Appendix B: Granite Reef Watershed: Phase II – Drainage Planning Study Report

CITY OF SCOTTSDALE

GRANITE REEF WATERSHED IMPROVEMENT PROJECT
PHASE II - DRAINAGE PLANNING STUDY

ADDENDUM #2 TO:
GRANITE REEF WASH DRAINAGE STUDY & PRELIMINARY DESIGN IMPROVEMENTS PROJECT
(PREPARED BY PSOMAS, DATED FEB. 28, 2008 AND AMENDED JAN. 16, 2009)

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(See Inside Cover for Revisions)

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JULY 2020 REVISIONS:

Revisions were made to the Recommend Plan in July 2020 to support a request for a Conditional Letter of Map Revision (CLOMR) on Granite Reef Wash. During the development of the CLOMR application, it was found that the Recommended Plan's water surface elevations along 87th Street, north of McDowell Road, were above the Lowest Adjacent Grade (LAG) of several adjacent homes. Therefore, the following revisions were made to the Recommended Plan that lower the water surface elevation in 87th Street:

- *Increased the diameter of the proposed storm drain pipe in 87th Street from 84 to 90 inches and reconfigured the inlet locations at Hubble Street. Refer to Sheet 13 of the Recommended Plan Exhibits in Appendix C for the updated storm drain.*
- *Added regrading of the paved alley at the upstream end of the Belle Rive Channel which includes a new drainage easement, a new retaining wall and alley repaving to lower the water surface elevation at the channel entrance. Refer to Sheet 14 of the Recommended Plan Exhibits in Appendix C for the new grading.*

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

The primary purpose of the Granite Reef Watershed Improvement Project is to eliminate the FEMA floodplain along Granite Reef Wash, but it will also provide an outfall for storm drain inlets in Pima Road that are planned as part of the future roadway widening. The existing FEMA floodplain is approximately 2 miles long and encompasses over 600 homes. It extends from Thomas Road downstream to the City's southern boundary at McKellips Road (refer to **Figure 1**: Study Area Map).

The project is being done in two phases. Phase I consisted of adding new storm drain laterals to increase inlet capacity on the existing storm drains in Jackrabbit, Chaparral, Camelback and Indian School Roads; all of which drain to Indian Bend Wash. Once completed, these drainage improvements will allow the existing storm drains to capture all the 100-year flood flows north of Indian School Road; effectively eliminating the area upstream of Indian School Road from the Granite Reef Wash contributing watershed. Phase II of the project is this Drainage Planning Study for the area south of Indian School Road.

This project has been developed as an alternative to the original flood control plan, referred to as the Pima Road Conduit, that was proposed with the *Granite Reef Wash Drainage Study*; prepared by Psomas in February 2008 and revised in an addendum dated January 2009 (Psomas Report). The final Pima Road Conduit plan proposed in the addendum consisted of a large conduit in Pima Road that would divert flow from Granite Reef Wash and convey it out to the Salt River in the Pima Road alignment. The conduit was planned to begin at Chaparral Road and was designed to collect and convey the 100-year flood flows from Granite Reef Wash with large diameter lateral storm drains. The proposed condition design flows for the Pima Road conduit were 1740 cfs at Thomas Road, conveyed in dual 120" pipes and 2250 cfs at McKellips Road, conveyed in a 12'x16' concrete box culvert. The cost to implement this plan in 2009 was estimated to be $51 million.

Since the time the Psomas Report and its addendum were prepared, there have been several developments that provided the impetus for this project. These developments include 1) a desire to reduce project costs, 2) the development of a new hydrologic model that estimates significantly lower peak flood flows along Granite Reef Wash, and 3) a planning effort by the Salt River Pima – Maricopa Indian Community (SRPMIC) that recommended a storm drain alignment along Granite Reef Wash as opposed to Pima Road.

In 2014 the City contracted with TY Lin International to update the hydrologic analysis on Granite Reef Wash using a new, 2-dimenional flow analysis along with updated rainfall data based on the new NOAA Atlas 14 Precipitation frequency estimates. The study resulted in peak flow rates that are substantially reduced from the design flows used in the Psomas Report. For example, at Thomas Road the existing condition, 100-year peak discharge is 1650 cfs according to the Psomas Report whereas the TY Lin Report provides a peak flow of 350 cfs (refer to Section 2.3 for an explanation of the reduction in peak discharge).The updated hydrologic analysis is documented in the *Granite Reef Wash Hydrology Update*, prepared by TY Lin International and dated June 2018.

In 2016, the SRPMIC contracted with Olsson Associates to prepare a Drainage Master Plan for Section 12 (Olsson Report), located downstream of McKellips Road. Their recommended plan includes a large diameter storm drain in the Granite Reef Wash alignment to convey offsite flows from Granite Reef Wash and to serve as an outfall for future street drainage in Section 12.

1.2 PURPOSE OF PHASE II STUDY

The purpose of this Phase II Drainage Planning Study is to identify, analyze and document drainage improvements south of Indian School Road that are necessary to eliminate or significantly reduce the flooding potential along Granite Reef Wash between Thomas Road and the Salt River. The alternatives that were analyzed consisted of new and/or upsized storm drains along the alignment of Granite Reef Wash, new detention basins within the watershed to attenuate peak flows and a new storm drain along Pima Road to both reduce the inflow to Granite Reef Wash and provide a drainage outfall for future roadway improvements on Pima Road.

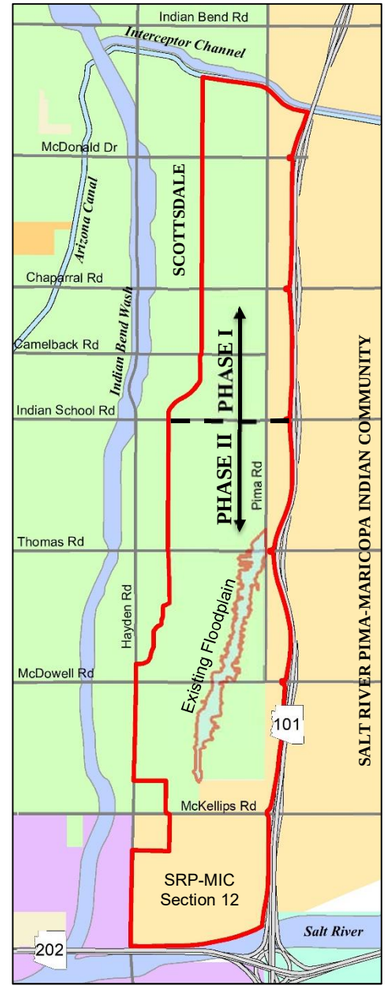

Figure 1: Study Area Map

1.3 PURPOSE OF REPORT

This report is intended to serve as the second Addendum to the original 2008 Psomas Report. It documents and summarizes the updated recommended plan of drainage improvements for the Granite Reef Watershed; downstream of Indian School Road. The report provides a summary of the data collection effort, the hydrologic/hydraulic analysis and documentation on alternative solutions that were investigated to determine the

most cost-effective recommended plan for Phase II of the Granite Reef Watershed Improvement Project.

1.4 STUDY AREA

The size of the Granite Reef Wash watershed is approximately 6.5 square miles, but the Phase II study area only covers about 4.4 square miles which represents the drainage area for the lower portion of the Granite Reef Wash, downstream of Indian School Road. The study area is bounded by Indian School Road to the north, the Salt River on the south, the Loop 101 freeway on the east and the ridge line along Granite Reef Road and Hayden Road on the west. The study area encompasses portions of the City of Scottsdale and the SRPMIC. Refer to **Figure 1** for the study area and the jurisdictional boundaries.

1.5 STAKEHODLERS

The Granite Reef Wash Drainage Planning Study was commissioned by the City of Scottsdale. The stakeholders include the City along with the SRPMIC and the Flood Control District of Maricopa County (District). All three stakeholders have a common interest in alleviating flooding along Granite Reef Wash and have entered into an agreement to share the cost of the proposed drainage improvements.

2.0 DATA COLLECTION

A considerable amount of data was collected to conduct this study which included the topographic mapping used in the analysis as well as previous drainage reports, maps of existing utilities, as-built plans of existing storm drains and grading and drainage plans for developments that have been constructed since the time the topographic mapping was prepared.

2.1 EXISTING UTILITIES

Maps of existing utilities were obtained to identify potential conflicts with major City water lines and existing gravity systems including City sewer lines and SRP irrigation lines. The water and sewer quarter section maps were obtained from the City of Scottsdale website and maps of the irrigation system were obtained from SRP. The collected information was used to plot the alignment of the existing utilities to identify conflicts. The information on the sewer quarter section maps was used to estimate the depth of the existing sewer lines. The plan and profile drawings of the recommended plan in **Appendix C** show the existing water and sewer lines as well as the existing SRP irrigation lines. There are several instances where the existing sewer will have to be realigned to avoid conflict with the proposed storm drains. These realignments are shown the plan and profile drawings.

2.2 TOPOGRAPHIC MAPPING

The topographic mapping was obtained from the District. The topographic mapping is based on aerial photography that was flown on November 2nd, 2007 and has a 2-foot contour interval accuracy. The aerial survey is based on the North American Vertical Datum of 1988 (NAVD 88) vertical datum and the North American Datum of 1983 (NAD 83) horizontal datum. This mapping was used to develop the FLO-2D model and to prepare the plan and profile drawings of the recommended plan.

2.3 DRAINAGE REPORTS

The following drainage reports were collected as part of the Phase II planning study:

Granite Reef Wash Drainage Study & Planning Design Improvements Project: Drainage Design Report, prepared by Psomas (dated February 2008) – This report, which is referred to as the Psomas Report was prepared for the City of Scottsdale to analyze the existing Granite Reef Wash drainage area and provide a recommended plan to mitigate the flooding problems along Granite Reef Wash. The recommended plan, referred to as the Pima Road Conduit plan, was based on a HEC-1 hydrology model and consists of a large conduit in Pima Road between Indian School Road and the Salt River. It included several large lateral storm drains to intercept runoff from Granite Reef Wash. The Pima Road Conduit plan was designed to collect and convey the 100-year flood flows in Granite Reef Wash which resulted in storm drain design flows of 1550 cfs at Thomas Road (2-120” pipes) and 2225 cfs at McKellips Road (12’x16’ box culvert). The cost to implement this plan was estimated to be $44 million.

Granite Reef Wash Drainage Study & Planning Design Improvements Project: Drainage Design Report – Addendum, prepared by Psomas (dated January 2009) – This report is an addendum to the original Psomas Report and resulted in revising the Pima Road Conduit plan by extending it one mile farther north along Pima Road from Indian School Road to Chaparral Road. It also included the addition of new storm drain laterals in Camelback Road and McKellips Road. The revised plan resulted in somewhat higher design flows for the Pima Road conduit of 1740 cfs at Thomas Road (2-120” pipes) and 2250 cfs at McKellips Road (12’x16’ box culvert). The cost to implement the revised plan was estimated to be $51 million.

Granite Reef Wash Hydrology Updated – Hydrologic Study, prepared by TY Lin International (dated June 2018) – The primary purpose of this study was to develop and document an updated hydrology model for the Granite Reef Wash watershed. The original HEC-1 hydrology model that was developed by Psomas was replaced by a new, two-dimensional FLO-2D hydrology model that incorporates SWMM to analyze the existing storm drain infrastructure. The new FLO-2D model utilized the updated topographic mapping, described in Section 2.2, as well as updated rainfall data based on the new NOAA Atlas 14 Precipitation frequency estimates. The study resulted in peak flow rates that are substantially reduced from the existing condition flows estimated with the Psomas Report. For example, at Thomas Road the

existing condition, 100-year, 6-hour peak flow decreased from 1650 cfs down to 350 cfs and at McKellips Road it decreased from 2210 cfs down to 550 cfs. The TY Lin report identified a number reasons for the large decrease in flow rate, but the primary factors are 1) the FLO-2D model accounts for surface storage that the HEC-1 model largely ignores, 2) the NOAA Atlas 14 precipitation depths used in the FLO-2D model reduced the rainfall depth about 22%; from 3.2 inches down to 2.5 inches, and 3) the Psomas Report assumed that the SRPMIC lands were fully developed whereas the TY Lin FLO-2D model was based on existing conditions with fallow agricultural fields (refer to the TY Lin Report for a full explanation of the reduction in the existing conditions peak discharge).

Technical Support Data Notebook for Letter of Map Revision, Granite Reef Wash Floodplain Redelineation, prepared by Gavan & Barker, Inc. (dated May 2018 – DRAFT) – This Technical Support Data Notebook was prepared in support of the request to obtain a Letter of Map Revision (LOMR) for the current Zone 'AE' Floodplain along Granite Reef Wash between Thomas Road and the Granite Reef Road cul-de-sac which lies about 1/5 mile south of Roosevelt Street. The redelineated floodplain is based on the updated hydrology developed by TY Lin International as described in the paragraph above. Using the updated hydrology from the FLO-2D model, the Granite Reef Wash floodplain was significantly reduced, but a substantial number of homes remain in floodplain; especially along 87th Street between Thomas Road and McDowell Road and along 84th Place from McDowell Road to Roosevelt Street.

Granite Reef Watershed Improvement Project: Phase II – Drainage Planning Study: Summary of Alternatives/Selected Plan, prepared by Gavan & Barker, Inc. (dated November 2017) – This report was prepared to document the alternative solutions that were considered for the Phase II Drainage Planning Study and to summarize the selected plan. The selected plan was chosen at a brainstorming meeting that was attended by the stakeholders. It formed the framework for the recommended plan that is summarized in this Phase II Drainage Planning Study.

3.0 PROJECT PHASING

The Granite Reef Watershed Improvement Project is divided into two separate areas which are referred to as Phase I and Phase II. Phase I covers the area north of Indian School Road and Phase II is south of Indian School Road. Refer to **Figure 1** for the location of each drainage improvement area.

3.1 PHASE I DRAINAGE IMRPOVEMENT AREA

The Phase I drainage improvements consist of adding inlet capacity to the existing storm drains located north of Indian School Road. The *"Granite Reef Watershed - Existing Storm Drain Assessment"*, prepared by Gavan & Barker dated April 19, 2014, concluded that there is significant existing unused storm drain capacity upstream of Indian School Road that can be used to collect additional runoff; thereby reducing stormwater flows that contribute downstream to Granite Reef Wash. The existing storm drains are in Jackrabbit, Chaparral, Camelback and Indian School Road. All four of them outlet to Indian Bend Wash. The Phase I improvements were designed to capture runoff from 100-year, 6-hour storm. The new laterals on the Jackrabbit, Chaparral and Camelback Road storm drains were constructed in 2018 and the new lateral on the Indian School Road storm drain is planned for construction in 2020. Upon completion of the Indian School Road storm drain improvements, Phase I will be complete and the 100-year runoff from the area north of Indian School Road will be intercepted and conveyed to Indian Bend Wash. Therefore, once Phase I is completed, Indian School Road will act as the northern watershed boundary for Granite Reef Wash.

3.2 PHASE II DRAINAGE IMPROVEMENT AREA

The Phase II drainage improvements are for the area south of Indian School Road where the existing drainage infrastructure is characterized by undersized storm drains, channels and inverted crown streets. The primary conveyance along Granite Reef Wash starts at Thomas Road and flows south along 87th Street which is an inverted crown street with a 48-inch storm drain. North of McDowell Road the storm drain outlets into an open channel that flows south for about ¼ mile to a 48-inch storm drain in 84th Place. At Roosevelt Street, the 48-inch storm drain increases to a 54-inch storm drain and continues south for about 1/5 mile to a concrete lined channel that flows south to McKellips Road where it discharges to an earthen channel that flows through Section 12 to the Salt River. Except for the concrete lined channel upstream of McKellips Road, the above described drainage infrastructure is significantly undersized; even after the Phase I improvements are completed.

As previously stated, this planning study was initiated by the City of Scottsdale to develop a more cost effective, alternative solution to the Pima Road Conduit plan proposed in the 2008 Psomas Report. Instead of diverting flow in Granite Reef Wash to one large storm drain in Pima Road, as outlined in the Psomas Report, this study focuses on designing new detention basins, storm drains and channel improvements along the Wash alignment to eliminate or significantly reduce the existing floodplain.

4.0 HYDROLOGIC AND HYDRAULIC ANALYSIS

The hydrologic and hydraulic model that was used to analyze the recommended plan was developed using the FLO-2D/SWMM integrated program. The hydrologic model was developed for the 100-year, 6-hour storm and incorporates existing retention basins, culverts, walls, channels and storm drains. It was originally developed by TY

Lin International for the City of Scottsdale and is documented in the *"Granite Reef Wash Hydrology Updated: Hydrology Study"* (refer to Section 2.3).

4.1 EXISTING CONDITIONS MODEL

As part of the Phase II planning effort certain updates and adjustments were made to the TY Lin FLO-2D model to include developments that have occurred since the model was developed and to make refinements in areas where it was found that the model did not accurately reflect existing flow conditions. The following paragraphs describe the revisions that were done to create an updated FLO-2D model of existing conditions in the watershed.

4.1.1 Updates to The Existing Conditions Model

There were two updates that were made to the TY Lin FLO-2D model. The first was the addition of the Phase I drainage improvements. These include the new laterals that were constructed on the storm drains in Jackrabbit, Chaparral, Camelback and Indian School Roads. The second was the Scottsdale Autoshow development. This consisted of the development of the new auto dealership complex between Pima Road and the Loop 101 Freeway from Indian School Road south to Earll Drive. These improvements also included the new retention basin on the northeast corner of Pima Road and Indian School Road that protects the Autoshow development from offsite flows. Refer to **Figure 2** for the location of the model updates that were done to the original TY Lin FLO-2D model.

4.1.2 Adjustments to The Existing Conditions Model

Two significant revisions were made to FLO-2D model where it did not accurately represent existing flow conditions. One location was the General Dynamics complex south of McDowell Road on the east side of Granite Reef Road. In this location, the model results indicated that much of the runoff from the General Dynamics Complex would bypass the onsite retention basins and flow out onto Roosevelt Street. However, it was clear from a field review of the complex that runoff from the site is directed to the onsite retention basins which must fill before they can overflow onto Roosevelt Street. Therefore, grid adjustments were made to match field conditions and direct runoff from the complex into the onsite retention basins.

The other location is the 1400-foot long concrete lined channel that runs from the cul-de-sac on Granite Reef Road downstream to McKellips Road. The grids in the FLO-2D model represented a much narrower channel than what exists in the field. This resulted in an unrealistic backwater effect that forced runoff to overflow the channel at the cul-de-sac and flow easterly along the north side of the Shadow Mountain Village Mobile Home Park. In order to correct this issue, the FLO-2D grids along the channel were revised to more accurately reflect the cross-sectional area of the existing channel. Refer to **Figure 2** for the location of the model adjustments that were done to the original model.

4.2 PROPOSED CONDITIONS MODEL

The updated existing conditions FLO-2D model was used to analyze the proposed features of the Phase II plan and to create a proposed conditions model of the recommended plan. The following paragraphs describe the modifications that were done to create the proposed conditions model.

4.2.1 Addition of Recommended Plan Features

Once the existing conditions FLO-2D model was developed, the proposed improvements of the recommended plan for Phase II were added to the model. An iterative approach was done to adjust storm drain pipe sizes in analyzing the recommended plan. As part of this planning level analysis, no attempt was made to size the new inlets or connector pipes. Instead the inlets were made large enough so that they would intercept enough flow to make sure that the storm drain capacity governs the amount of flow intercepted, as opposed to the inlets limiting the amount of flow that can enter the storm drain system. Similarly, no attempt was made to size the connector pipes. In the FLO-2D model, they were set to a relatively large diameter of 36 inches to preclude any constraint on the flow transfer from the inlets to the proposed main storm drain lines. Refer to **Figure 6** for the proposed features of the Phase II Improvement Plan.

