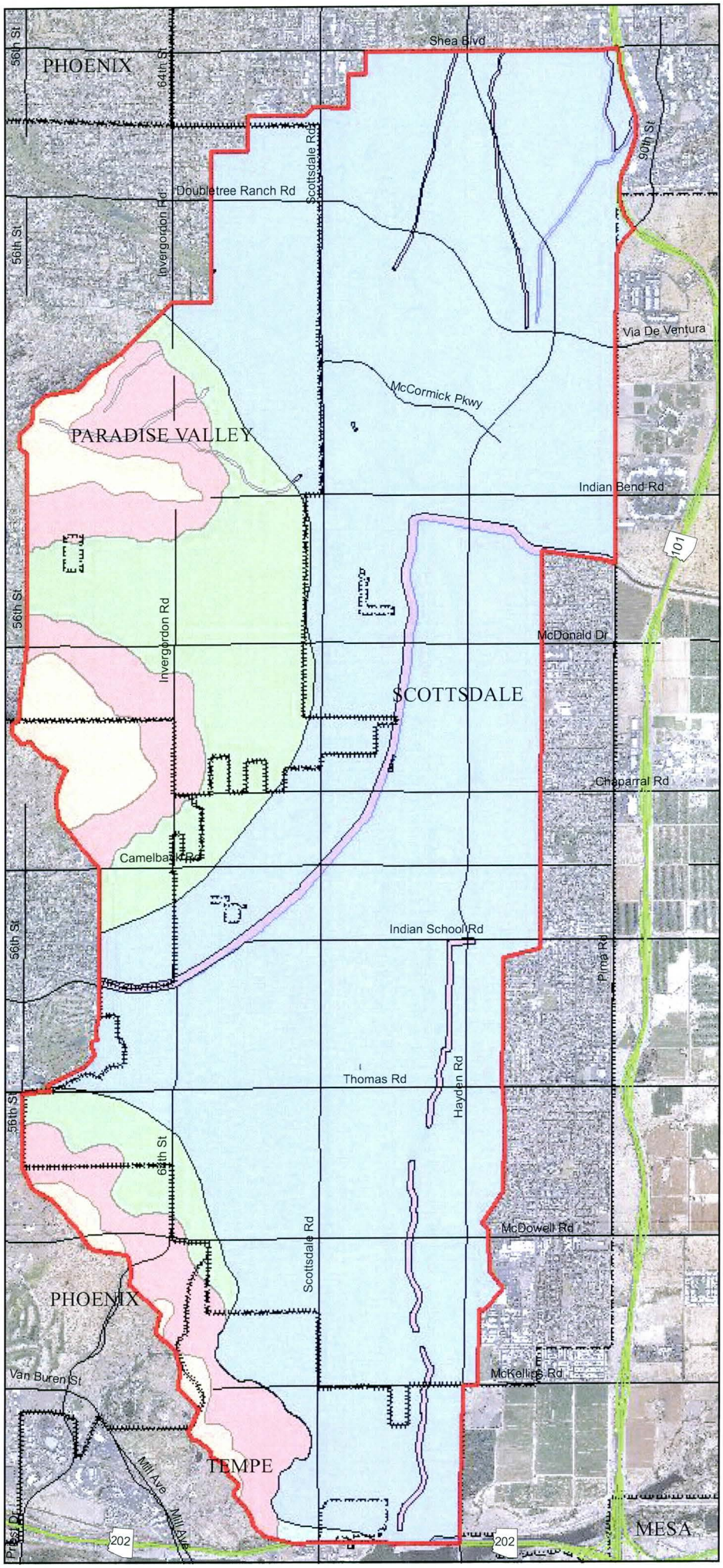
Appendix I: LIA Maps



Landscape Character Physical Settings

EXHIBIT 12.a

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

- Arroyo
- Lower Bajada
- Mountains
- River Terrace
- Upper Bajada
- Valley Plains
- Valley Wash

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

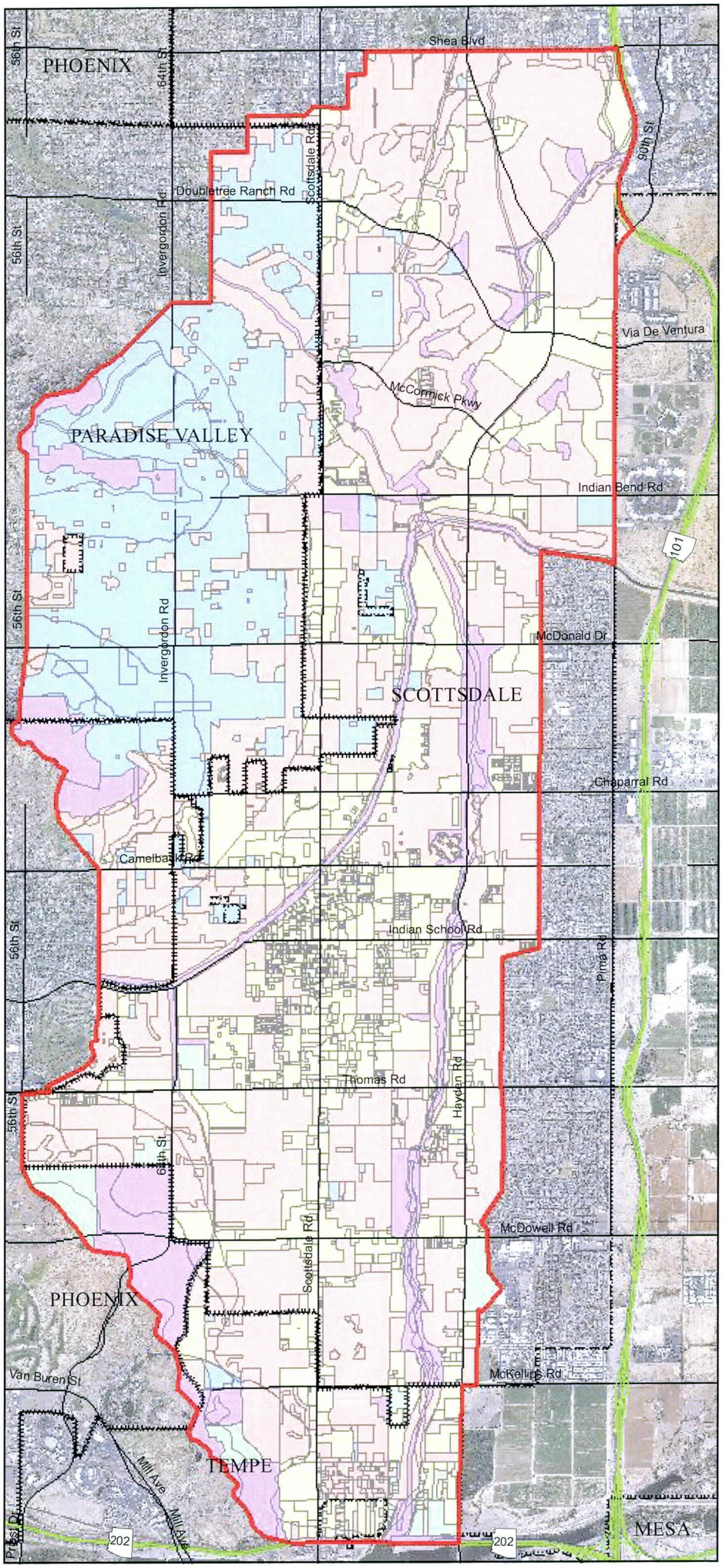
FCDMC-L.I.A.: Landscape Character Physical Settings, 2010