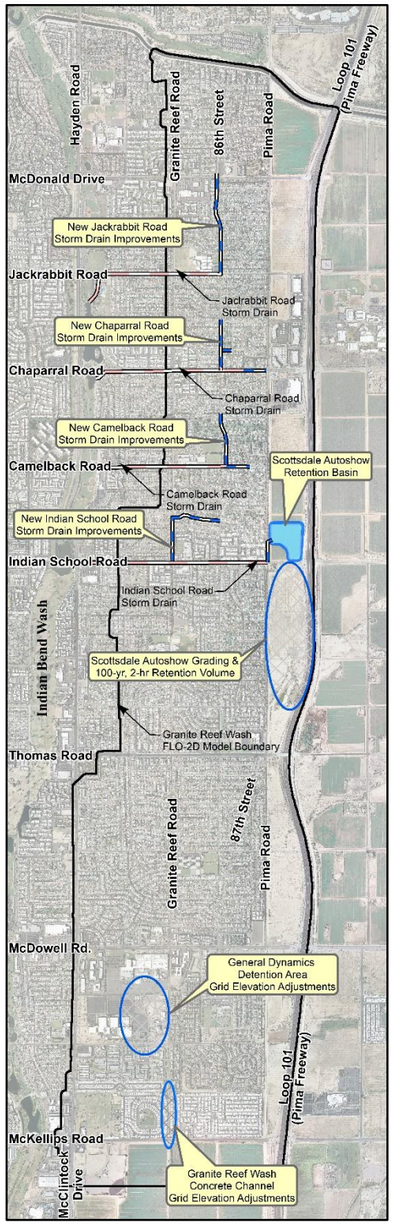

Figure 2: Adjustments/Updates to Existing Conditions Model

4.2.2 Adjustments for Future Pima Road

Adjustments were made to the proposed conditions FLO-2D model to account for the future widening of Pima Road to make sure that the proposed Pima Road storm drain will provide enough capacity to collect and convey the future pavement drainage. The proposed Pima Road storm drain runs from Thomas Road to Granite Reef Wash, discharging to the Wash at McKellips Road. The new storm drain will serve a dual

purpose. First it was designed to serve as the outfall for the proposed Pima Park Detention Basin including the low flow, basin bypass flows in both the Pima Road and Thomas Road storm drains. Second, it was sized to convey the runoff generated from the fallow agricultural land east of Pima Road plus the runoff from the future Pima Road widening between Indian School Road and McDowell Road.

To account for the future widening of Pima Road, the proposed conditions FLO-2D model was modified to represent the runoff from the future, wider roadway section. The width of the future roadway was taken from the 2009 Pima Road DCR prepared by Parsons Brinkerhoff. The DCR indicates that it will have four lanes with a landscaped median with a total curb to curb width of 68 feet. This future roadway section was incorporated into the FLO-2D model by re-grading the model grids in the agricultural fields east of the existing roadway. The infiltration parameters of the modified grids were also adjusted to represent the future paved conditions.

The FLO-2D results indicate that the proposed Pima Road storm drain between Thomas Road and Oak Street, a quarter of a mile north of McDowell Road, is governed by the outflow from the proposed Pima Park Detention Basin. Downstream of Oak Street, however, the storm drain design flow is governed by runoff from the agricultural fields and the future Pima Road.

4.3 HYDROLOGIC RESULTS

As described in Section 4.1, certain updates and adjustments were made to the TY Lin FLO-2D model to include developments that have occurred since the model was developed and to make refinements in areas where it was found that the model did not accurately reflect existing flow conditions. These model adjustments resulted in revised estimates of the existing condition peak discharges. The following paragraphs summarize the revised peak flows for the existing conditions as well as the storm drain design flows associated with the proposed conditions which include the planned Phase II drainage improvements.

4.3.1 Existing Conditions Hydrologic Results

The updates and adjustments to TY Lin FLO-2D model had a significant impact on the existing condition peak discharges along Granite Reef Wash. The updates included the Phase I storm drain improvements, the recently constructed Scottsdale Autoshow, and adjustments to the grid elevations at both the General Dynamics Complex and the concrete lined channel north of McKellips Road. These adjustments resulted in a decrease in the existing condition peak discharge at Thomas Road, from 350 cfs down to 310 cfs, but farther downstream, at McKellips Road, the adjustments resulted in an increase in peak flow from 550 cfs to 620 cfs. The increase at McKellips Road is due the grid elevation adjustments for the concrete lined channel. These adjustments resulted the 100-year flow being contained in the channel, removing the unrealistic breakout flow (see *Section 4.1.2*) from the FLO-2D model. The breakout flow occurred upstream of McKellips Road along the north side of the Shadow Mountain Village Mobile Home Park. Precluding the breakout flow was the primary reason for the 70 cfs increase in peak flow at McKellips Road. Refer to the table in **Figure 3** for the existing conditions peak discharges along Granite Reef Wash.

Granite Reef Wash Flow Comparison Location	Existing Condition Peak Discharge (cfs)	Proposed Condition Peak Discharge (cfs)
87th Street Downstream of Thomas Road	310^	110^
87th Street Downstream of Oak Street	490^	330^
Granite Reef Wash Downstream of McDowell Road	590	560^
Granite Reef Road Downstream of Roosevelt Street	600^	640^
Granite Reef Wash Upstream of McKellips Road	620	690
Granite Reef Wash Downstream of McKellips Road	660	980^

^The listed peak discharge represents the combined surface and storm drain flow

Figure 3: Granite Reef Wash Peak Discharge Summary

4.3.2 Proposed Conditions Hydrologic Results

The elements of the Phase II plan were added to the existing conditions FLO-2D model to create the proposed conditions model for the recommended plan. The proposed conditions model was used to size the storm drains and estimate the residual flows along Granite Reef Wash.

The proposed condition peak discharge on the upstream end of Granite Reef Wash at Thomas Road is reduced from an existing condition flow of 310 cfs down to 110 cfs. Not only is the peak flow reduced by 200 cfs, but the time of the peak is also delayed by over 40 minutes from 4.9 hours to 5.6 hours. Moreover, the runoff volume is reduced from 64 acre-feet to 11 acre-feet. Refer to **Figure 4** for the hydrograph comparison between the existing and proposed conditions flows just downstream of Thomas Road. The delay in the time of the peak is caused by the storage attenuation provided with the proposed Pima Park Detention Basin whereas the volume reduction is due to the flow that is diverted through the low-flow pipes that bypass the Basin and outlet to the proposed Pima/McKellips Road storm drain. Refer to the table in **Figure 3** that summarizes the existing versus proposed conditions peak discharges along Granite Reef Wash between Thomas Road and McKellips Road.

The 110 cfs peak discharge at Thomas Road is composed of 80 cfs overflowing from the proposed detention basin plus 30 cfs from 87th Terrace (Pima Frontage Road) that exceeds the capacity of the storm drain. Since the proposed time to peak is significantly delayed, the downstream drainage infrastructure along Granite Reef Wash (87th Street), which consist of an inverted crowned street and a 48-inch storm drain, has sufficient capacity to convey the proposed conditions 110 cfs without causing flooding.

As can be seen in **Figure 3**, the proposed condition peak discharge along Granite Reef Wash increases to 330 cfs at Oak Street and 560

cfs at McDowell Road. The peak flow at McDowell Road is only 30 cfs less than the existing conditions peak discharge of 590 cfs. Farther downstream, at Roosevelt Street, the proposed condition peak discharge of 640 cfs exceeds the existing condition flow of 600 cfs. Similarly, just upstream of McKellips Road, the proposed condition peak discharge of 690 cfs exceeds the existing condition peak discharge of 620 cfs, while just downstream of McKellips Road the addition of the proposed Pima/McKellips Road storm drain increases the proposed condition peak discharge to 980 cfs compared to the existing condition peak discharge of 660 cfs. Refer to **Appendix B** for the existing and proposed conditions FLO-2D max depth and peak discharge exhibits.

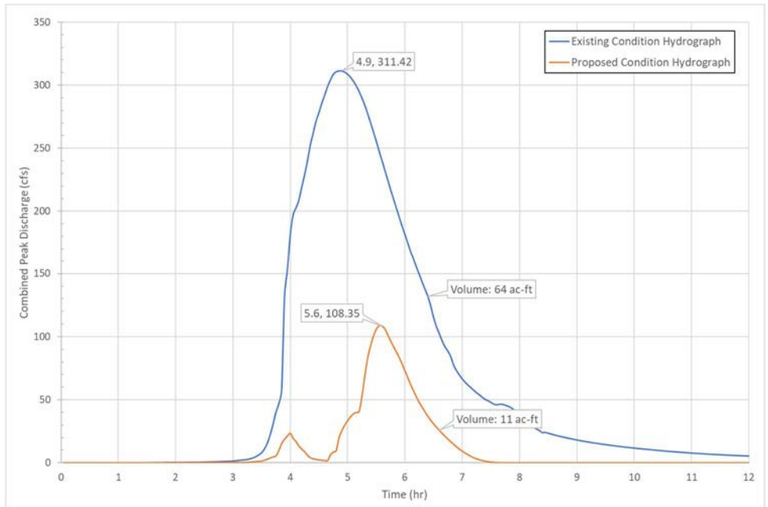

Figure 4: Hydrograph Comparison Downstream of Thomas Road

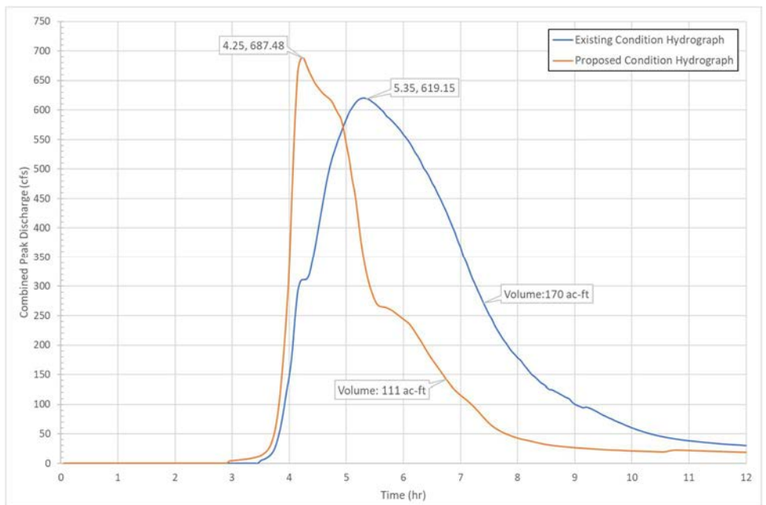

Figure 5: Hydrograph Comparison Upstream of McKellips Road

Since the proposed conditions include a new detention basin and diversions to the Pima Road storm drain, it seems counterintuitive that the peak discharges along Granite Reef Wash would increase. But the storm drains associated with the proposed conditions increase the efficiency with which the peak flows are conveyed along Granite Reef Wash, reducing the time to peak and significantly reducing the attenuation effects of surface storage. Under existing conditions, the storm drains in Granite Reef Wash are undersized and easily exceeded with most of the flow being conveyed at significant depths along inverted crowned streets and open channels. This surface flow provides significant storage that has a considerable impact on peak flows. The addition of the recommended plan improvements reduces the travel time of the flood flows along Granite Reef Wash and significantly reduces the attenuation provided by the flow in the streets.

As can be seen in **Figure 5**, which compares the existing and proposed conditions flood hydrographs just upstream of McKellips Road, the existing condition peak discharge of 620 cfs occurs more than an hour after the proposed condition peak discharge. The figure shows that the proposed condition hydrograph is much narrower with a higher peak as compared to the existing condition hydrograph which is a result of the faster travel times and the elimination of most of the surface storage that is currently provided with flow in the streets.

5.0 COST ESTIMATING

Budgetary cost estimates were prepared for each major element of the recommended plan. The cost of the proposed storm drains was based the number of inlets, the length of storm drain pipe, the number of manholes and any special structures and/or features such as detention basin excavation, roadway repaving and relocation of sanitary sewers. The unit price of inlets includes the cost of the connector pipe and pavement replacement and the unit price of storm drain pipe includes trenching, pipe cost and pavement replacement. Based on the combined cost of these storm drain components, it was found from past projects that other costs for such items as removal of existing drainage infrastructure, utility relocation, construction surveying, traffic control and mobilization are usually about 25-30 percent of the storm drain installation cost. So, an additional 30 percent was added to cover these ancillary costs. Then, to determine the total construction cost, a contingency of 20 percent was added to cover the potential for other, unknown expenses. The total project budget for each element of the plan includes an additional 25 percent of the total construction cost to account for fees associated with design, construction administration, plan review and permitting. Refer to **Appendix A** for a detailed description on how the unit prices were developed for the installation of storm drain pipe, inlets and manholes.

6.0 ASSUMPTIONS & FINAL DESIGN REQUIREMENTS

The following paragraphs summarize the assumptions that were made in developing the recommended plan and requirements of the final designer:

1) All proposed storm drains and basins were sized using the 100-year, 6-hour FLO-2D/SWMM integrated model. However, there were instances where it was impractical to intercept the entire 100-year flow in the storm drains either due to large

flows or constraints such as existing utility conflicts. At these locations, including 87th Street and 84th Place, the excess flow is conveyed in the street at depths that are believed to be below the floor elevation of the adjacent houses. The approximate storm drain sizes are shown on the preliminary plans and can also be found in the FLO-2D/SWMM model for the recommended plan. It is the duty of the final designer to verify and refine, as necessary, all storm drain sizes. It is also the responsibility of the final designer to verify that the residual flow depths remain below the floor elevations of the adjacent houses.

2) No attempt was made to size the storm drain inlets. The inlets that are shown on the preliminary plans and included in the FLO-2D model of the recommended plan were placed where flow concentrates and made large enough to fully utilize the proposed storm drain. The final designer shall be responsible for properly sizing and placing the proposed inlets.
3) Similarly, no attempt was made to size the connector pipes. In the FLO-2D model of the recommend plan they were set to a relatively large diameter of 36 inches and a length of 20 feet to preclude any constraint on the flow transfer from the inlets to the storm drain lines. The final designer shall be responsible for properly sizing the catch basin connector pipes.
4) Minor loss coefficients were included in the FLO-2D/SWMM storm drain model, however the final designer shall be responsible for verifying the applicability of the coefficients used.
5) The final designer shall prepare a Design Data Report that documents amongst other things, the FLO-2D/SWMM model revisions, inlet calculations and updated storm drain hydraulic grade line calculations; including the connector pipes.

7.0 OTHER ALTERNATIVES CONSIDERED

There were certain features of the selected plan, as described in the *Summary of Alternatives/Selected Plan* report, that were not carried forward in the recommended plan. These were the Osborn Road storm drain and the Apache Park detention basin. In addition, after development of the selected plan, consideration was given to the construction of an open channel along Pima Road, south of McDowell Road. That proposed element was also not included in the final recommended plan. The following sections explain why these three elements were not carried forward.

7.1 OSBORN ROAD STORM DRAIN

The Osborn Road storm drain was the upstream most drainage improvement described in the selected plan. It was eliminated from the recommended plan for several reasons including cost, lack of significant impact on downstream flows in Granite Reef Wash and the potential difficulty in obtaining permission to discharge to Indian Bend Wash.

The storm drain would have run from Indian Bend Wash to 86th Street, intercepting the 100-year, 6-hour peak discharge from 83rd Street, Granite Reef Road, 85th Street and 86th Street. It would have significantly reduced the peak discharges and runoff volumes at the proposed Pima Park Detention Basin, but it was an expensive feature of the selected plan; estimated to cost approximately $7.0 million.

Since the Osborn Road storm drain would have created a new penetration into Indian Bend Wash, approval would need to be obtained from both the District and the United States Army Corps of Engineers (USACE). Additionally, due to the existence of the Continental Golf Club golf cart underpass on the east side of the wash, the proposed storm drain would need to be designed to avoid the underpass and bubble-up in the golf course just south of Osborn Road. The low flows and bubble-up structure would drain through a new 36-inch low flow pipe that connects to the existing golf course lake.

During the hydrologic and hydraulic analysis of the recommended plan, it was found that the impact of the Osborn Road storm drain on the peak discharges in Granite Reef Wash floodplain was negligible. It would have significantly improved the drainage conditions between Osborn Road and Thomas Road, but had little impact on the project goal of reducing the floodplain on Granite Reef Wash.

Building the Osborn Road storm drain in combination with the recommended Thomas Road storm drain and Pima Park detention basin would allow the entire 100-year, 6-hour peak discharge and volume to be contained in the proposed Pima Park Detention Basin or be bypassed through the proposed low flow bypass pipes. However, since there is significant surface conveyance capacity in 87th Street downstream of Thomas Road, it is not imperative that the entire 100-year storm event be intercepted with the proposed Pima Park detention basin.

By eliminating the Osborn Road storm drain, the size of the proposed Thomas Road and Pima/McKellips Road storm drains had to be increased to allow for the interception of larger peak discharges. In addition, the runoff volume entering the proposed 26 ac-ft Pima Park Detention Basin increased substantially resulting in the basin spilling during the 100-year design flood, but the attenuation provided by the basin's storage volume significantly reduces the flows and shifts the time to peak at the intersection of 87th Street and Thomas Road, which is the upstream end of the Granite Reef Wash. The reduction of flow and the shift in the time to peak do not increase the peak discharge downstream of Thomas Road because it does not add directly to the runoff from the downstream watershed. In other words, when the proposed Pima Park Basin starts to spill, the downstream drainage

infrastructure which is comprised of the inverted crown on 87th Street and the 48-inch storm drain is free to convey the overflow from the basin because the peak flow from the downstream watershed has already passed.

7.2 APACHE PARK DETENTION BASIN

The selected plan included a new detention basin at Apache Park which is located on 85th Place approximately a third of a mile south of McDowell Road. It was not included in the recommended plan due to its high cost and the fact that it does not eliminate the need to make improvements to Granite Reef Wash downstream of McDowell Road.

The Apache Park detention basin would have included a new large diameter storm drain in 87th Street/McDowell Road/85th Place that would intercept Granite Reef Wash flows in 87th Street, approximately 500 feet north of McDowell Road, and convey them to a new detention basin at Apache Park. The Basin's outlet pipe would be constructed in 85th Place and Roosevelt Street, running back to Granite Reef Wash. By intercepting most of the 100-year, 6-hour peak discharge in 87th Street and conveying it to the basin, the flow on Granite Reef Wash downstream of 87th Street would be significantly reduced.

The estimated cost of the Apache Park detention basin, including the inflow and outflow pipes, was $9.0 million. One of the reasons for the high cost is because the basin outlet pipe must be large enough to match the conveyance capacity of the basin inflow pipe. That is because, under existing conditions, flow in Granite Reef Wash does not reach Apache Park. Therefore, the basin inflow pipe that would capture flows in Granite Reef Wash at 87th Street and convey them to Apache Park represents a flow diversion. In the event of back-to-back storms that exceed the storage volume of the basin, or a clogged low-flow outlet pipe, the surrounding neighborhood would be susceptible to flooding from the diverted flows. Hence, the outlet pipe capacity would have to be designed to match the capacity of the basin inflow pipe to make sure that any flows diverted from Granite Reef Wash could be safely conveyed out of the neighborhood. The preliminary design of the basin included a low-level outlet for the design storm and a high-level outlet that would act as a safety valve if the basin storage capacity is exceeded. In that event, runoff would be intercepted with the high-level outlet and discharged through the outlet pipe back to Granite Reef Wash. Therefore, the storm drain that conveys flows out of the Apache Park Detention Basin would need to be designed to match the conveyance capacity of the basin inflow storm drain.

The primary goal of the Apache Park Detention Basin and storm drain was to intercept flood flows on Granite Reef Wash at 87th Street, north of McDowell Road, in order to reduce downstream flows enough to eliminate the need to upsize the existing storm drain in 84th Place, downstream of McDowell Road. However, the hydraulic analysis of the selected plan indicated that the 84th Place storm drain would still have to be enlarged, even if all of the flow in Granite Reef Wash at 87th Street was diverted to the Apache Park Detention Basin. That is because the flow that enters Granite Reef Wash downstream of 87th Street exceeds the capacity of the existing 84th Place storm drain. These inflows include the McDowell Road storm drain that enters from the west and the runoff from the local watershed between McDowell Road and Roosevelt Street. Therefore, in addition to building the $9.0 million Apache Park Detention Basin and storm drain, additional drainage improvements along Granite Reef Wash would have also been required.

7.3 PIMA ROAD OPEN CHANNEL

After development of the selected plan, the feasibility of an open channel in the Pima Road alignment, south of McDowell Road, was analyzed. The open channel would replace the storm drain pipe that was proposed in the selected plan. It was found, however, that construction of the open channel would cost more, both in terms of construction costs and long-term maintenance costs, and therefore it was eliminated for the plan.

Pima Road currently terminates at McDowell Road, but south of McDowell Road there is significant land available for an open channel, including 75 feet of roadway right-of-way and a 30-foot wide drainage easement for a total width of 105 feet. However, there is an existing drainage channel in the 30-foot drainage easement that is part of the drainage system for the adjacent subdivision. There is also an existing 8-foot pathway and a sound wall that were built within the 75-foot wide Pima Road ROW. These existing features limit the land available for an open channel. Nonetheless, a channel could be constructed between the existing pathway and the sound wall. But it would require the removal of over thirty mature trees. Also, because of the space constraints, the channel would only have a 10-foot bottom width with relatively steep side slopes of 4H:1V and it would require a containment curb west of the pathway to prevent channel flows from spilling into the subdivision drainage system. Moreover, a new 4 to 5-foot-high retaining wall along the east bank would need to be constructed along the base of the sound wall in order to make the channel fit within the area between the pathway and sound wall.