0 0.5 1

1 in = 1 mile

Flood Control District of Maricopa County

Gavan & Barker Inc. Civil Engineering & Landscape Architecture



Cultural Settings

EXHIBIT 12.b

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

- Industrial
- Natural
- Rural
- Suburban
- Urban

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

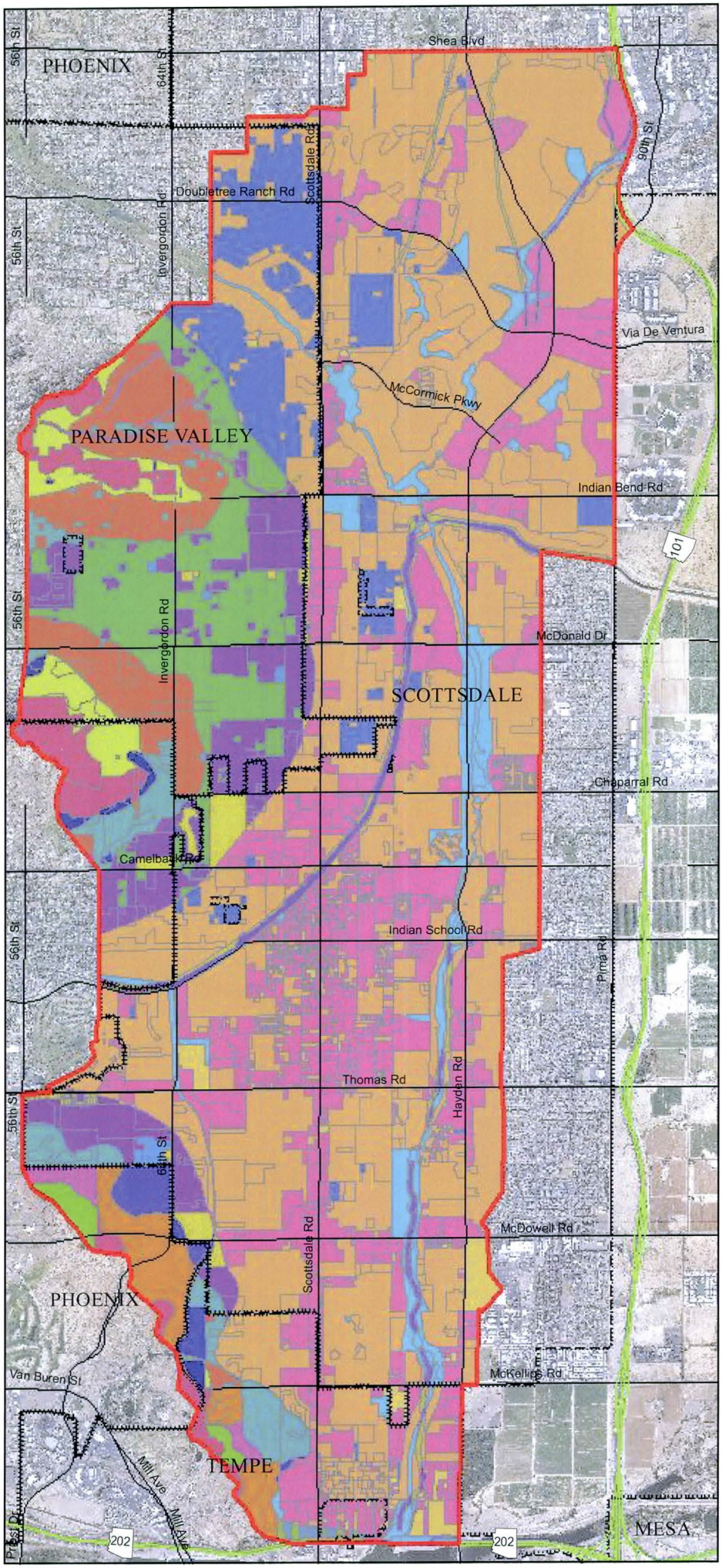
FCDMC-L.I.A.: Future Cultural Settings, 2010

0 0.5 1

1 in = 1 mile

Flood Control District of Maricopa County

Gavan & Barker Inc. Civil Engineering & Landscape Architecture



Landscape Character Units

EXHIBIT 12.c

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

- Industrial Lower Bajada
- Industrial Mountains
- Industrial River Terrace
- Industrial Upper Bajada
- Industrial Valley Plains
- Industrial Valley Wash
- Natural Lower Bajada
- Natural Mountains
- Natural River Terrace
- Natural Upper Bajada
- Natural Valley Plains
- Natural Valley Wash
- Rural Arroyo
- Rural Lower Bajada
- Rural Mountains
- Rural Upper Bajada
- Rural Valley Plains
- Rural Valley Wash
- Suburban Arroyo
- Suburban Lower Bajada
- Suburban Mountains
- Suburban River Terrace
- Suburban Upper Bajada
- Suburban Valley Plains
- Suburban Valley Wash
- Urban Lower Bajada
- Urban Mountains
- Urban River Terrace
- Urban Upper Bajada
- Urban Valley Plains
- Urban Valley Wash