It was estimated that the new channel, including grading, rock rip-rap, retaining wall and containment curb would cost in excess of $420 per lineal foot, whereas the recommended 66-inch storm drain, which would be located within the Pima Road ROW, east of the sound wall would cost less at approximately $410 per lineal foot. Therefore, since the channel option is more expensive, would require more maintenance and would result in the loss of numerous mature trees, it was eliminated from the final recommended plan.

Placing the open channel on the east side of the sound wall was not considered because this space is reserved for the future extension of Pima Road from McDowell Road to McKellips Road.

8.0 RECOMMENDED PLAN

The following sections contain the summary descriptions of each major element of the recommended plan.

8.1 THOMAS ROAD STORM DRAIN AND PIMA PARK DETENTION BASIN

The Thomas Road Storm Drain and Pima Park Detention Basin is the most upstream element of the recommended plan. The proposed detention basin is located within Pima Park at the northeast corner of 86th Street and Thomas Road. The proposed storm drain extends along Thomas Road from the detention basin upstream to 82nd Street. Refer to **Figure 6** for the location of the Pima Park Detention Basin and the extents of the Thomas Road storm drain and to Sheets 2-6 of the Recommended Plan in **Appendix C**.

In addition to the new basin and storm drain; paving improvements along 86th Street between Avalon and Catalina Drives are proposed to dewater the street into a new channel within Pima Park, adjacent to 86th Street. The recommended plan also calls for a new splitter structure to be constructed at the northeast corner of the Pima Storage facility, located on the east side of the Park. Its purpose is to divert high flows from the existing Pima Road storm drain into the detention basin through the existing, buried 54-inch storm drain that runs through the Pima Storage facility. The last part of the plan is to improve the interception capacity of the existing grated inlet at Earll Drive and 87th Terrace (Pima Frontage Road).

The proposed Pima Park Detention Basin consists of two individual basins that are connected with 4-36 inch pipe culverts. The smaller of the two is located at the southeast corner of the park. It is 5-feet deep and has a storage capacity of 2.6 ac-ft. It intercepts surface flows from 86th Street and serves as the outfall for the Thomas Road storm drain. The basin's spill elevation is 1229.0 feet.

The primary basin is 10-feet deep with a storage capacity of 23.2 ac-ft. Flows enter the basin from the 4-36 inch pipe culverts that connect the smaller basin and the existing 54-inch buried storm drain that diverts high flows from the existing Pima Road storm drain. The basin is drained through a 36-inch outlet pipe that is connected to the proposed Pima Road storm drain.

To increase the basin storage capacity, a low, 12-foot wide bench was designed to increase the basin's top elevation to 1229.0 feet to match the top elevation of the smaller basin. However, since the basin will spill during the 100-year storm event, a spillway was included that allows the basin to spill into Thomas Road at an elevation of 1228.0 feet. The combined storage capacity of the two basins is approximately 26 ac-ft.

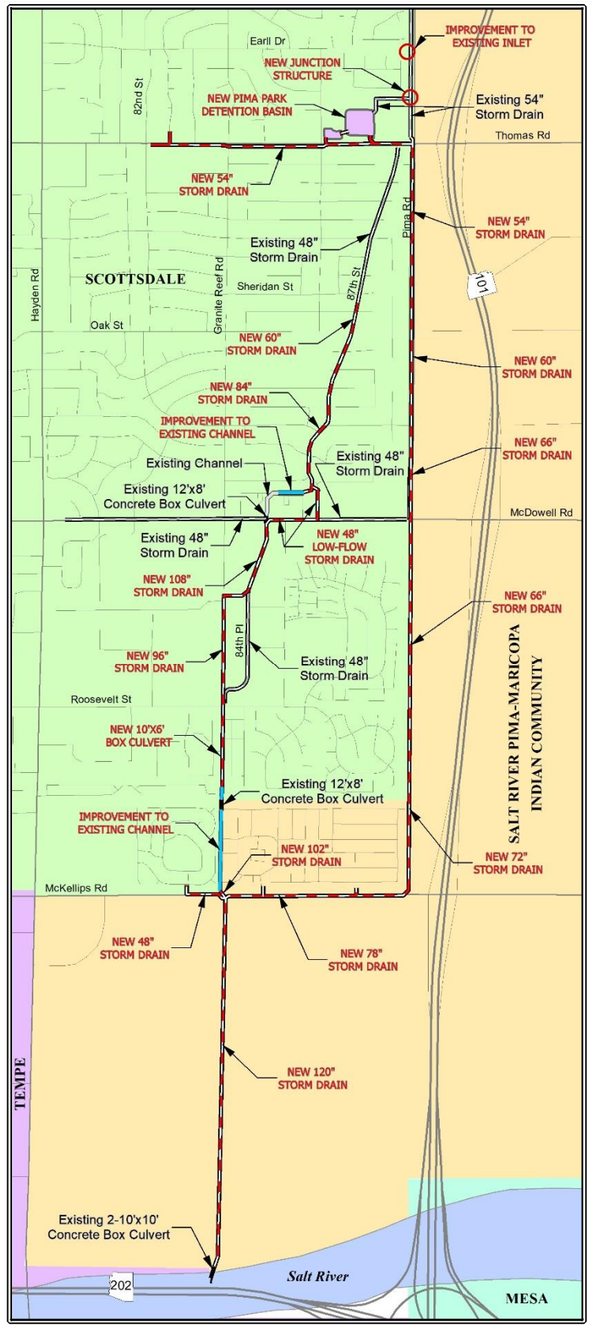

Figure 6: Phase II Improvements

The Thomas Road storm drain was designed to intercept the 100-year 6-hour peak discharge along Thomas Road and the intersecting streets at 82nd Street, 83rd Street, Granite Reef Road and 86th Street. By sizing the storm drain to intercept the peak discharges from the 100-year storm event, no runoff will flow across Thomas Road which helps to reduce flood flows to the south along Granite Reef Wash. To avoid existing utilities, the storm drain was aligned in the south Thomas Road Frontage Road between Granite Reef Road and 86th Street.

The storm drain includes an 18-inch low flow bypass pipe, which allows flows from minor storms to bypass the detention basin. The 18-inch storm drain increases to a 42-inch pipe where it combines with the 36-inch basin outlet pipe. The design high water elevation in the detention basin is above the elevation of Thomas Road. Therefore, pressure manhole covers will be required on the storm drain between the basin outlet pipe and Pima Road.

From the hydrologic analysis it was found that 86th Street between Earll Drive and Thomas Road conveys a large amount of flow. However, due to the presence of multiple large diameter water lines in 86th Street, it is not feasible to construct a large diameter storm drain lateral to intercept the flow. Instead, it is proposed to repave the eastern half of 86th Street between Avalon and Catalina Drives to allow the street to surface flow into Pima Park. The

proposed paving improvements would remove the existing curb and gutter on the east side of the street and replace it with a series of sidewalk scuppers that would allow water to flow from 86th Street into the Park. To convey the flow to the proposed detention basin, a new 15-foot wide, grass-lined channel with gentle 10H:1V side slopes is proposed within the Park, behind the sidewalk on 86th Street.

No paving improvements are recommended for the west half of 86th Street. The flow on the western half of the street is conveyed south to Thomas Road, where it will be intercepted with a new curb opening catch basin on the northeast corner of Thomas Road and 86th Street. Once flow exceeds the capacity of the west half of the street, runoff will spill over the crown and dewater into the Pima Park channel. The combination of the new inlet for the west half of the street and the sidewalk scuppers for the east half street will ensure that the majority of flow from 86th Street will be intercepted and routed through the proposed Pima Park Detention Basin.

Inflow will also enter the new basin through the existing buried 54-inch storm drain that runs from Pima Road, through the Pima Storage facility. It was constructed by the City in anticipation of a future detention basin in Pima Park. Its purpose is to divert high flows into the basin from the existing 54-inch Pima Road storm drain. In order to connect the buried storm drain to the existing Pima Road storm drain, a new splitter structure will need to be constructed. The splitter structure is included to allow low flows to bypass the basin and run south in the proposed Pima/McKellips Road Storm Drain while high flows are diverted to the Pima Park basin.

The last item in this element of the plan is to increase the interception capacity of the existing grated inlet at Earll Drive (extended) and 87th Terrace. The existing grated inlet is highly susceptible to clogging, which limits the flow that is collected in the existing Pima Road storm drain. The proposed improvements would consist of elevating the grate, to reduce its susceptibility to clogging, and grading a new spillover elevation within the existing pathway to raise the headwater at the existing inlet. These two improvements will allow the inlet to fully utilize the conveyance capacity of the existing 54-inch Pima Road storm drain.

The estimated cost of the Thomas Road Storm Drain and Pima Park Detention Basin improvements is **$8,070,000**. Refer to **Appendix C** for detailed exhibits showing each component of the improvements and **Appendix D** for the budgetary cost estimate.

8.2 PIMA/MCKELLIPS ROAD STORM DRAIN

The Pima/McKellips Road Storm Drain runs along Pima Road from Thomas Road to McKellips Road and along McKellips Road from Pima Road to Granite Reef Wash. There is also a segment of new storm drain west of Granite Reef Wash that extends to the entrance drive of the Pueblo Sereno Mobile Home Park. Refer to **Figure 6** for the location of the Pima/McKellips Road Storm Drain and Sheets 7-11 of the Recommended plan in **Appendix C**.

The upstream end of the storm drain at Thomas Road was sized to convey the low flows that bypass the Pima Park Detention Basin and the runoff from the future Pima Road widening between Indian School Road and McDowell Road. To size the proposed storm drain for the widening of Pima Road, the FLO-2D model was modified to represent the future, wider roadway. The FLO-2D model was modified by regrading the grids to represent street and gutter flow and adjusting the infiltration parameters to represent future fully paved conditions.

The fallow agricultural parcels between Pima Road and the Loop 101 Freeway from the Scottsdale Autoshow south to McDowell Road are all located on the SRPMIC. Future developments on these parcels are required to provide 100-year, 2-hour storm water retention. However, there is no current timetable as to when they will be developed. Therefore, the proposed Pima/McKellips Road storm drain was sized to convey the existing conditions runoff from the agricultural parcels between the southern boundary of the Scottsdale Autoshow and McDowell Road. As part of the Pima Road widening project, the design team will have to appropriately size and locate storm drain catch basins to intercept the 100-year, 6-hour peak discharges from the agricultural parcels.

A benefit of designing the proposed Pima/McKellips Road storm drain to accept the runoff from the undeveloped agricultural parcels is that the stormwater retention requirement for the future development could be reduced to the runoff from pre vs. post conditions which is the increase in runoff caused by the land development. This would significantly reduce the storage requirement from the normal 100-year, 2-hour runoff volume. The pre vs. post detention basins could discharge into the Pima/McKellips Road storm drain provided that the peak discharges do not exceed the existing condition flows.

There is an existing 48-inch storm drain in Pima Road at McDowell Road that drains 87th Terrace. This storm drain will be connected to the new Pima Road storm drain in order to reduce the flow that is conveyed to Granite Reef Wash.

The ground profile along the Pima Road alignment between McDowell Road and McKellips Road falls sharply. Due to this steep slope, the proposed Pima Road storm drain will need to be designed with multiple drop structures to prevent the storm drain velocities reaching unacceptably high levels.

At McKellips Road, the storm drain turns to the west and runs on the south side of the street. It intercepts flow at the two driveway entrances into the Shadow Mountain Village Mobile Home Park before discharging to the proposed SRPMIC Section 12 Storm Drain. West of

Granite Reef Wash, a new 48-inch storm drain is extended for 500 feet to intercept flow from the Pueblo Sereno Mobile Home Park.

The estimated cost of the Pima/McKellips Road Storm Drain is **$11,630,000**. Refer to **Appendix C** for detailed exhibits showing each component of the improvements and **Appendix D** for the budgetary cost estimate.

8.3 87TH STREET STORM DRAIN IMPROVEMENTS

The 87th Street Storm Drain Improvements extend from McDowell Road north to Sheridan Street along 87th Street which include replacing the existing 48-inch storm drain with a larger diameter pipe. The improvements also include a new low-flow bypass storm drain in McDowell Road, regrading the existing drainage channel behind the Scottsdale Belle Rive apartment complex and new alley grading between 87th Street and the upstream end of the Belle Rive channel. 87th Street is an inverted crown street that has a significant surface conveyance capacity. There is also an existing 48-inch storm drain in the street that has grated inlets along the inverted crown. Refer to **Figure 6** for the location of the 87th Street Storm Drain Improvements and Sheets 12-14 of the Recommended Plan in **Appendix C**.

As can be seen in **Figure 4**, with the recommended Thomas Road Storm Drain and Pima Park Detention Basin in place, the peak discharge at the intersection of 87th Street and Thomas Road is significantly reduced and the peak of the flood hydrograph is shifted so that it does not add directly to the peak discharge from the local watershed south of Thomas Road. However, farther downstream of Thomas Road at Sheridan Street, the conveyance capacities of the existing inverted crown street and the existing 48-inch storm drain are exceeded. This is due to a large inflow at Sheridan Street, which collects flow from Wilshire Drive and Lewis Avenue at 85th Place and conveys it across 86th Street to 87th Street. To accommodate the increase in flow, the recommended plan calls for the storm drain to be upsized to 60-inches and new curb opening catch basins be installed on Sheridan Street to intercept the flow before it reaches 87th Street. Other inflows downstream of Sheridan Street require the proposed storm drain to increase in size to a 72-inches at Oak Street and 90-inches at Hubble Street.

There are several shallow 8-inch sewers that cross 87th Street between Sheridan Street and Coronado Road. The existing 48-inch storm drain goes underneath the existing sewers. At some locations there is as little as 6-inches of clearance between the existing sewer and the existing 48-inch storm drain. The invert elevations of the proposed, larger diameter storm drain were set lower as to allow for a minimum of 2-foot of separation to the sewers. Due to this design approach, the invert of the 90-inch storm drain is much lower than the invert of the outfall channel at the Belle Rive apartments. To accommodate the storm drain, a new bubble-up junction structure is proposed in the City-owned parcel west of 87th Street at Coronado Road with a new 48-inch storm drain conveying low flows from the 90-inch storm drain to the proposed 84th Place/Granite Reef Road storm drain at McDowell Road.

As part of the improvements, the Belle Rive channel will also be regraded to remove the standing water issue and uncontrolled vegetative growth in the bottom of the channel. From inspection of the contours it was found that the Belle Rive apartment drive is higher than the existing channel which results in standing water in the channel after storm events pass. The proposed channel improvements include regrading of the channel to allow it to drain back to the proposed drop inlet/bubble up structure which will enable it to completely drain through the 48-inch low flow pipe after storm events. During major storm events, the flow in the 90-inch storm drain combined with the surface flow from 87th Street will exceed the capacity of the 48-inch low flow storm drain and bubble up in the channel through the proposed 72-inch storm drain. Once the 72-inch storm drain is exceeded, runoff will surface flow from the 87th Street low spot to the channel, just like under existing conditions.

To lower the water surface elevation on 87th Street, the plan includes regrading the existing narrow alley that constricts the flow at the upstream end of the Belle Rive channel. The proposed grading will double the width of the alley from 20 feet to 40 feet, which lowers the water depth that spills into the channel with a corresponding reduction in water surface elevation on 87th Street. To widen the alley, the landscaping and concrete blocks on the south side of the existing alley will be removed and replaced with a new 5-foot high retaining wall. In addition, a new 20-foot wide drainage easement to cover the widened portion of the alley will have to be acquired from the Belle Rive apartment complex.

The estimated cost of the 87th Street Storm Drain Improvements is **$5,480,000**. Refer to **Appendix C** for detailed exhibits showing each component of the improvements and **Appendix D** for the budgetary cost estimate.

8.4 84TH PLACE/GRANITE REEF ROAD STORM DRAIN

The 84th Place/Granite Reef Road Storm Drain runs from the existing 12’x8’ McDowell Road concrete box culvert to the Granite Reef Road cul-de-sac which lies about 1/5 of a mile south of Roosevelt Street. The storm drain follows the alignment of the existing earthen channel south of McDowell Road. At the downstream end of the earthen channel, it turns west and runs to Granite Reef Road through the existing drainage easement on the south side of the Circle Lofts Subdivision. From there it runs south for about ½ mile in Granite Reef Road where it discharges to the existing concrete lined channel. Refer to **Figure 6** for the

location of the 84th Place/Granite Reef Road Storm Drain and Sheets 15-16 of the Recommended Plan in **Appendix C**.

At its upstream end, the storm drain connects to the existing 12'x8' box culvert under McDowell Road. The connection is done with a new special bubble-up junction structure that connects the existing box culvert and new 48-inch low-flow bypass storm drain from 87th Street. The proposed 108-inch storm drain will convey the vast majority of the flow south along the alignment of the existing earthen channel. However, a shallow channel above the storm drain is proposed to intercept the runoff from the local watershed and to preserve the conveyance corridor for flood flows that exceed the 100-year event.

At the downstream end of the existing earthen channel, a new bubble-up junction structure is proposed that will allow most of the flow to bypass to the new 96-inch storm drain in Granite Reef Road, but the existing 48-inch storm drain in 84th Place will also be connected to the junction structure; allowing higher flows that exceed the 96-inch storm drain to run through the existing 48-inch pipe. The structure will also allow peak flows, that exceed the capacity of the two storm drains, to bubble-up and surface flow south through the existing inverted crown on 84th Place. The size of the 96-inch bypass storm drain in Granite Reef Road was based on limiting the residual surface flow to a rate that can be safely conveyed in the inverted crown roadway section on 84th Place. Also, a new, relatively small drainage easement of 1,500 square feet will be required for the 96-inch pipe between the proposed junction structure and the existing Circle Lofts drainage easement.

The surface profile of Granite Reef Road drops sharply at Roosevelt Street and due to the loss of cover, the proposed storm drain was transitioned from a 96-inch pipe to a 10'x6' box culvert just upstream of Roosevelt Street. South of Roosevelt Street, Granite Reef Road has an inverted crown which further reduces the available cover. Therefore, the plan includes repaving the street to remove the inverted crown which raises the street grade and provides the cover needed over the proposed 10'x6' box culvert.

The estimated cost of the 84th Place/Granite Reef Road Storm Drain is **$7,260,000**. Refer to **Appendix C** for detailed exhibits showing each component of the improvements and **Appendix D** for the budgetary cost estimate.

8.5 GRANITE REEF WASH CHANNEL IMPROVEMENTS

The Granite Reef Wash Channel runs from the Granite Reef Road cul-de-sac, approximately 1/5 of a mile south of Roosevelt Street, and flows south to McKellips Road. Refer to **Figure 6** for the location of the Granite Reef Wash Channel Improvements and to Sheet 17 of the Recommended Plan in **Appendix C**.

The existing concrete lined channel as well as the 12'x8' concrete box culvert at the SRP well site were found to have sufficient capacity to convey the proposed flows within Granite Reef Wash. However, due to the age of the channel, the lining has started to fail which has become a maintenance problem for the City of Scottsdale. Since the channel has sufficient capacity to convey Granite Reef Wash flows, no new major grading of the channel is necessary. The proposed improvement consists of removing and replacing the concrete lining.

The estimated cost of the Granite Reef Wash Channel Improvements is **$1,200,000**. Refer to **Appendix C** for an exhibit showing the improvements and **Appendix D** for the budgetary cost estimate.

8.6 SRPMIC SECTION 12 STORM DRAIN

The SRPMIC Section 12 Storm Drain is the most downstream element of the recommended plan. It runs for a distance of one mile from McKellips Road to the Salt River. Refer to **Figure 6** for the location of the SRPMIC Section 12 Storm Drain and to Sheets 18-19 of the Recommended Plan in **Appendix C**.

The proposed storm drain serves as an outfall for both the existing concrete lined channel upstream of McKellips Road and the proposed storm drain in McKellips Road. A new, special drop inlet structure is required at the downstream end of the concrete lined channel, upstream of McKellips Road, that will transition the channel flows into a 102-inch pipe that runs under the roadway. The storm drain increases to 120-inch diameter at the junction with the proposed Pima/McKellips Road storm drain on the downstream side of McKellips Road. The outlet for the storm drain is the existing dual 10'x10' concrete box culvert at the levee on the Salt River, just north of the Loop 202 Red Mountain Freeway.

The proposed storm drain is located along the existing Granite Reef Wash alignment, which under existing conditions is an undersized earthen ditch that frequently gets exceeded during flooding events. The future development plan for Section 12 includes a new roadway along the proposed storm alignment.

Since the Section 12 Storm Drain serves as the downstream outfall for all the proposed elements of the recommended plan, it must be constructed prior to or concurrently with the Pima/McKellips Road storm drain. Under existing conditions, the majority of the land in Section 12 consists of individually allotted parcels. Therefore, a storm drain right-of-way with a minimum width of 30 feet must be acquired in order to construct the storm drain. Based on information received from the SRPMIC, the right-of-way in Section 12 was estimated to cost $15 per square foot.

The sizing of the SRPMIC Section 12 Storm Drain did not include any inflow from the local watershed in Section 12. However, there is excess capacity in the proposed 120-inch storm drain that should be

more than enough to convey runoff from the future streets in Section 12, which is what the Olsson Report indicated. The recommend plan from the Olsson Report indicates that the storm drain should be sized to convey the offsite flow in Granite Reef Wash plus runoff from the future streets. It also indicates that each individual interior parcel within Section 12 will provide onsite storm water retention. The excess capacity in the storm drain coupled with the offset in time to peak between the offsite watershed and the local watershed should result in more than enough capacity to accommodate inflows from future development in Section 12. A detailed drainage analysis during the parcel development would need to be performed, however it is reasonable to assume that the proposed storm drain can be used as an outfall for the future Section 12 development.

Summary of Cost Estimates	Cost
THOMAS ROAD STORM DRAIN AND PIMA PARK BASIN (New Detention Basin and New Storm Drain in Thomas Road from 82nd Street to Pima Road)	$8,070,000
PIMA/McKELLIPS ROAD STORM DRAIN (New Storm Drain from Thomas Road to Granite Reef Wash at McKellips Road)	$11,630,000
87th STREET STORM DRAIN (New Larger 87th Street Storm Drain with Low-Flow Outfall to Granite Reef Wash)	$5,480,000
84th PLACE/GRANITE REEF ROAD STORM DRAIN (New Storm Drain from McDowell Road Culvert to Granite Reef Road cul-de-sac)	$7,260,000
GRANITE REEF WASH CHANNEL LINING REPLACEMENT (Replace Conc. Channel Lining between the Granite Reef Rd. Cul-De-Sac and McKellips Rd.)	$1,200,000
SRPMIC SECTION 12 STORM DRAIN (New Storm Drain from McKellips Road to the Salt River)	$8,540,000
Total Recommended Plan =	**$42,180,000**

Figure 7: Recommended Plan Cost Summary Table

The estimated cost of the SRPMIC Section 12 Storm Drain is **$8,540,000**. Refer to **Appendix C** for detailed exhibits showing the proposed storm drain and **Appendix D** for the budgetary cost estimate.

9.0 BUDGETARY COST ESTIMATE

The goal of this study was to develop a drainage plan for reducing or eliminating the existing Zone AE FEMA floodplain along Granite Reef Wash between Thomas Road and McKellips Road. It was done to find a more cost-effective solution to the flooding issues along Granite Reef Wash than what was proposed in the Psomas Report. The Psomas Pima Road conduit plan consisted of large diameter storm drains and box culverts in Pima Road from Chaparral Road to the Salt River, including large diameter storm drains to convey flow from Granite Reef Wash to the new Pima Road conduit. The estimated cost of the Pima Road conduit plan in 2009 was $51 million, which when adjusted to 2020 construction costs based on the RSMeans® Historical Cost Index yields an estimated cost of approximately $68 million.

For comparison purposes, the estimated cost of this new recommended plan for the Phase II Improvements Project is $42 million, which represents a savings of about $26 million over the estimated cost of the Psomas Pima Road conduit plan. Refer to **Figure 7** for a cost summary of the recommended plan and **Appendix D** for the budgetary cost estimate.

10.0 IMPLEMENTATION PLAN

The recommended plan for the Phase II improvement area includes six individual elements which consist of a new detention basin, new storm drains and channel improvements. Some of these elements can be implemented as standalone projects that can be constructed without having other segments in place, whereas others require downstream segments to be in place or be constructed concurrently.

10.1 RECOMMENDED SEQUENCE OF CONSTRUCTION

Three of the recommended plan segments, the 84th Place/Granite Reef Road Storm Drain, the Granite Reef Wash Channel Improvements and the SRPMIC Section 12 Storm Drain can be constructed as standalone projects and therefore can be constructed concurrently or one after another without regard to construction sequencing. The remaining three segments, the Thomas Road Storm Drain and Pima Park Detention Basin, the Pima/McKellips Road Storm Drain and the 87th Street Storm Drain Improvements all require downstream elements of the recommended plan to either be in place at the time of construction or be constructed concurrently.

The following is the recommended sequence of construction:

1. **SRPMIC Section 12 Storm Drain** – The construction of the Section 12 Storm Drain, from McKellips Road to the existing dual 10'x10' concrete box culvert at the Salt River, provides the outfall for all elements of the recommended plan and should be constructed first.
2. **Pima/McKellips Road Storm Drain** – Construction of the Pima/McKellips Road storm drain will provide the outfall for the proposed Pima Park Detention Basin at Thomas Road. This element of the plan is only dependent on the construction of the SRPMIC Section 12 Storm Drain.
3. **Thomas Road Storm Drain and Pima Park Detention Basin** – The construction of the Thomas Road Storm Drain and Pima Park Detention Basin will, on their own, significantly reduce flows on Granite Reef Wash downstream of Thomas Road; providing considerable flood protection for the downstream properties. This element of the plan requires both the Pima/McKellips Road Storm

Drain and the SRPMIC Section 12 Storm Drain to be in place to provide the outlet works for the detention basin.

4. **84th Place/Granite Reef Road Storm Drain** – The construction of the 84th Place/Granite Reef Road Storm Drain is not dependent on any other recommended plan segments. It can be constructed from McDowell Road to the existing Granite Reef Wash Channel south of the Granite Reef Road cul-de-sac without any other improvements being in place.
5. **87th Street Storm Drain Improvements** – The construction of the 87th Street Storm Drain Improvements is dependent on the construction of the 84th Place/Granite Reef Road Storm Drain.
6. **Granite Reef Wash Channel Improvements** – The rebuilding of the concrete lined Granite Reef Wash Channel can be done independently of any of the other elements of the recommended plan. The channel improvements, which only consist of relining the channel can be constructed last.

Appendix A: Cost Estimate Unit Price Calculation

Catch Basin – Unit Price Estimate:

- Catch Basin Cost: **$9,000**
  The catch basin cost includes existing sidewalk and curb & gutter removal.

- Connector Pipe Cost: **$13,800**
  From past projects, it was found that on average there are 60 lineal feet of connector pipe for each catch basin. On average the cost of connector pipes is $230 per lineal foot. Therefore, the cost associated for the connector pipe is:

$$60\,LF \times 230\,\frac{\$}{LF} = \$13{,}800$$

- Pavement Replacement Cost: **$2,700**
  The pavement replacement cost is comprised of replacing the pavement over the connector pipe trench. The trench width (3.75 feet) was estimated for a 24" connector pipe using Table 601-1 in the *"MAG Uniform Standard Specifications and Details for Public Works Construction"* manual. In addition to the trench width, the City of Scottsdale Standard Detail 2200, specifies an additional 12-inches of pavement replacement on each side of the trench. From past projects, it was found that pavement replacement cost is approximately $70 per square yard. As aforementioned, the average length of the connector pipe is 60 lineal feet. Therefore, the total pavement replacement cost is:

$$\left[\frac{\left(3.75\,ft + 1.0\,ft + 1.0\,ft\right) \times 60\,ft}{9\left(\frac{ft^2}{yd^2}\right)}\right] \times 70\left(\frac{\$}{yd^2}\right) = \$2700$$

Total Catch Basin Unit Price:

Catch Basin Cost + Connector Pipe Cost + Pavement Replacement Cost
$9,000 + 13,800 + 2,700
$25,500

The approximate Catch Basin Unit Price is $25,500

Project Title: Granite Reef Wastershed Imrpovement Project – Phase II Drainage Planning Study
Project No. 1408 Subject: Cost Estimate Unit Price Calculation Worksheet

Storm Drain Unit Price Estimate:

- Storm Drain Pipe Cost (per lineal foot):

Pipe Diameter (inches)	Cost per Foot ($/LF)	Pipe Diameter (inches)	Cost per Foot ($/LF)
30"	**160**	72"	**350**
36"	**200**	78"	**380**
42"	**230**	84"	**410**
48"	**250**	90"	**450**
54"	**280**	96"	**480**
60"	**300**	108"	**520**
66"	**320**	120"	**550**

- Storm Drain Box Culvert Cost (per lineal foot):

Box Culvert Span (Feet)	Box Culvert Hight (Feet)	Cost per Foot ($/LF)	Box Culvert Span (Feet)	Box Culvert Hight (Feet)	Cost per Foot ($/LF)
6'	4'	**520**	10'	8'	**810**
6'	6'	**630**	10'	10'	**920**
8'	4'	**575**	12'	4'	**750**
8'	6'	**690**	12'	6'	**810**
8'	8'	**750**	12'	8'	**920**
10'	4'	**690**	12'	10'	**980**
10'	6'	**750**	12'	12'	**1050**

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3030 North Central Avenue, Suite 1530 Phoenix, Arizona 85012
Phone 602-200-0031 Fax 602-200-0032 gavanbarker.com

Pavement Replacement Width:

The pavement replacement width for each pipe size is based on the trench width as defined in Table 601-1 of the *"MAG Uniform Standard Specifications and Details for Public Works Construction"* manual. The trench width for each box culvert was also approximated from Table 601-1 based on an equally wide pipe diameter. Additionally, the pavement replacement width incorporates City of Scottsdale Standard Detail 2200, which specifies an additional 12-inches of pavement replacement on each side of the trench.

Cost per Foot:
From past projects, it was found that pavement replacement cost is approximately $70 per square yard. Therefore, the cost per linear foot can be calculated by the following formula:

$$\frac{70\left(\frac{\$}{yd^2}\right)}{9\left(\frac{ft^2}{yd^2}\right)} \times \text{Pavement Replacement Width}\left(feet\right)$$

- Storm Drain Pipe Pavement Replacement Cost (per lineal foot):

Pipe Diameter (inches)	Pavement Replacement Width (feet)	Cost per Foot ($/LF)	Pipe Diameter (inches)	Pavement Replacement Width (feet)	Cost per Foot ($/LF)
30"	6.5	**51**	72"	11.7	**91**
36"	7.0	**54**	78"	12.2	**95**
42"	8.2	**64**	84"	13.3	**103**
48"	8.7	**68**	90"	13.8	**107**
54"	9.2	**72**	96"	14.3	**111**
60"	9.7	**75**	108"	15.4	**120**
66"	11.2	**87**	120"	16.5	**128**

- Storm Drain Box Culvert Pavement Replacement Cost (per lineal foot):

Box Culvert Span (Feet)	Pavement Replacement Width (feet)	Cost per Foot ($/LF)
6'	12.0	**93**
8'	15.0	**117**
10'	18.2	**142**
12'	20.5	**159**

Total Storm Drain Unit Price:

- Storm Drain Pipe Unit Price:

Pipe Diameter (inches)	Storm Drain Pipe Cost ($/LF)	Pavement Replacement Cost ($/LF)	Total Storm Drain Pipe Unit Price ($/LF)
30"	160	51	**211**
36"	200	54	**254**
42"	230	64	**294**
48"	250	68	**318**
54"	280	72	**352**
60"	300	75	**375**
66"	320	87	**407**
72"	350	91	**441**
78"	380	95	**475**
84"	410	103	**513**
90"	450	107	**557**
96"	480	111	**591**
108"	520	120	**640**
120"	550	128	**678**

- Storm Drain Box Culvert Unit Price:

Box Culvert Span (Feet)	Box Culvert Hight (Feet)	Box Culvert Cost ($/LF)	Pavement Replacement Cost ($/LF)	Total Box Culvert Unit Price ($/LF)
6'	4'	520	93	**613**
	6'	630	93	**723**
8'	4'	575	117	**692**
	6'	690	117	**807**
	8'	750	117	**867**
10'	4'	690	142	**832**
	6'	750	142	**892**
	8'	810	142	**952**
	10'	920	142	**1062**
12'	4'	750	159	**909**
	6'	810	159	**969**
	8'	920	159	**1079**
	10'	980	159	**1139**
	12'	1050	159	**1209**

Manhole – Unit Price Estimate and Quantity Estimate Guidelines:

- Storm Drain Manhole Cost: **$7,000**
  The number of manholes is based on the following minimum manhole spacing requirements as outlined in Table 6.9 of the *"Drainage Policies and Standards for Maricopa County, Arizona"*

≤ 30″	Storm Drain Diameter ==> 1 Manhole for each 330 feet
33″ – 45″	Storm Drain Diameter ==> 1 Manhole for each 440 feet
48″ – 84″	Storm Drain Diameter ==> 1 Manhole for each 660 feet
> 84″	Storm Drain Diameter ==> 1 Manhole for each 1320 feet

The approximate Manhole Unit Price is $7,000

Additional Storm Drain Construction Costs

- Standard Utility Relocation, Removals, Construction Surveying, Permitting, Fees, Mobilization, Traffic Control, etc.: **30%**
  From past projects, it was found that the additional costs to construct a storm drain system are usually around 25% to 30% percent of the inlet, manhole and pipe cost.
- Contingency: **20% of Construction Cost**
- Design, Construction Administration, Plan Review, Permitting: **25% of Total Construction Cost (including Contingency)**

Appendix B: FLO-2D Results Exhibits

GRANITE REEF WATERSHED PHASE II IPROVEMENTS

LEGEND

Existing Drainage Infrastructure

- Existing Drainage Channel
- Existing Culvert
- Study Area Boundary

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

Peak Discharge Summary

- Qs=500 cfs — Surface Flow (w/100-year, 6-hour Peak Discharge)
- Qp=50 cfs, DIA=48 in — Storm Drain Flow (w/100-year, 6-hour Peak Discharge & Pipe Diameter)
- Qc=450 cfs — Culvert Flow (w/100-year, 6-hour Peak Discharge)

EXISTING CONDITIONS

100-yr, 6-hr Max Depth

EXHIBIT B.1

N

0 1/8 1/4

1 inch = 1/8 miles

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GRANITE REEF WATERSHED PHASE II IMPROVEMENTS

LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

Peak Discharge Summary

- Qs=500 cfs — Surface Flow (w/100-year, 6-hour Peak Discharge)
- Qp=50 cfs, DIA=48 in — Storm Drain Flow (w/100-year, 6-hour Peak Discharge & Pipe Diameter)
- Qc=450 cfs — Culvert Flow (w/100-year, 6-hour Peak Discharge)

PROPOSED CONDITIONS

100-yr, 6-hr Max Depth

EXHIBIT B.2

N

0 1/8 1/4

1 inch = 1/8 miles

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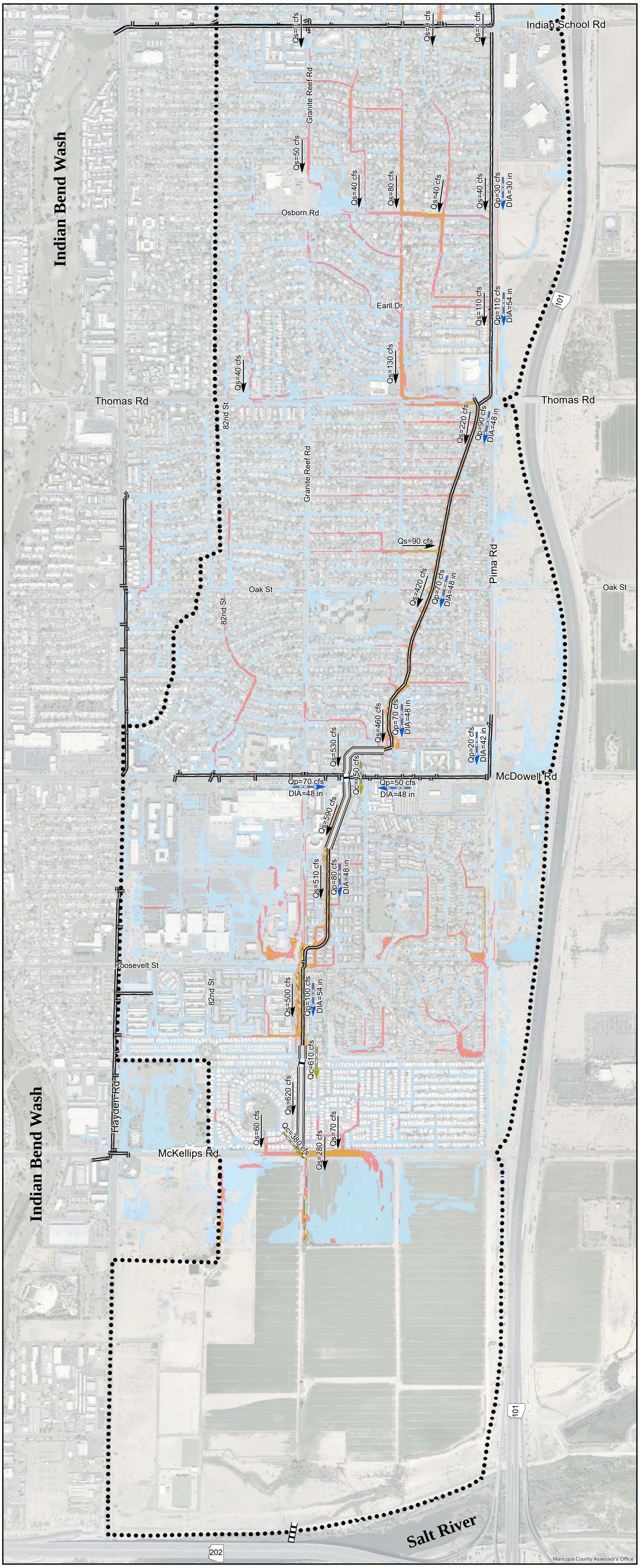
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE ARIZONA

Maricopa County Assessor's Office

GRANITE REEF WATERSHED PHASE II IPROVEMENTS



LEGEND

Existing Drainage Infrastructure

- Existing Drainage Channel
- Existing Culvert
- Study Area Boundary

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

Peak Discharge Summary

- Qs=500 cfs — Surface Flow (w/100-year, 6-hour Peak Discharge)
- Qp=50 cfs, DIA=48 in — Storm Drain Flow (w/100-year, 6-hour Peak Discharge & Pipe Diameter)
- Qc=450 cfs — Culvert Flow (w/100-year, 6-hour Peak Discharge)

EXISTING CONDITIONS

100-yr, 6-hr Peak Discharges

EXHIBIT B.3

N

0 1/8 1/4

1 inch = 1/8 miles

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CITY OF SCOTTSDALE ARIZONA

GRANITE REEF WATERSHED PHASE II IMPROVEMENTS

LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

Peak Discharge Summary

- Qs=500 cfs — Surface Flow (w/100-year, 6-hour Peak Discharge)
- Qp=50 cfs, DIA=48 in — Storm Drain Flow (w/100-year, 6-hour Peak Discharge & Pipe Diameter)
- Qc=450 cfs — Culvert Flow (w/100-year, 6-hour Peak Discharge)