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

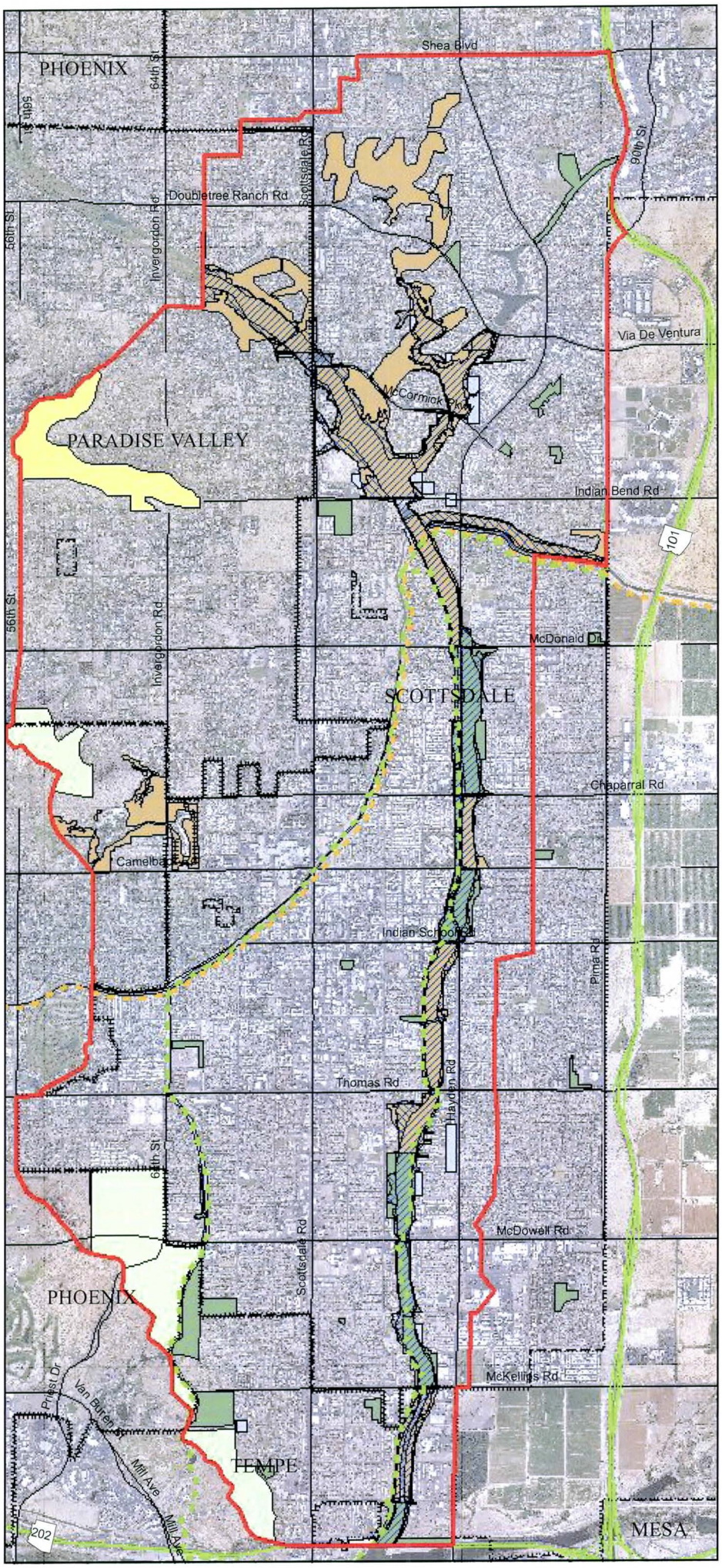
FCDMC-L.I.A.: Future Landscape Character Units, 2010

0 0.5 1

1 in = 1 mile

Flood Control District of Maricopa County

Gavan & Barker Inc. Civil Engineering & Landscape Architecture



Parks/Open Space

EXHIBIT 12.d

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

- Bureau of Land Management
- City Regional Parks
- Floodplain Fringe & Other Floodplain Zones
- Floodway
- Open Space Conservation Areas
- Open Space Retention Areas
- Local City Parks
- Local Golf Courses
- COS Shared Use Path
- Sun Circle Trail