PROPOSED CONDITIONS

100-yr, 6-hr Peak Discharges

EXHIBIT B.4

N

0 1/8 1/4

1 inch = 1/8 miles

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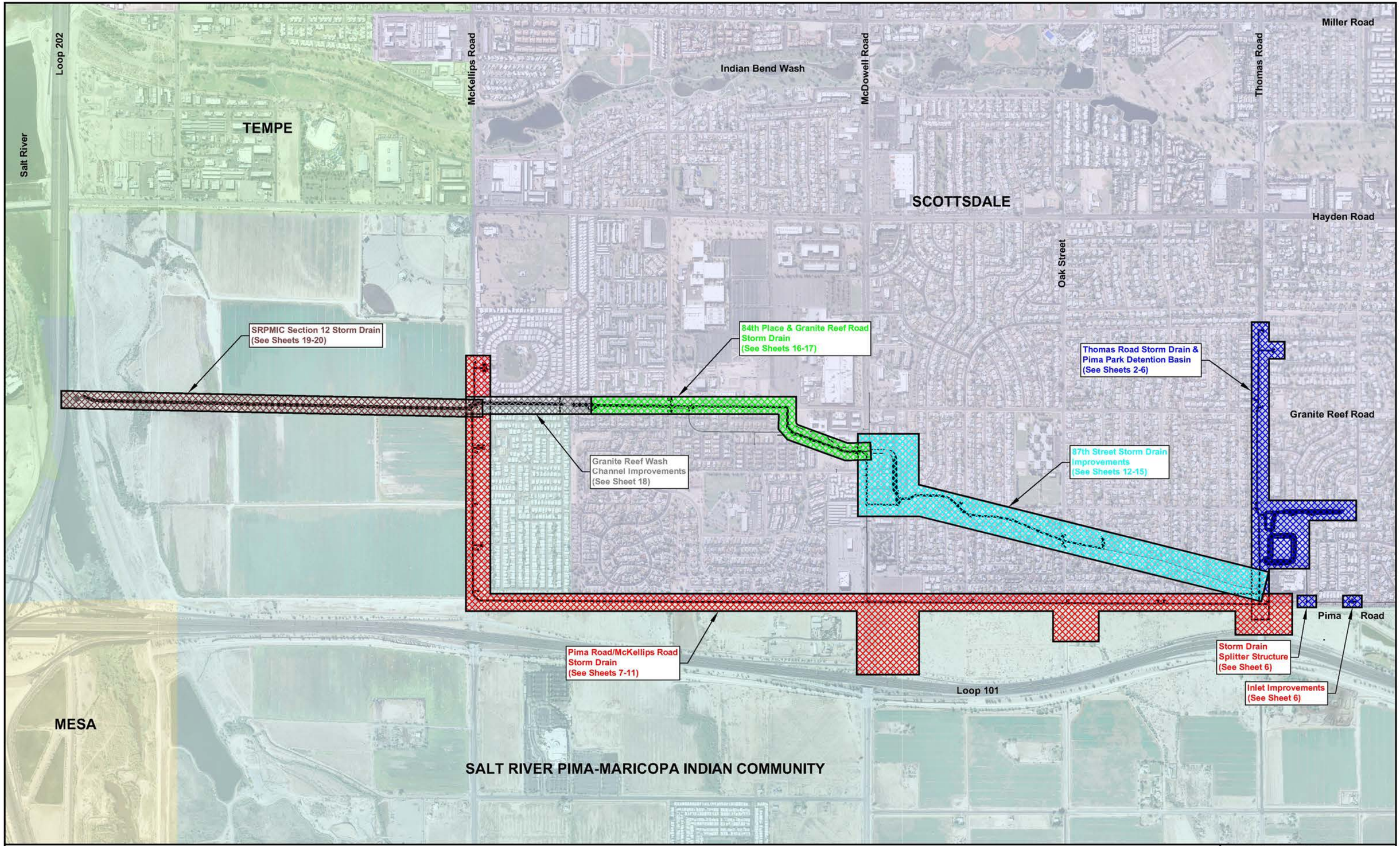
Appendix C: Granite Reef Watershed Phase II Recommended Plan Exhibits



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Flood Control District of Maricopa County

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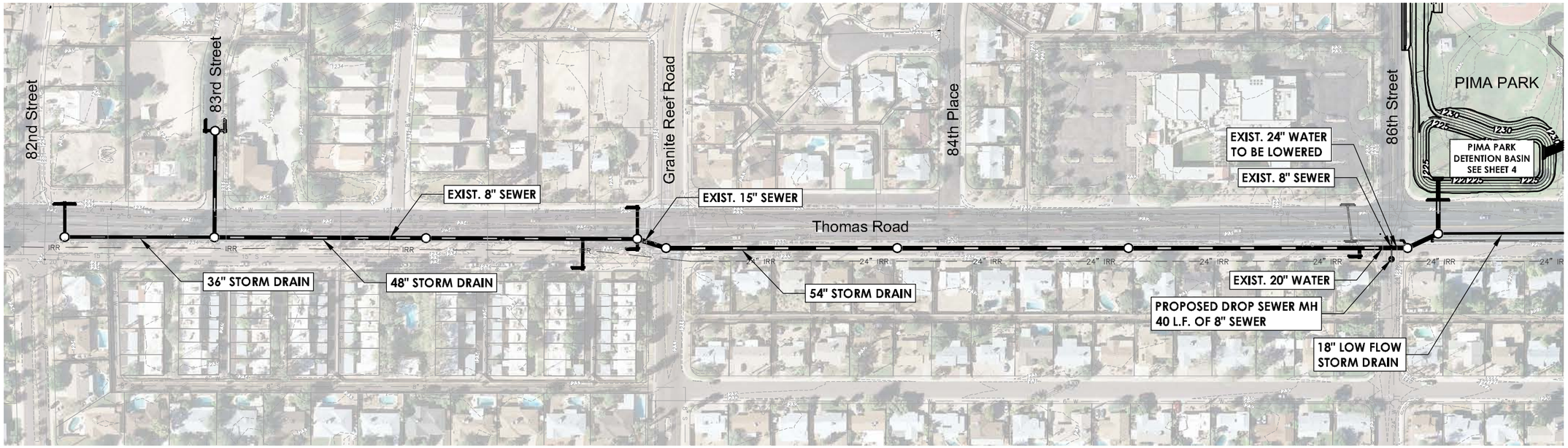
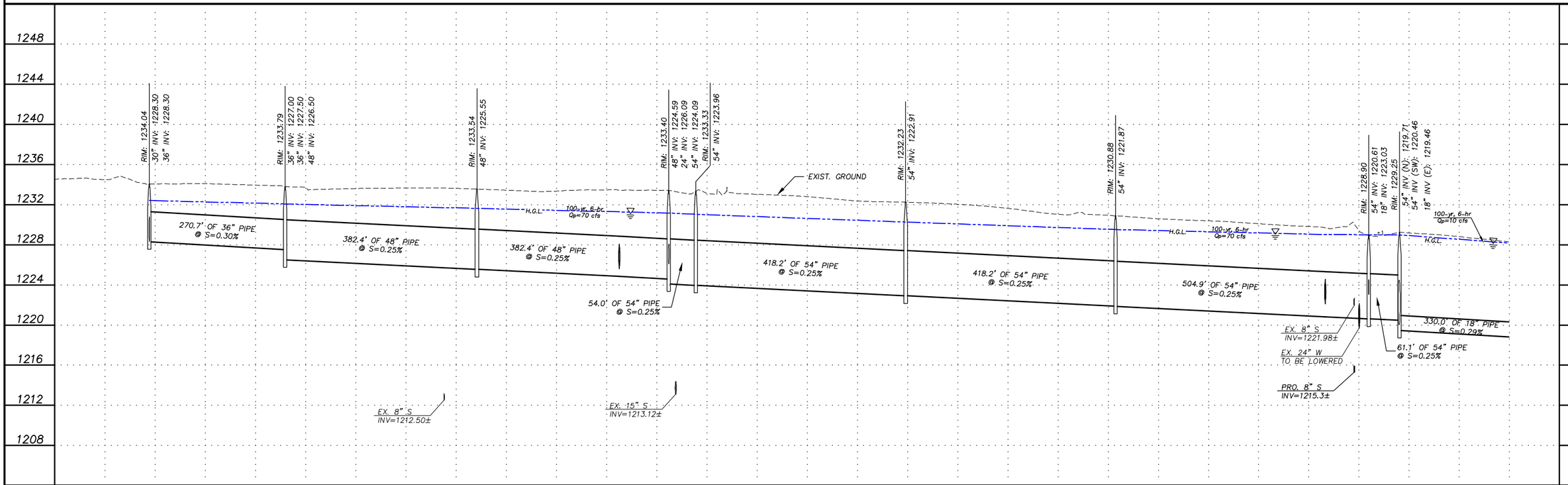
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

PROPOSED IMPROVEMENTS:
Recommended Plan Key Map

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021

Sheet 1 Of 20



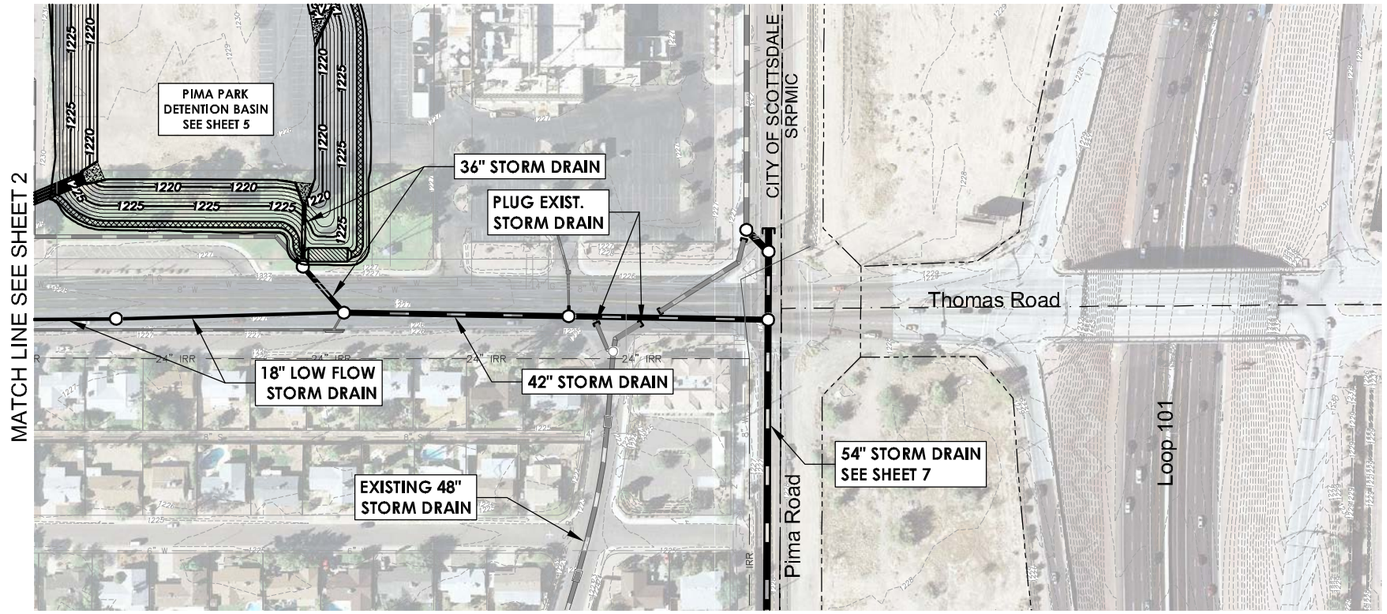


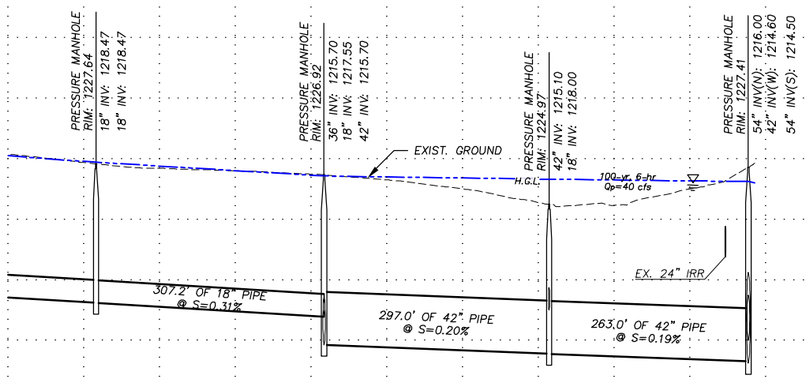
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical

PROPOSED IMPROVEMENTS:
THOMAS RD. STORM DRAIN & PIMA PARK DETENTION BASIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



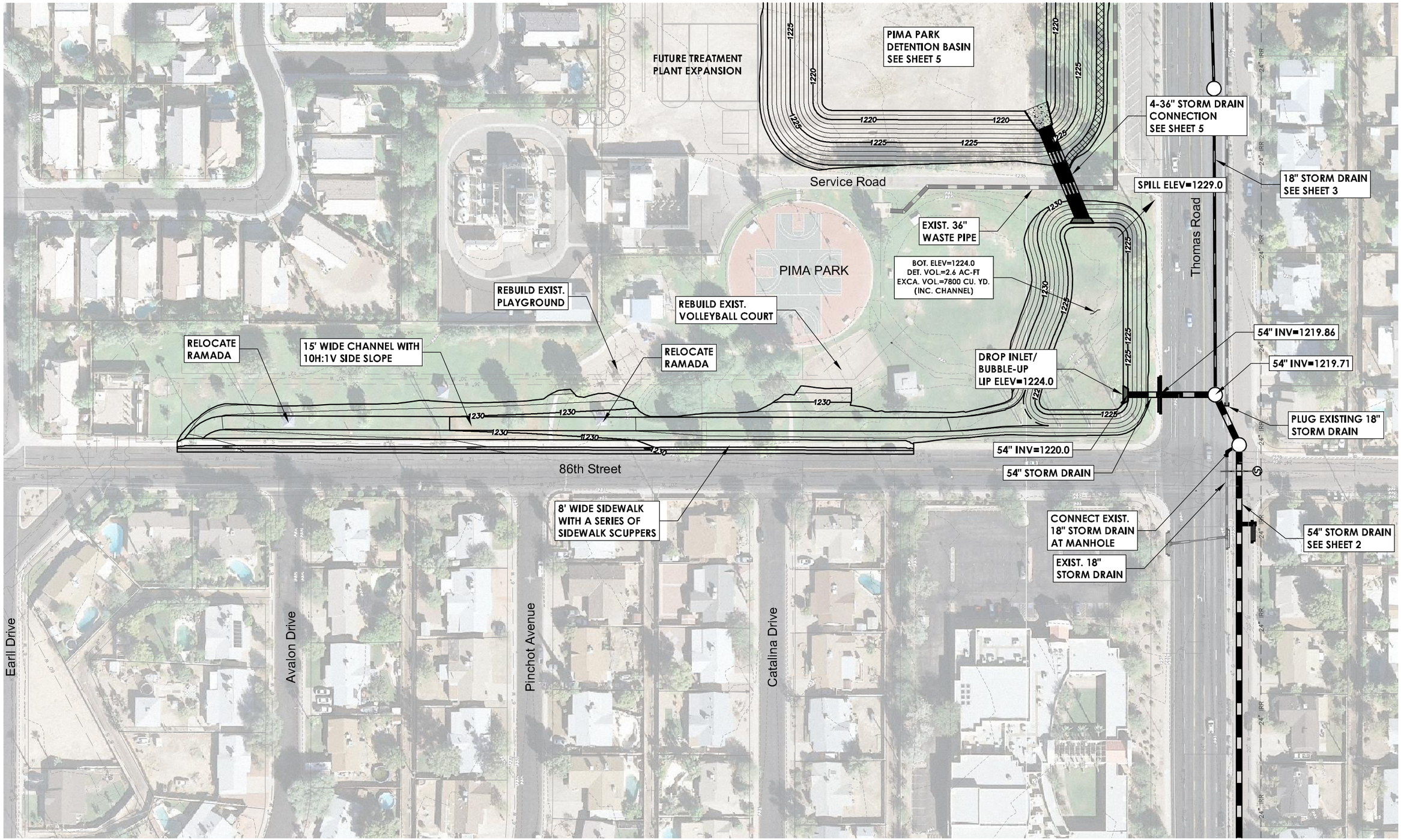


GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
THOMAS RD. STORM DRAIN & PIMA PARK DETENTION BASIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021

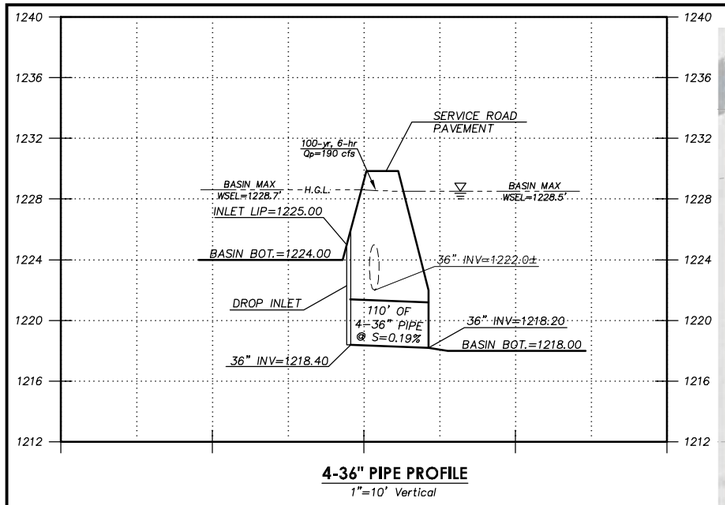


GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

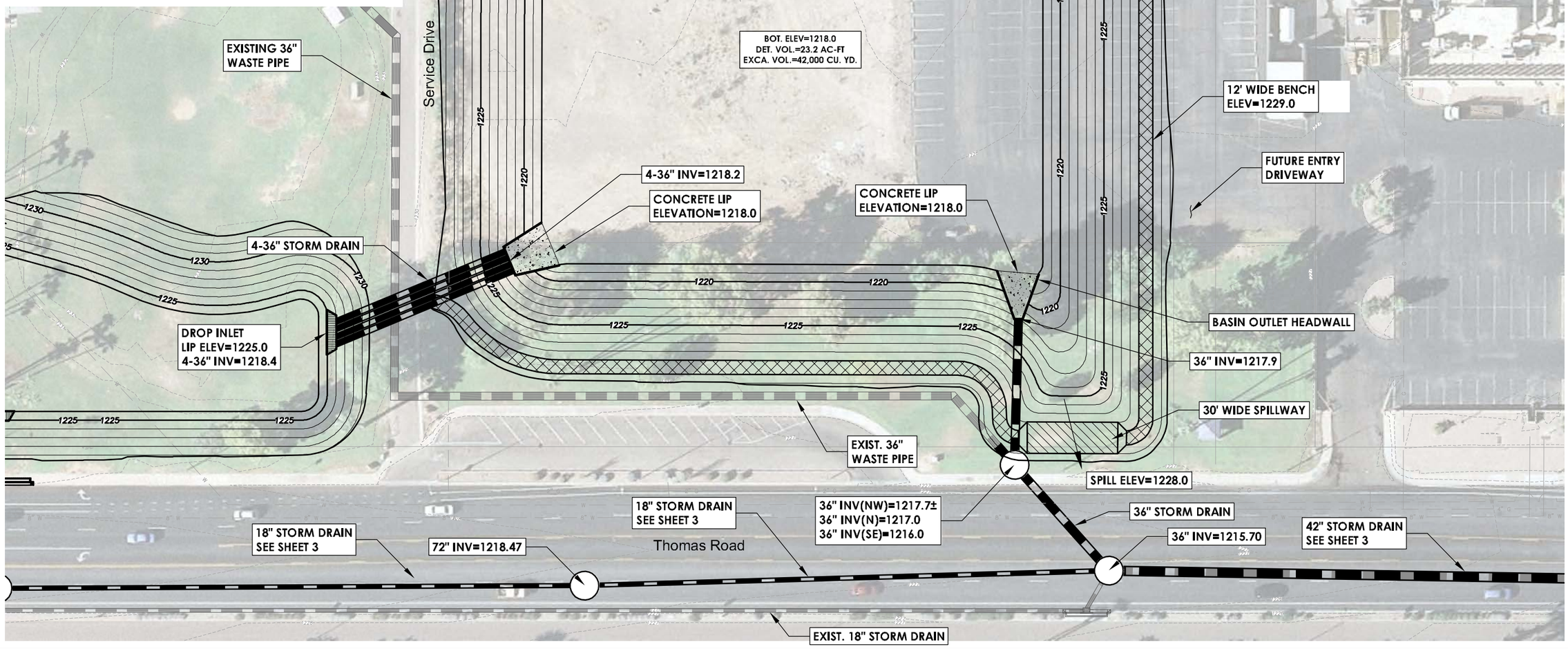
Scale: 1"=100' Horizontal

PROPOSED IMPROVEMENTS:
THOMAS RD. STORM DRAIN & PIMA PARK DETENTION BASIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



4-36" PIPE PROFILE
1"=10' Vertical



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Flood Control District of Maricopa County

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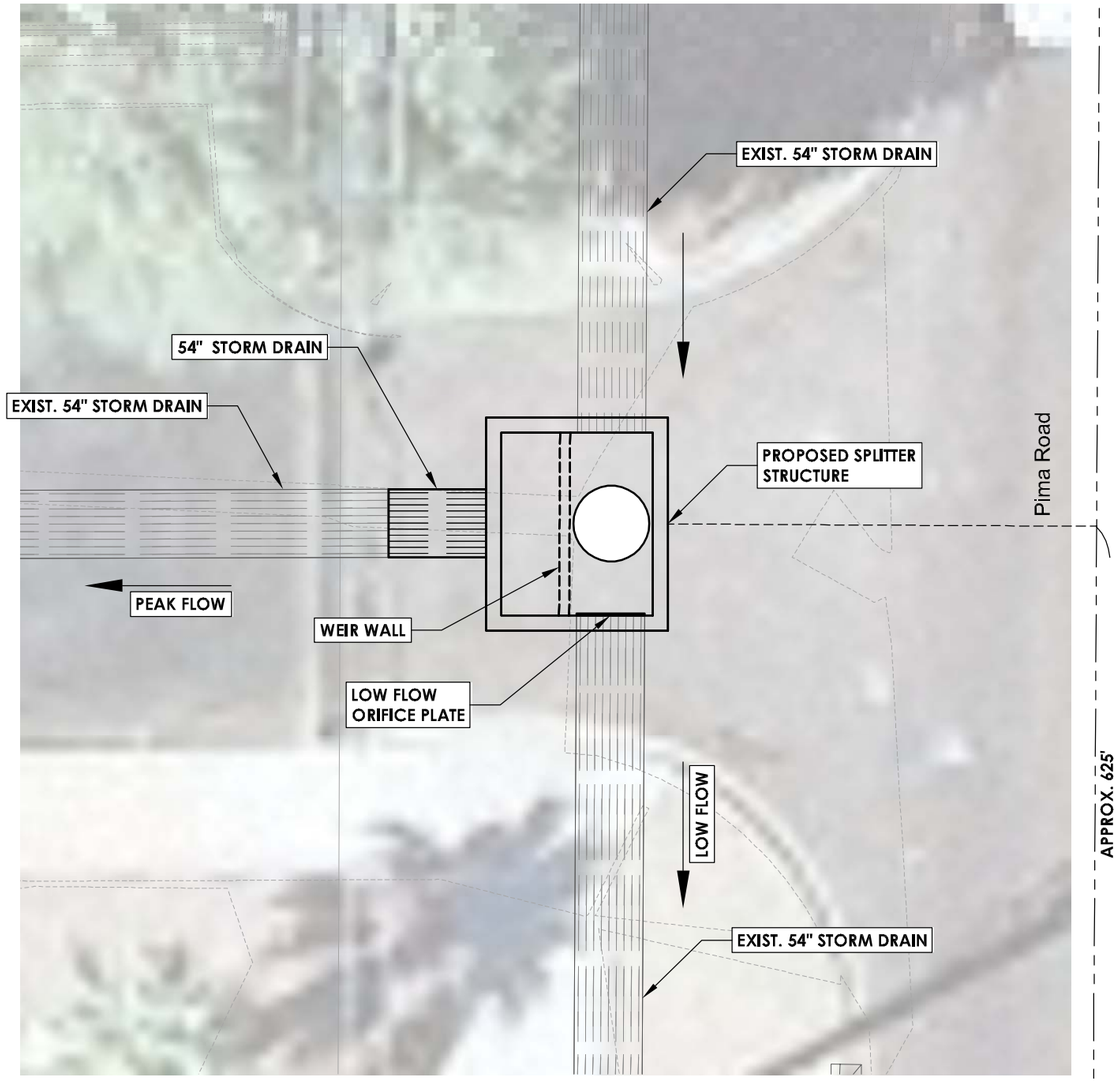
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

15 0 15 30
Scale: 1"=60' Horizontal

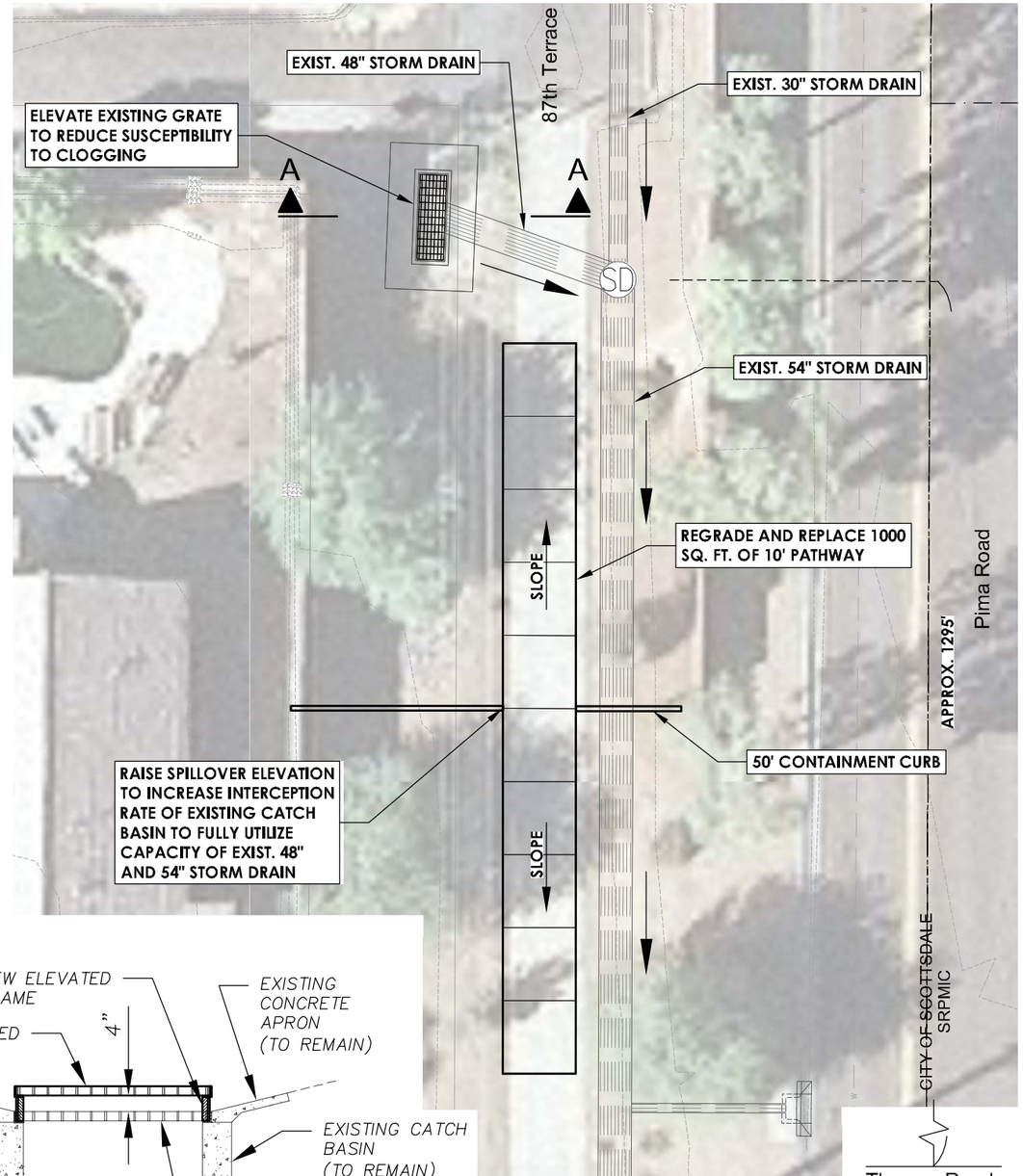
PROPOSED IMPROVEMENTS:
THOMAS RD. STORM DRAIN & PIMA PARK DETENTION BASIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



PIMA ROAD STORM DRAIN
SPLITTER STRUCTURE

Scale: 1"=10' Horizontal



SECTION A-A
NTS

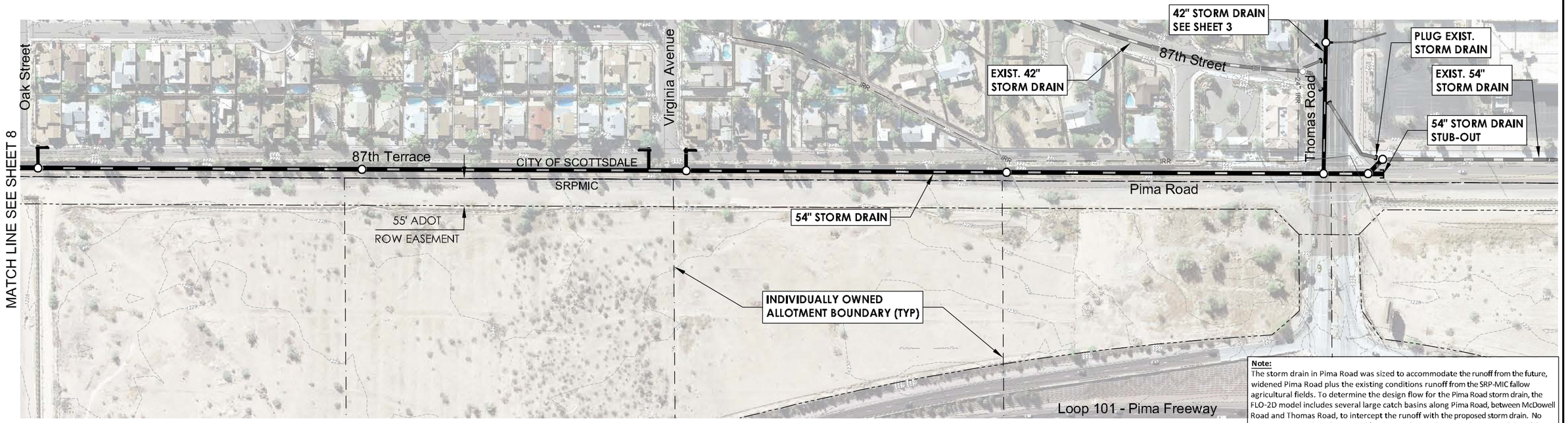
EXISTING EARLL ROAD (EXTENDED)
AND 87TH TERRACE
GRATED INLET IMPROVEMENTS

Scale: 1"=20' Horizontal

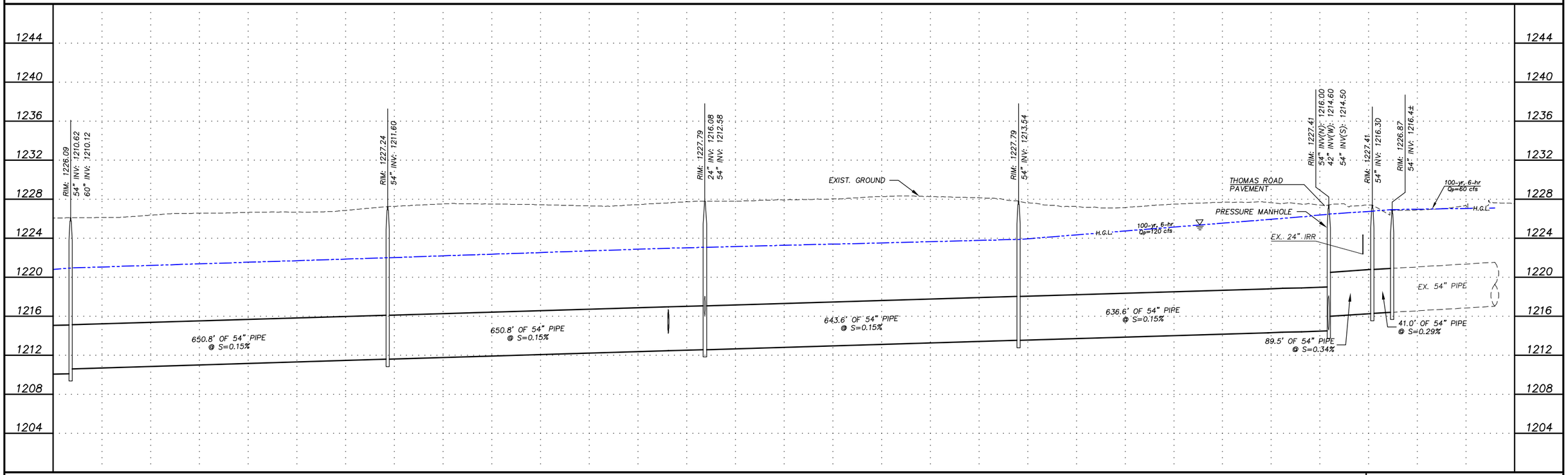
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

PROPOSED IMPROVEMENTS:
THOMAS RD. STORM DRAIN & PIMA PARK DETENTION BASIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



Note:
The storm drain in Pima Road was sized to accommodate the runoff from the future, widened Pima Road plus the existing conditions runoff from the SRP-MIC fallow agricultural fields. To determine the design flow for the Pima Road storm drain, the FLO-2D model includes several large catch basins along Pima Road, between McDowell Road and Thomas Road, to intercept the runoff with the proposed storm drain. No attempt was made to locate and/or design these inlets. It is the responsibility of the designer of the Pima Road widening project to properly size and locate the storm drain catch basins along Pima Road to capture the runoff from the 100-year, 6-hour storm.

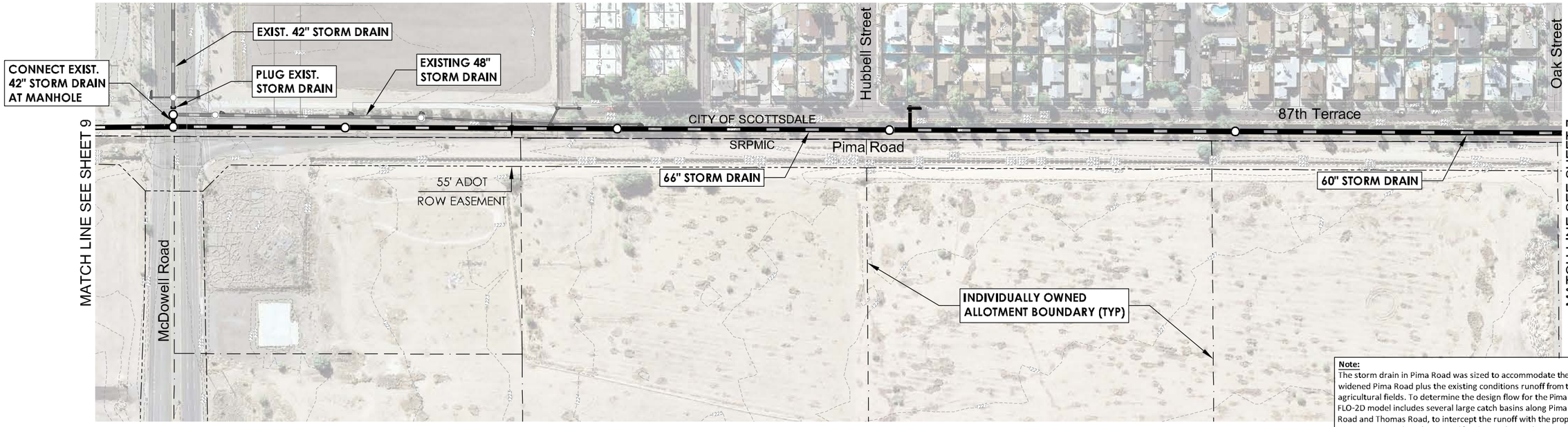


GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

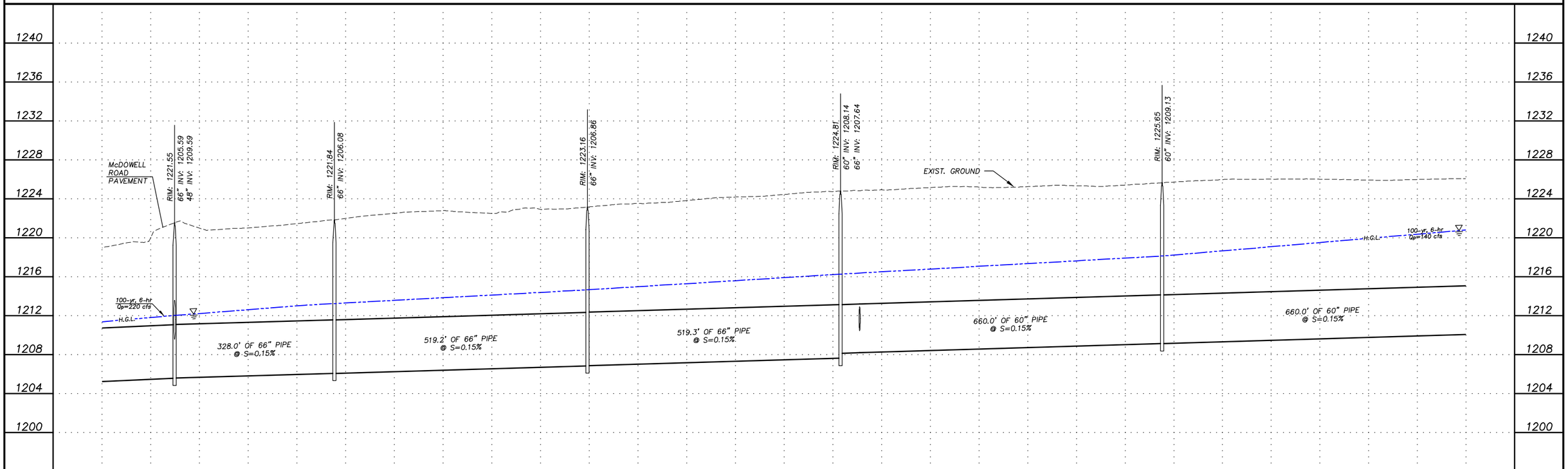
Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
PIMA/MCKELLIPS ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



Note:
The storm drain in Pima Road was sized to accommodate the runoff from the future, widened Pima Road plus the existing conditions runoff from the SRP-MIC fallow agricultural fields. To determine the design flow for the Pima Road storm drain, the FLO-2D model includes several large catch basins along Pima Road, between McDowell Road and Thomas Road, to intercept the runoff with the proposed storm drain. No attempt was made to locate and/or design these inlets. It is the responsibility of the designer of the Pima Road widening project to properly size and locate the storm drain catch basins along Pima Road to capture the runoff from the 100-year, 6-hour storm.