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

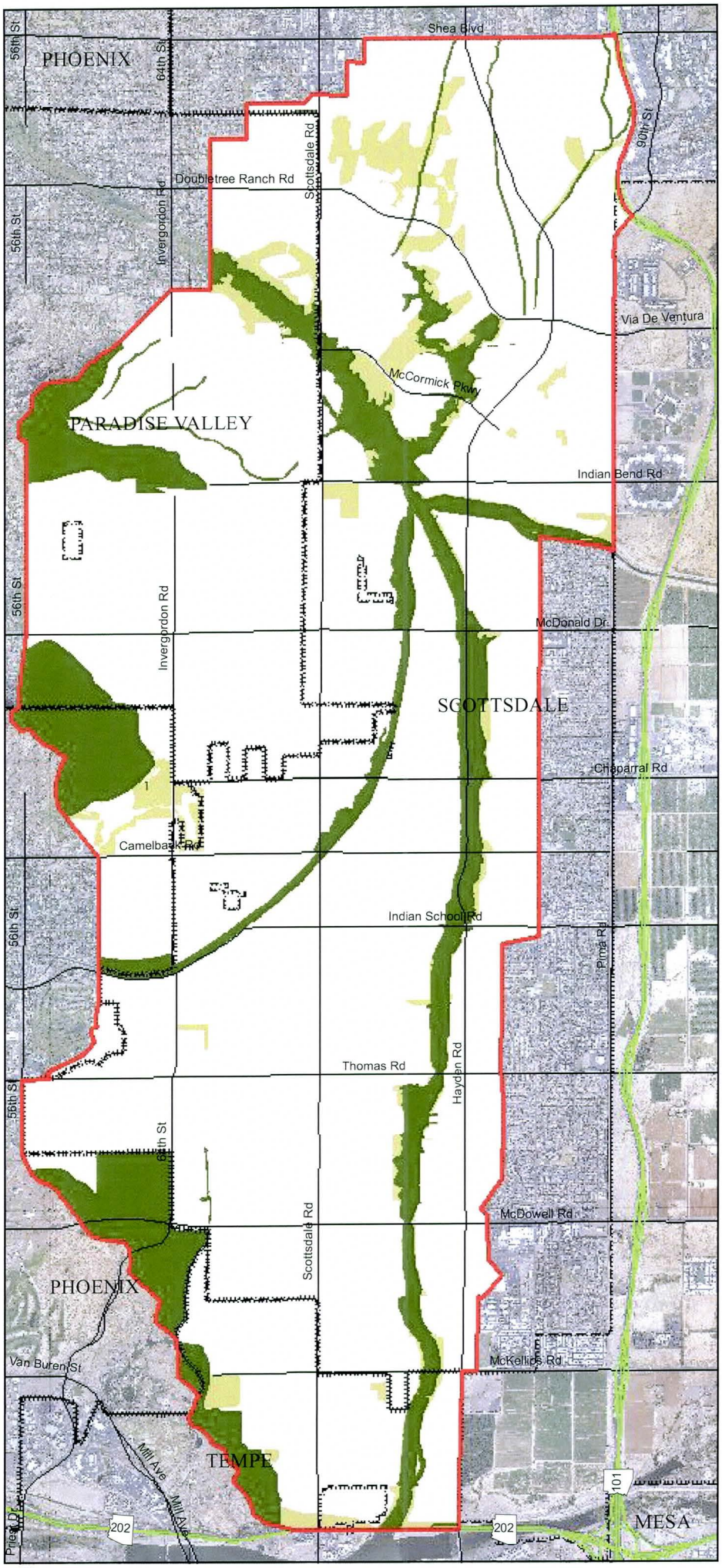
FCDMC-L.I.A.: Parks and recreation Resources Map, 2010
FCDMC-L.I.A.: Open Space Resources Map, 2010
City of Scottsdale General Plan, Draft 2011

0 0.5 1

1 in = 1 mile

Flood Control District of Maricopa County

Gavan & Barker Inc. Civil Engineering & Landscape Architecture



Combined Structural Types Compatibility

EXHIBIT 12.e

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

Compatibility Classes	Natural Structures	Underground Pipe	Channel Levee	Conveyance Channel	Storage Basin	Dam
Class 1	■					
Class 2		■				
Class 3	■	■	■			
Class 4	■	■	■	■		
Class 5	■	■	■	■	■	
Class 6						