CITY OF SCOTTSDALE

Flood Control District of Maricopa County

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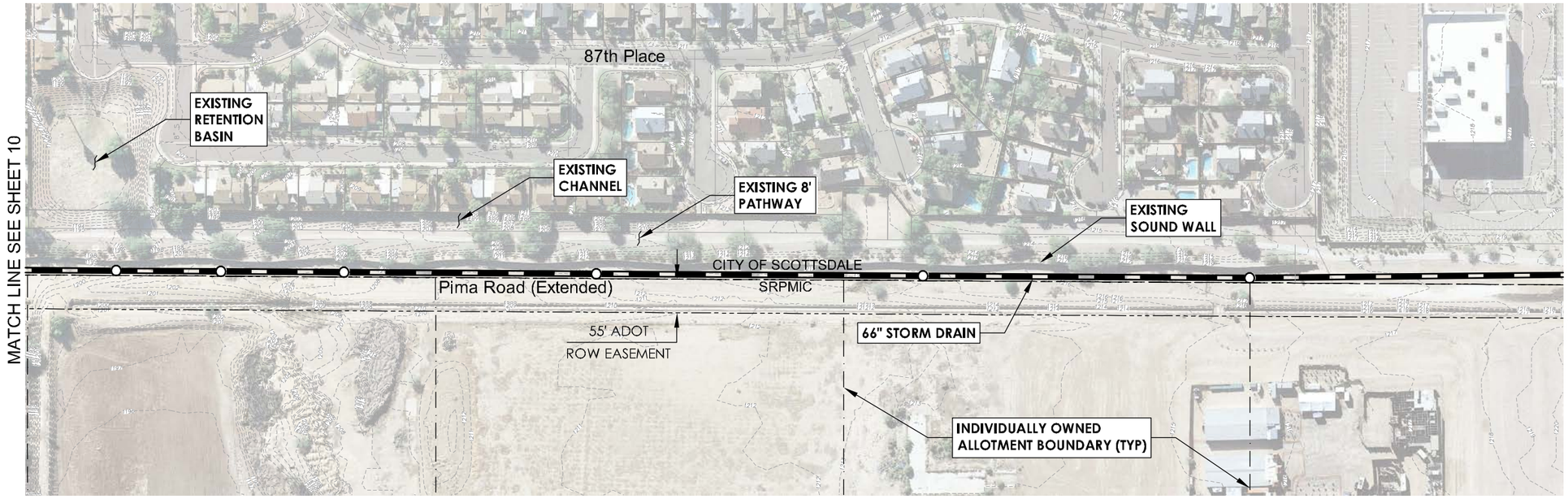
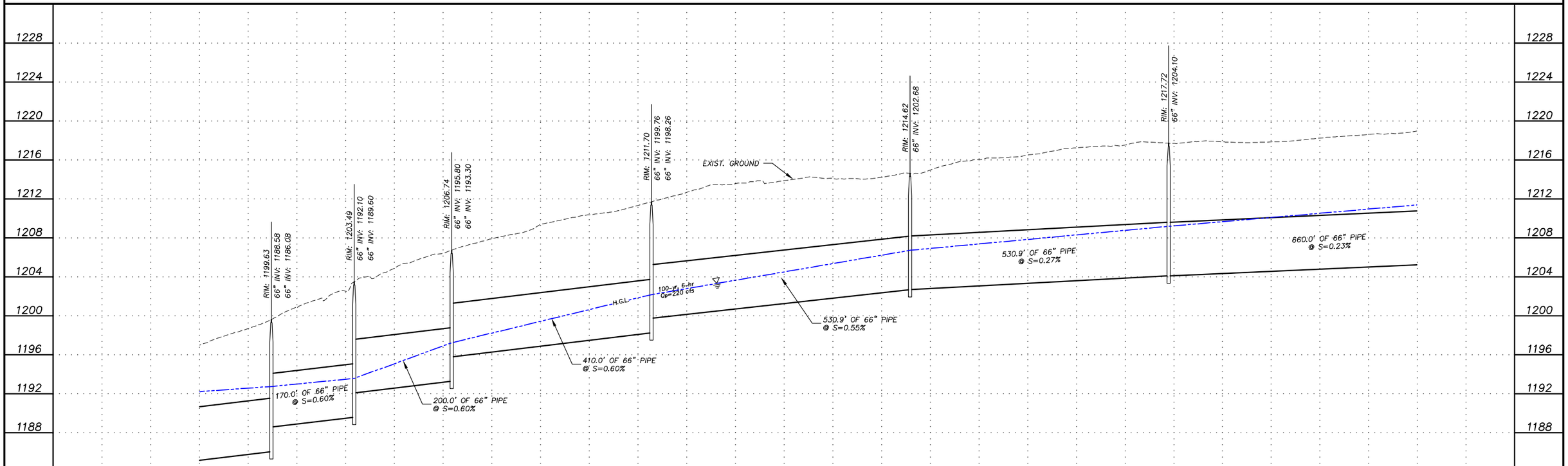
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

50 0 50 100
Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
PIMA/MCKELLIPS ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021





CITY OF SCOTTSDALE

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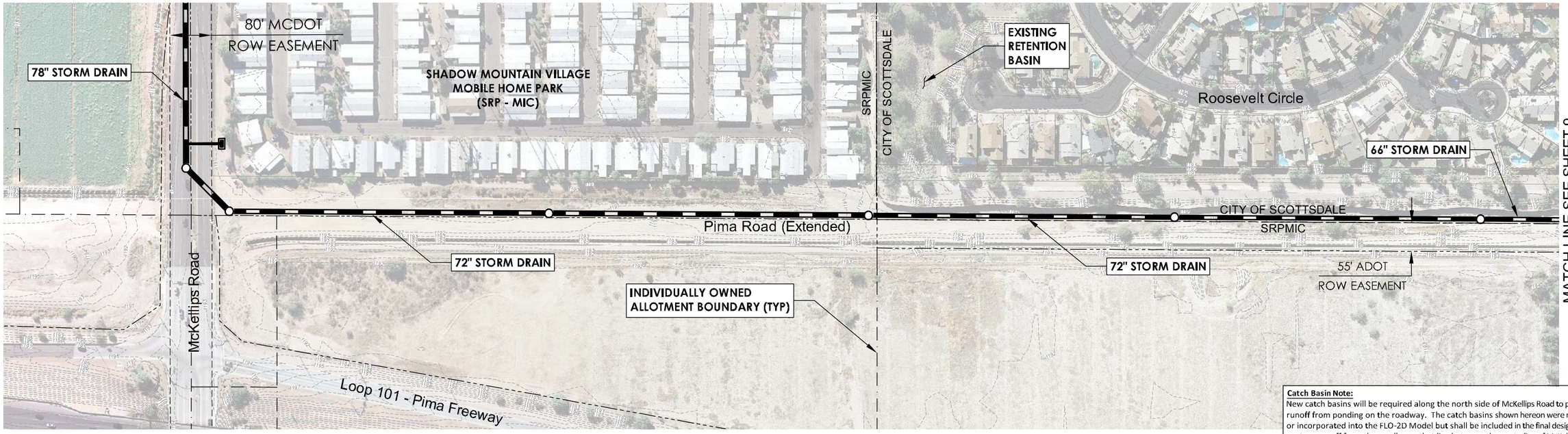
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical (50 0 50 100)

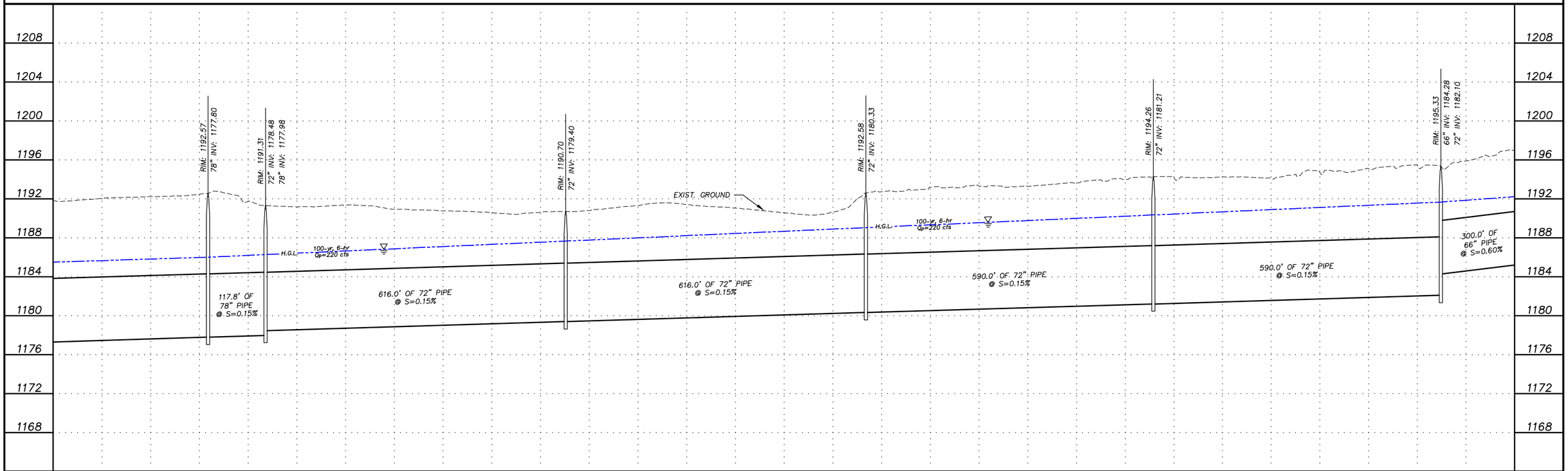
PROPOSED IMPROVEMENTS:
PIMA/MCKELLIPS ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021

MATCH LINE SEE SHEET 11



Catch Basin Note:
New catch basins will be required along the north side of McKellips Road to prevent runoff from ponding on the roadway. The catch basins shown hereon were not sized or incorporated into the FLO-2D Model but shall be included in the final design to capture runoff from the small area that lies between the centerline of McKellips Road and the perimeter walls of the mobile home parks.

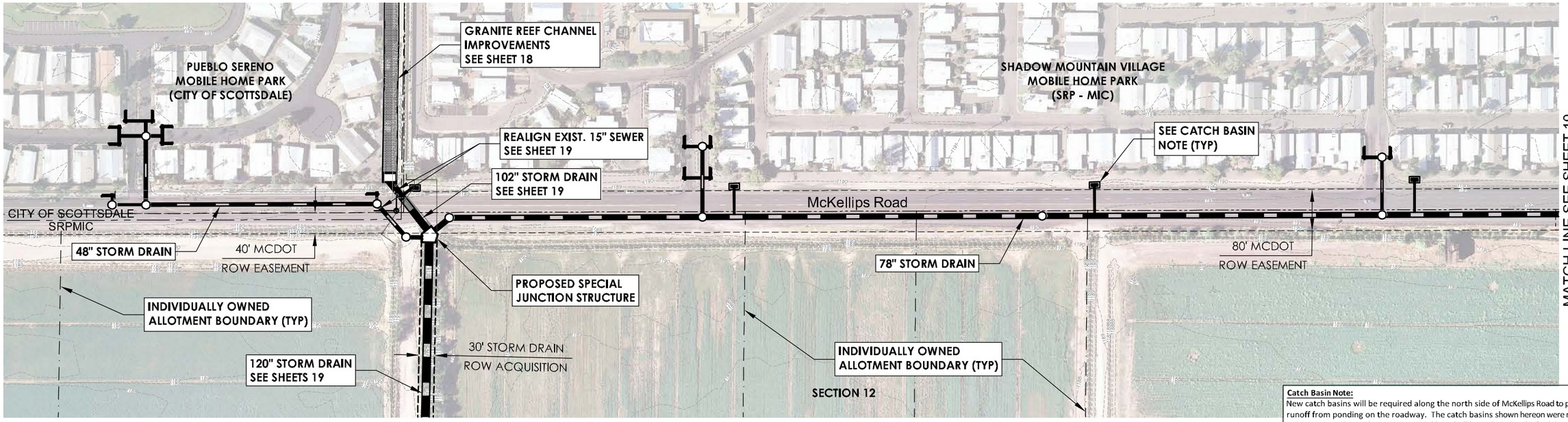


GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
PIMA/MCKELLIPS ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



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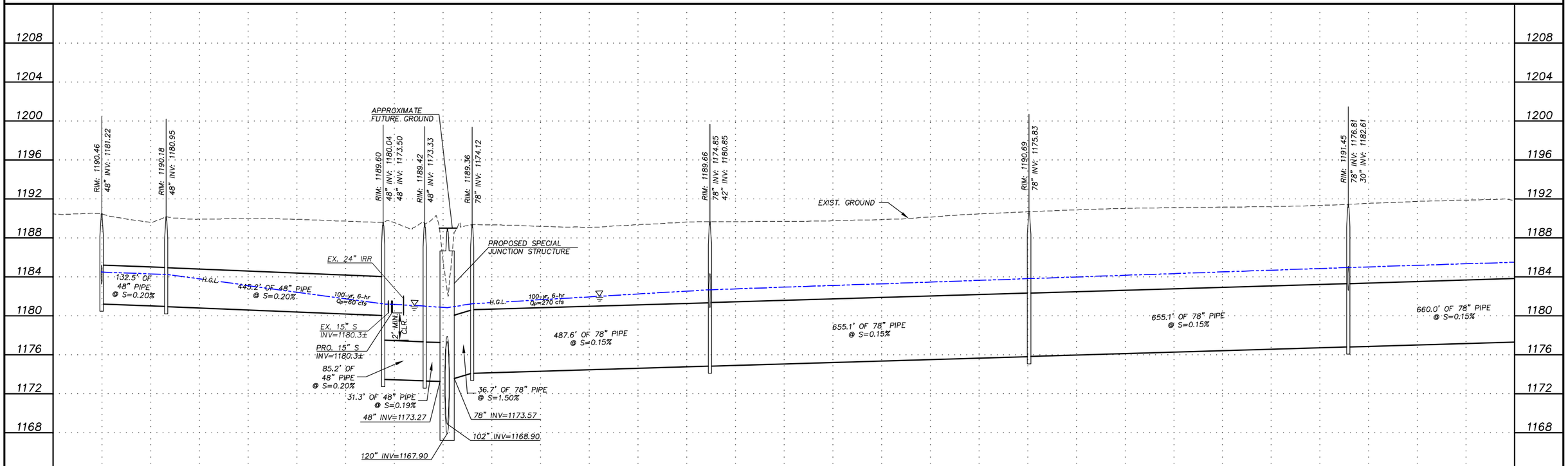
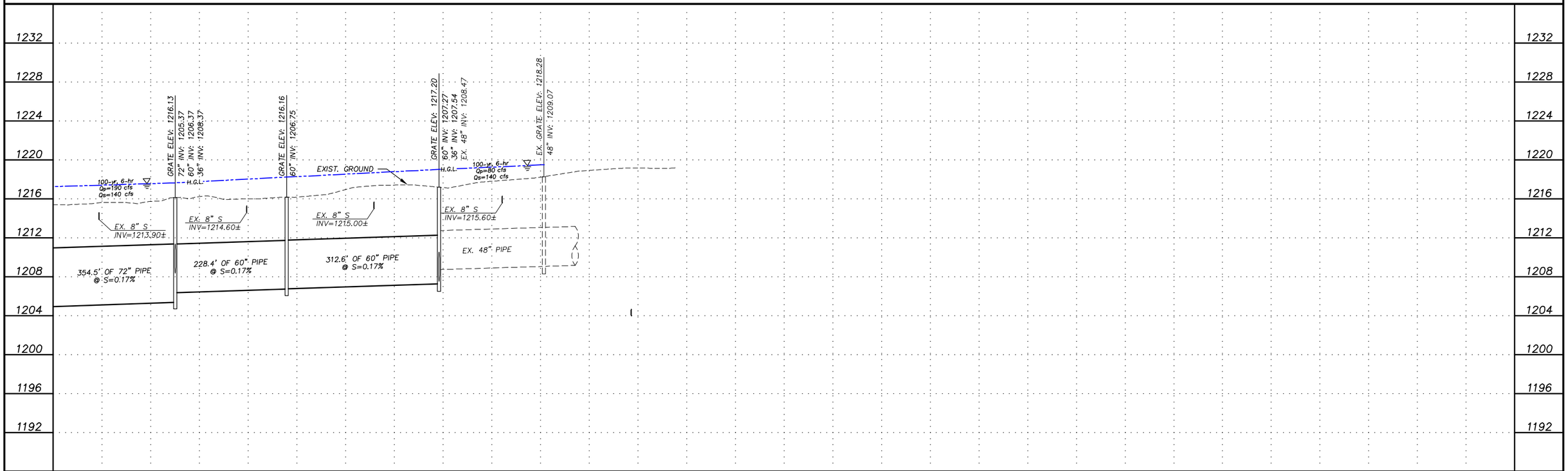


GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical

PROPOSED IMPROVEMENTS:
PIMA/MCKELLIPS ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021

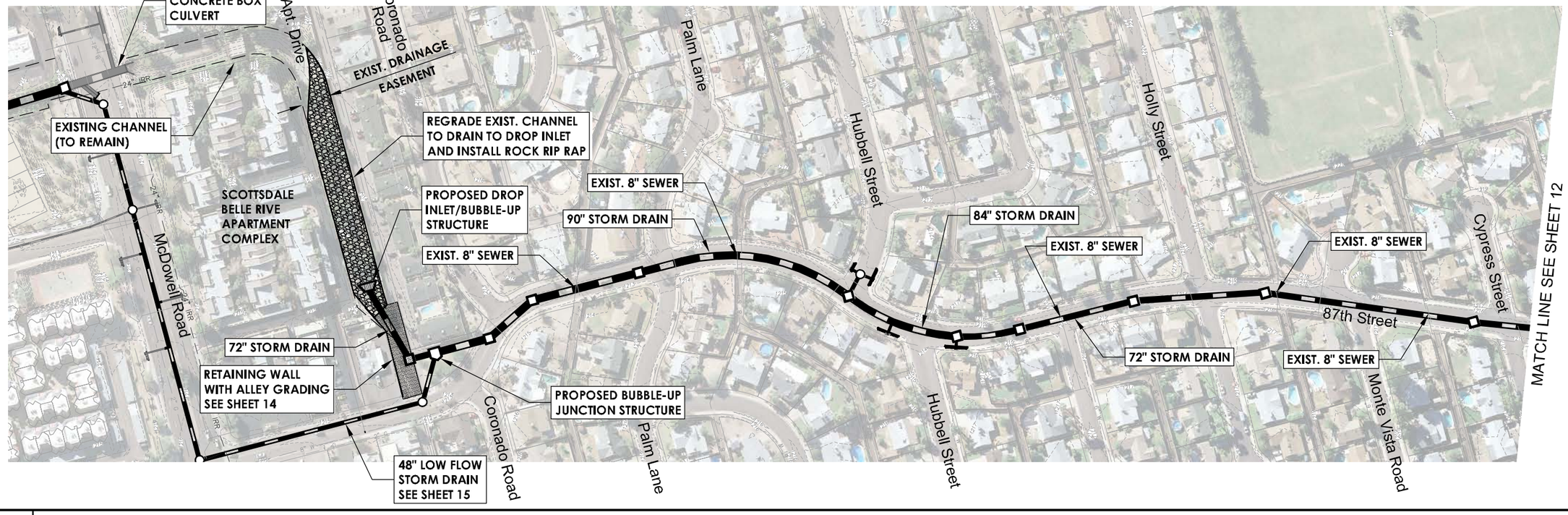


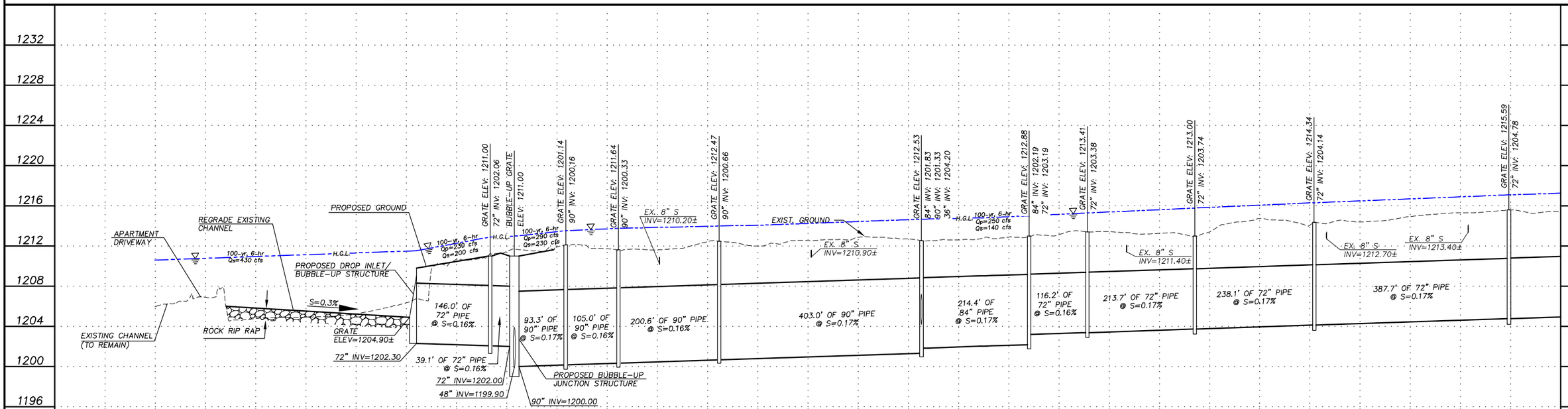
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
87TH STREET STORM DRAIN IMPROVEMENTS