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

FCDMC-L.I.A.: Combined Future Structure Types Compatibility, 2010

0 0.5 1

1 in = 1 mile

Flood Control District of Maricopa County

Gavan & Barker Inc.
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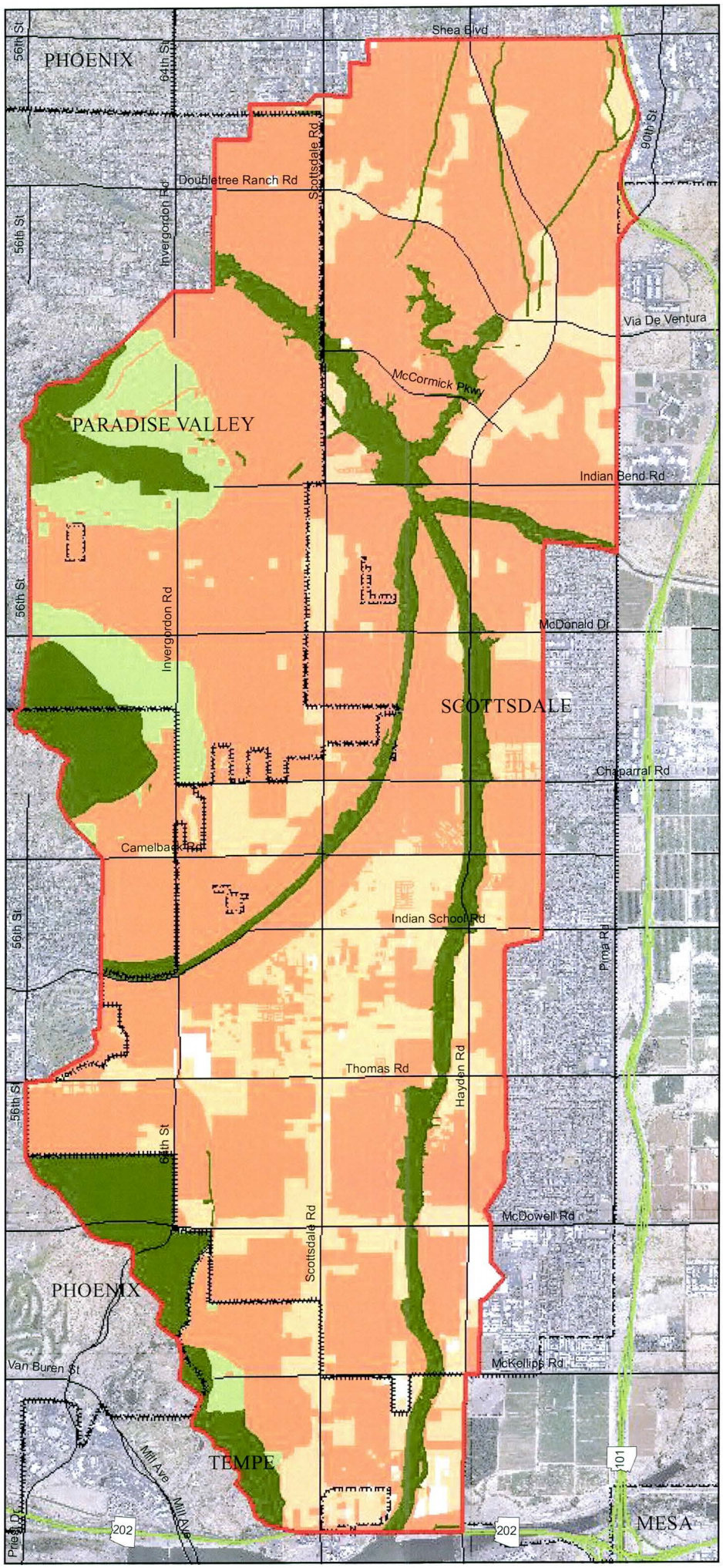


Combined Structural Methods Compatibility

EXHIBIT 12.f

Land & Resources Context

LOWER INDIAN BEND WASH ADMP

Legend

Compatibility Classes	Natural Methods	Soft Structural	Semi-Soft Structural	Enhanced Hard Structural	Semi-Hard Structural	Hard Structural
Class 1	■					
Class 2	■	■				
Class 3	■	■	■			
Class 4	■	■	■	■		
Class 5	■	■	■	■	■	
Class 6						

Reference Features

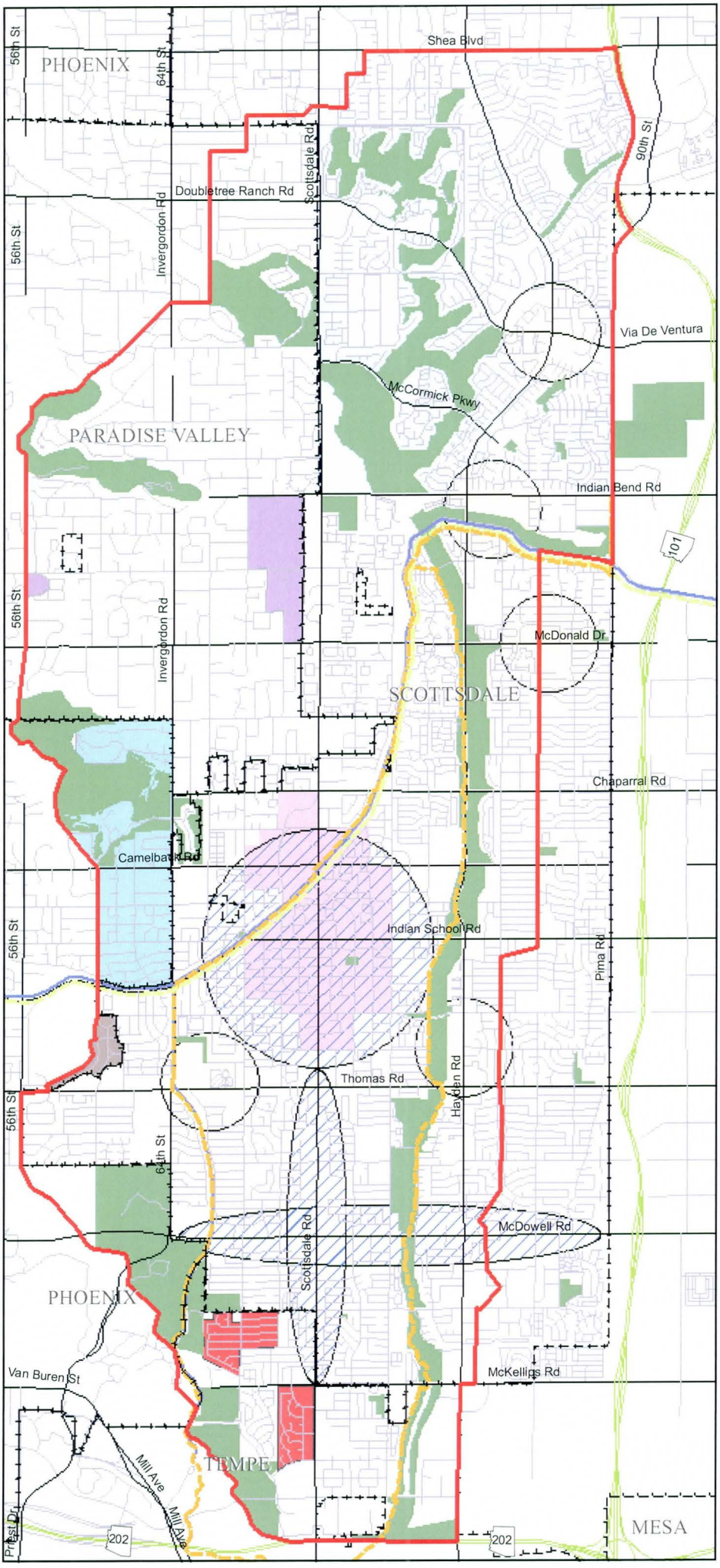
- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boundary

Data Sources

FCDMC-L.I.A.: Combined Future Structural Methods Compatibility, 2010

0 0.5 1

1 in = 1 mile



Community Context

EXHIBIT 12.g

Land & Resource Context

LOWER INDIAN BEND WASH ADMP

Legend

- Park/Open Space
- COS Shared Use Path
- Sun Circle Trail

City of Scottsdale

- Shea Character Area
- Downtown Character Area
- Southern Scottsdale Character Area
- Growth Area
- Activity Area

City of Phoenix

- Camelback East Planning Village
- Arcadia Camelback Special Planning District

City of Tempe

- Potentially Eligible Historic Property

Town of Paradise Valley

- Development Area

Reference Features

- Freeway
- Major Road
- Lower Indian Bend Wash ADMS
- City Boudary

Data Sources

FCDMC-L.I.A.: Open Space Resources Map, 2010
FCDMC-L.I.A.: Parks Recreational Resources Map. 2010
City of Scottsdale General Plan, Draft 2011
City of Phoenix General Plan, Revised 2010
City of Tempe General Plan 2030, Adopted 2003
Town of Paradise Valley 2012 General Plan

0 0.5 1

1 in = 1 mile

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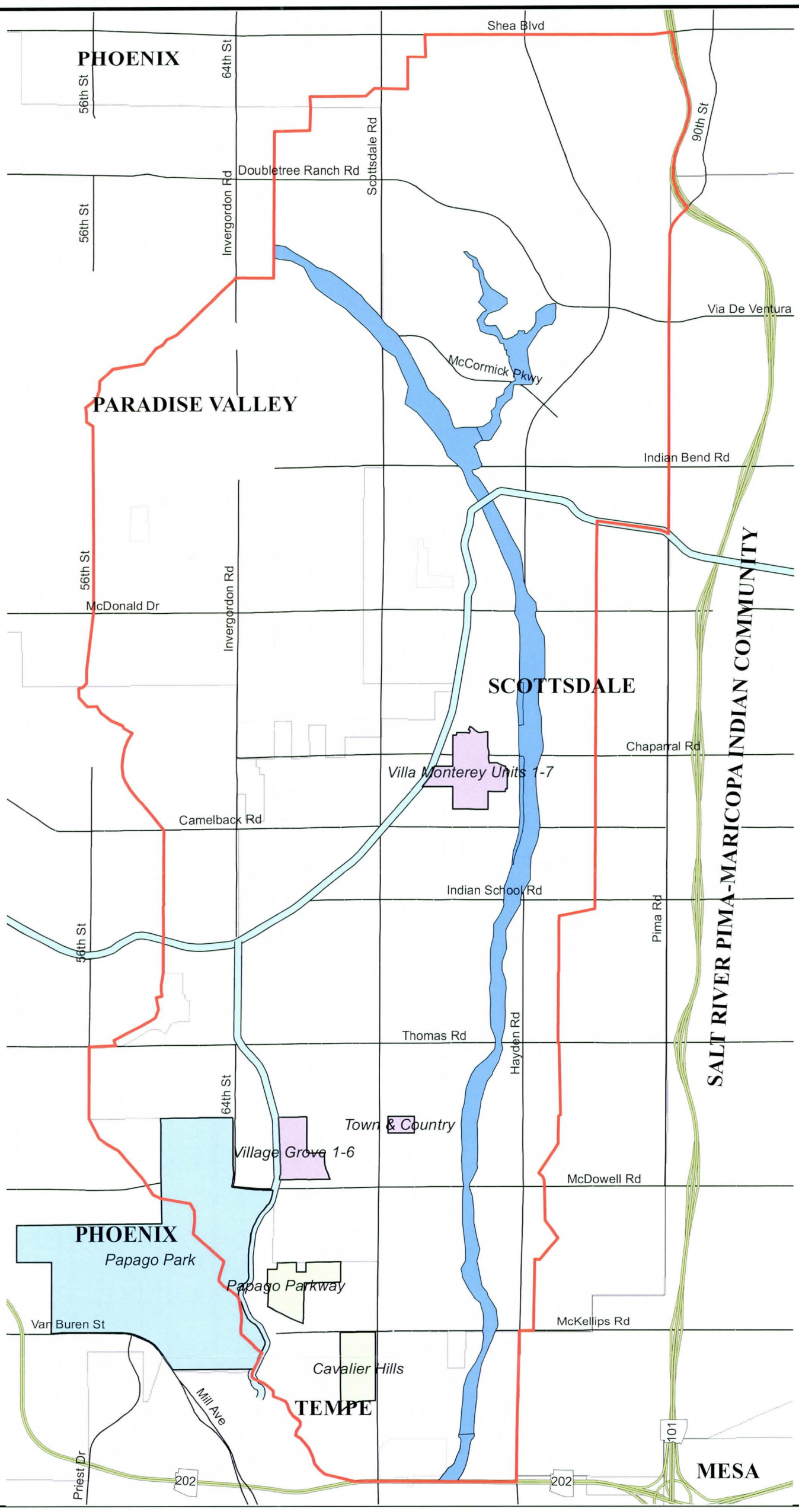
Appendix J: Historic Districts



Lower Indian Bend Wash ADMS
Historical Districts
Appendix J

Legend

- Study Area Boundary
- Historic Nonresidential District
- Historic District
- Potentially Eligible Historic District
- Municipality Boundary

4,100 0 4,100 Feet
1 inch = 4,167 feet

Flood Control District of Maricopa County

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Appendix K: Digital Data – Storm Drain Geo-Database