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



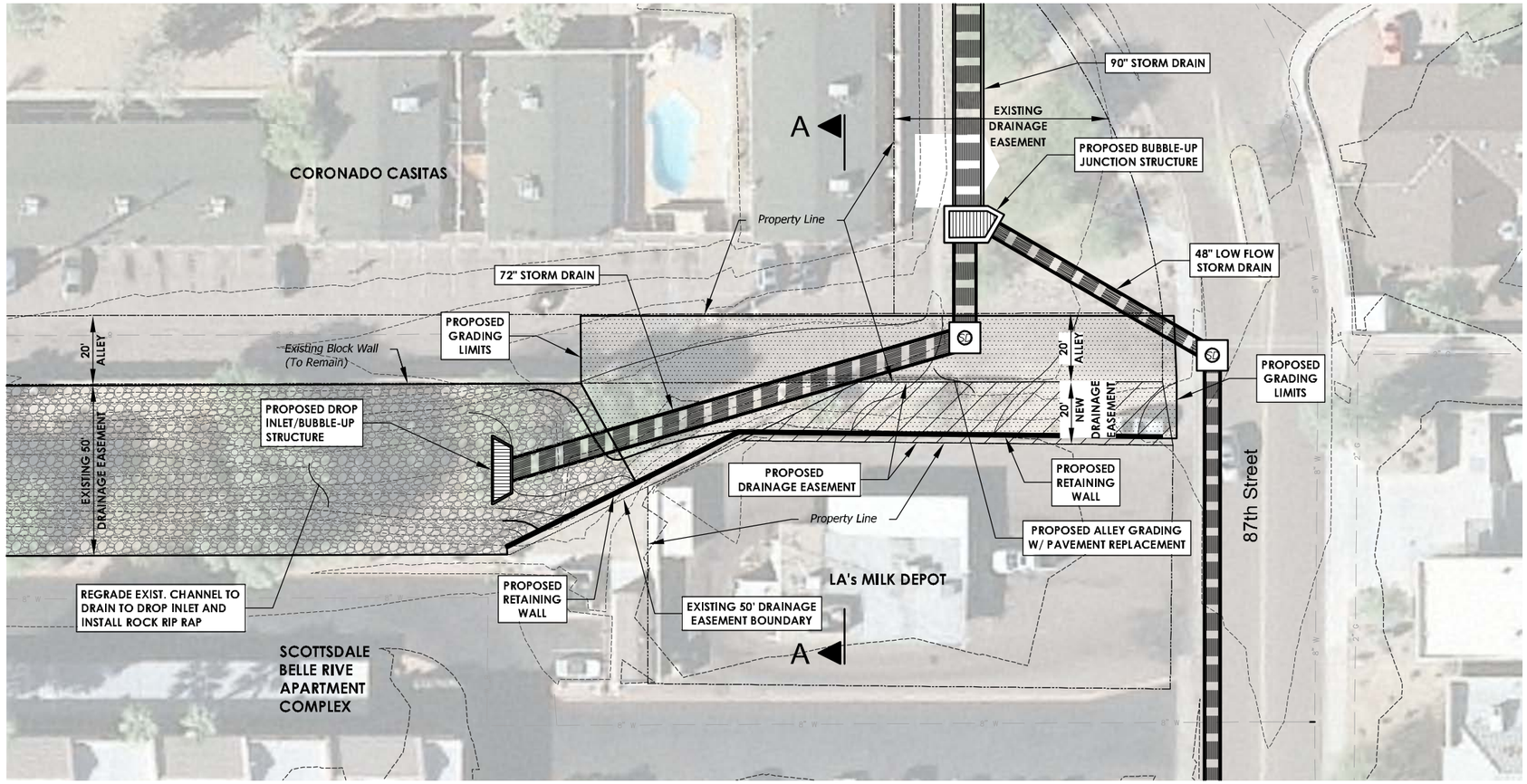


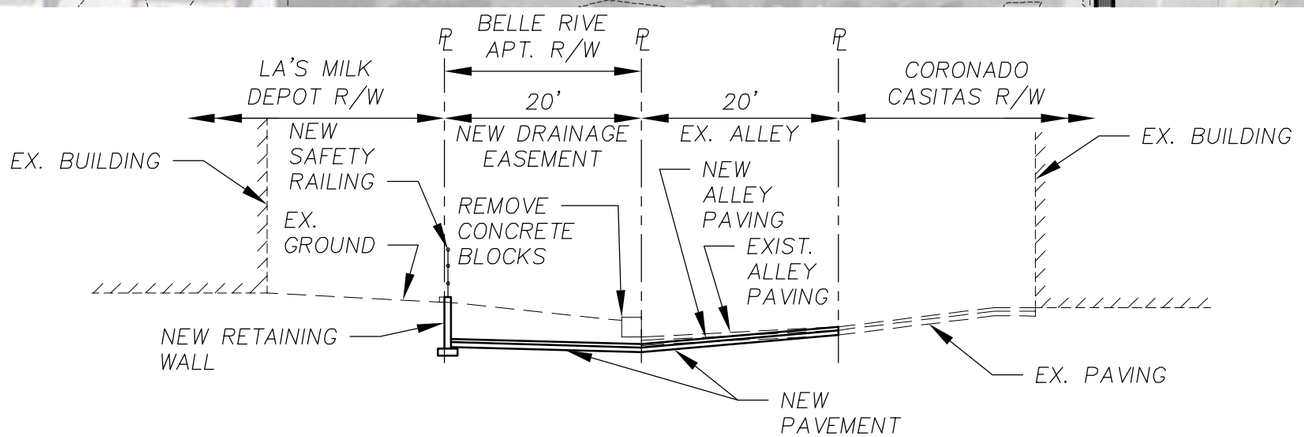
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical (50 0 50 100)

PROPOSED IMPROVEMENTS:
87TH STREET STORM DRAIN IMPROVEMENTS

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021





SECTION A-A
NTS

CITY OF SCOTTSDALE

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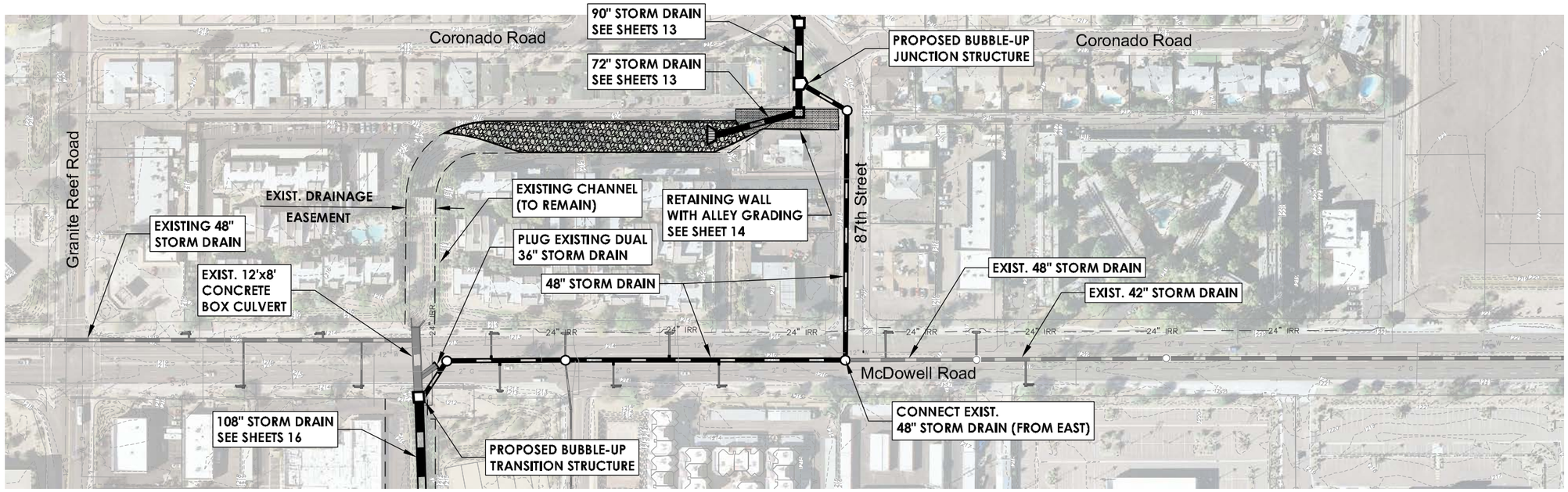
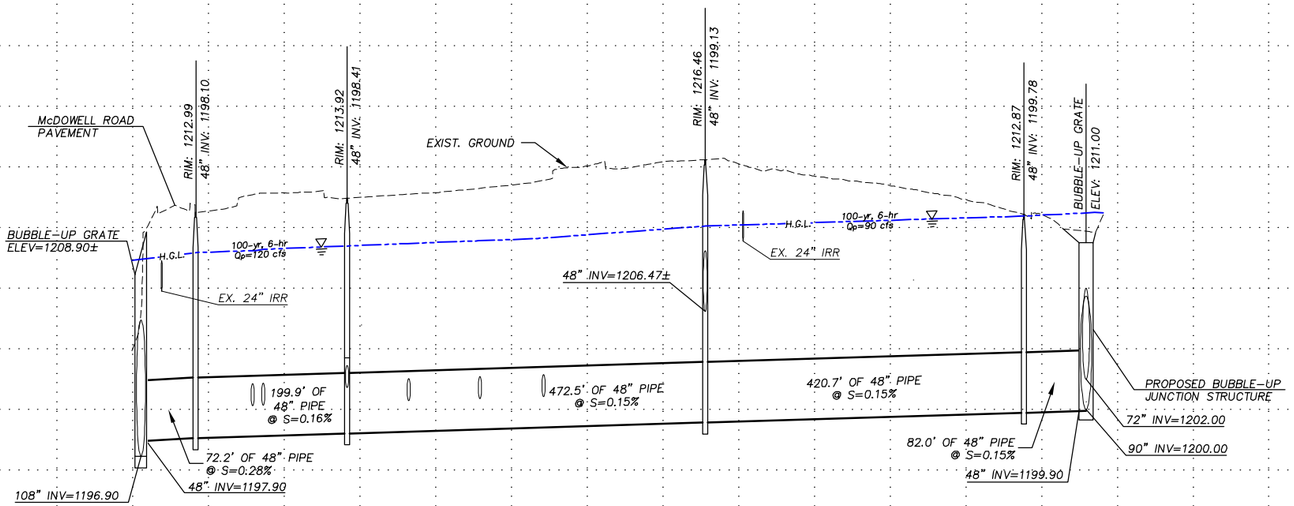
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

10 0 10 20
Scale: 1"=40' Horizontal

PROPOSED IMPROVEMENTS:
87TH STREET STORM DRAIN IMPROVEMENTS

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



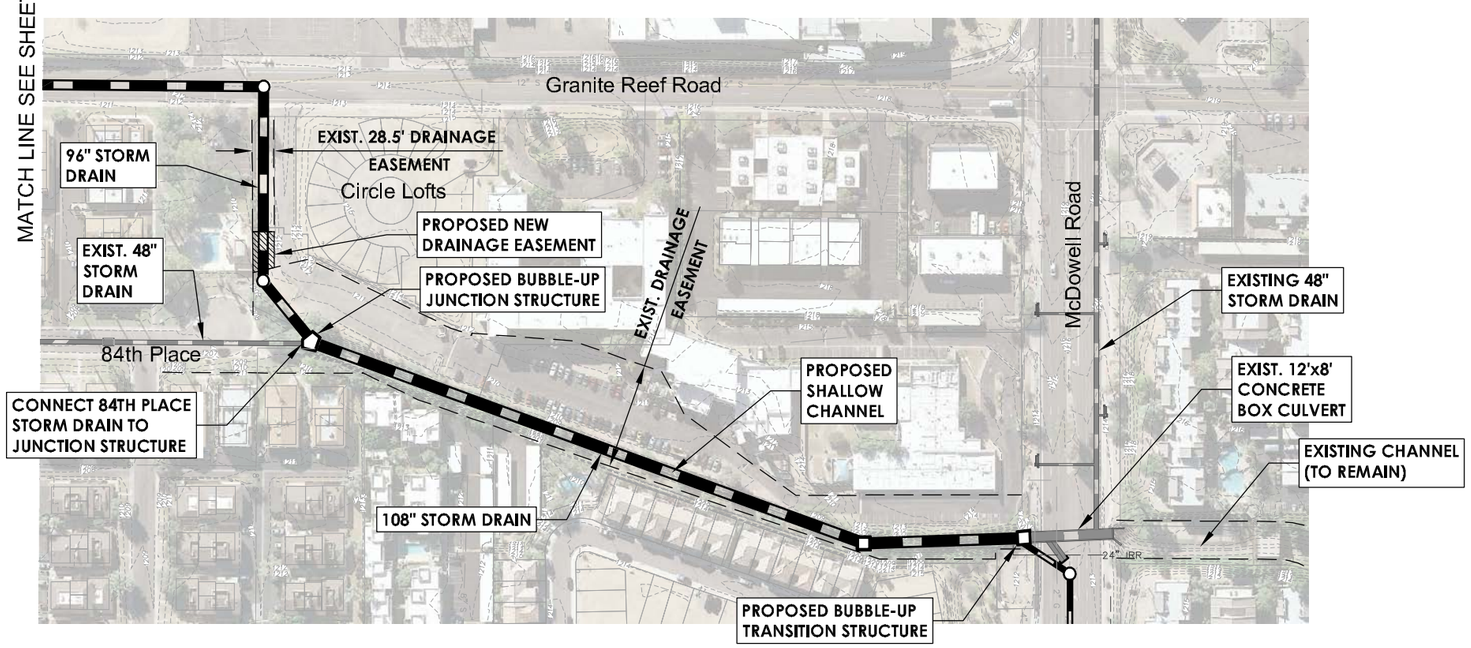


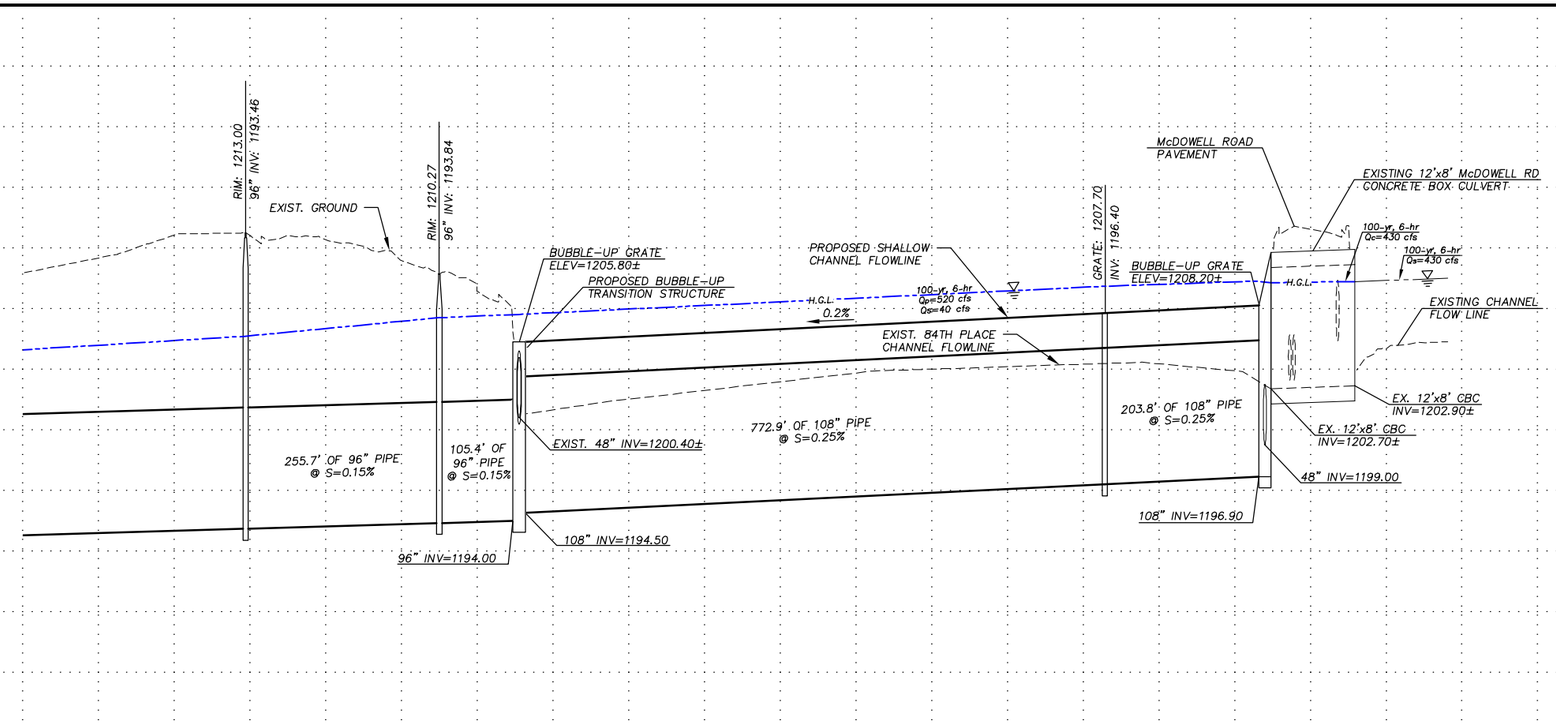
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
87TH STREET STORM DRAIN IMPROVEMENTS

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



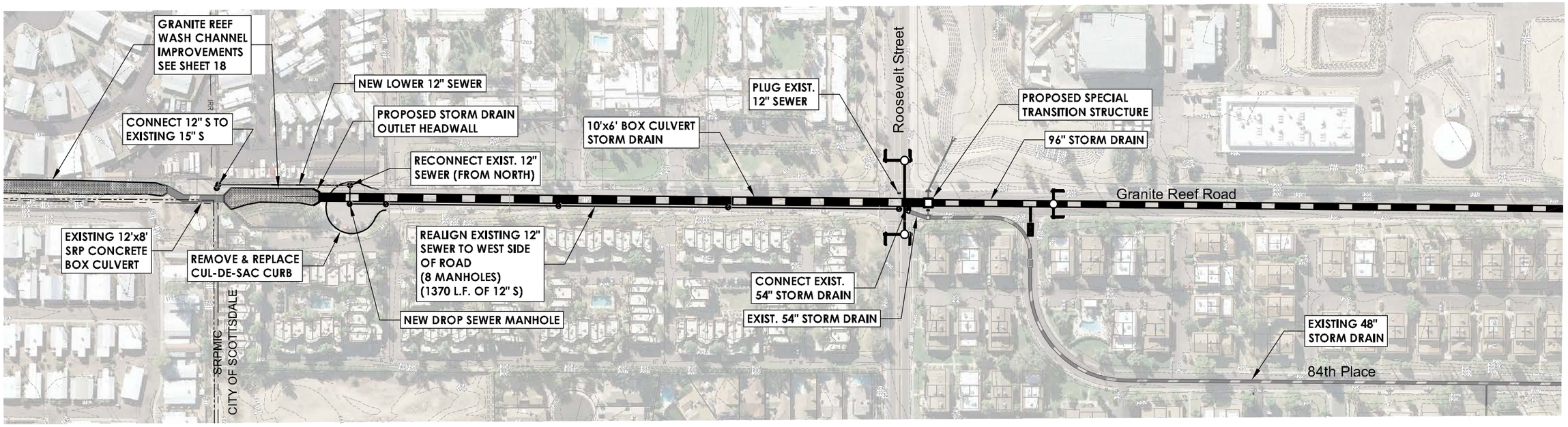


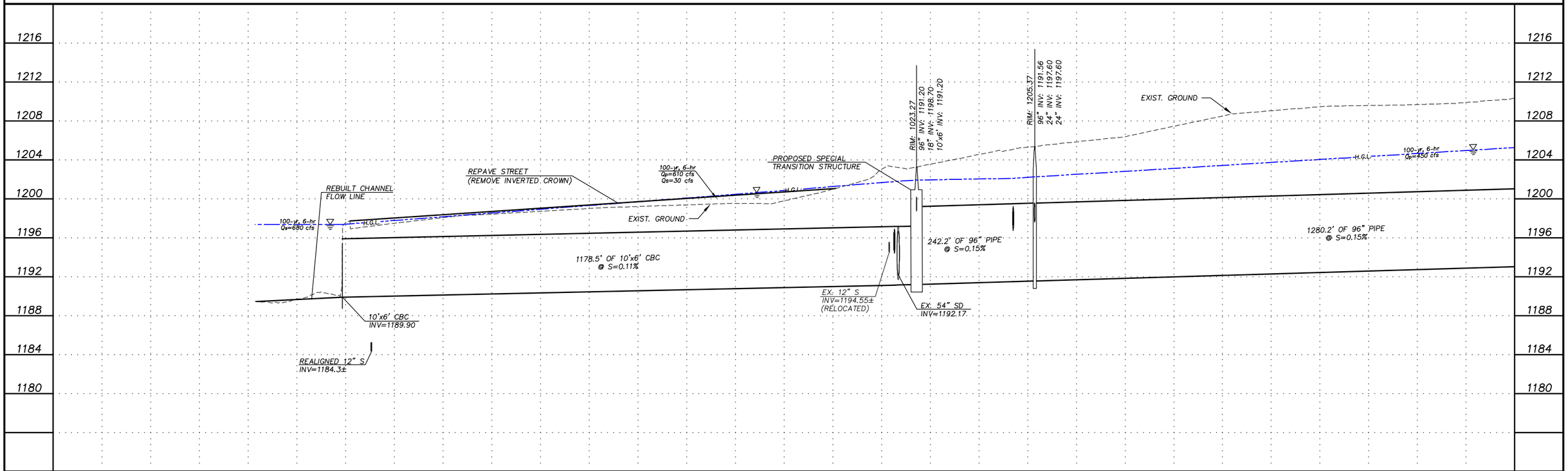
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical (50 0 50 100)

PROPOSED IMPROVEMENTS:
84TH PLACE/GRANITE REEF ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021





GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal, 1"=10' Vertical

PROPOSED IMPROVEMENTS:
84TH PLACE/GRANITE REEF ROAD STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
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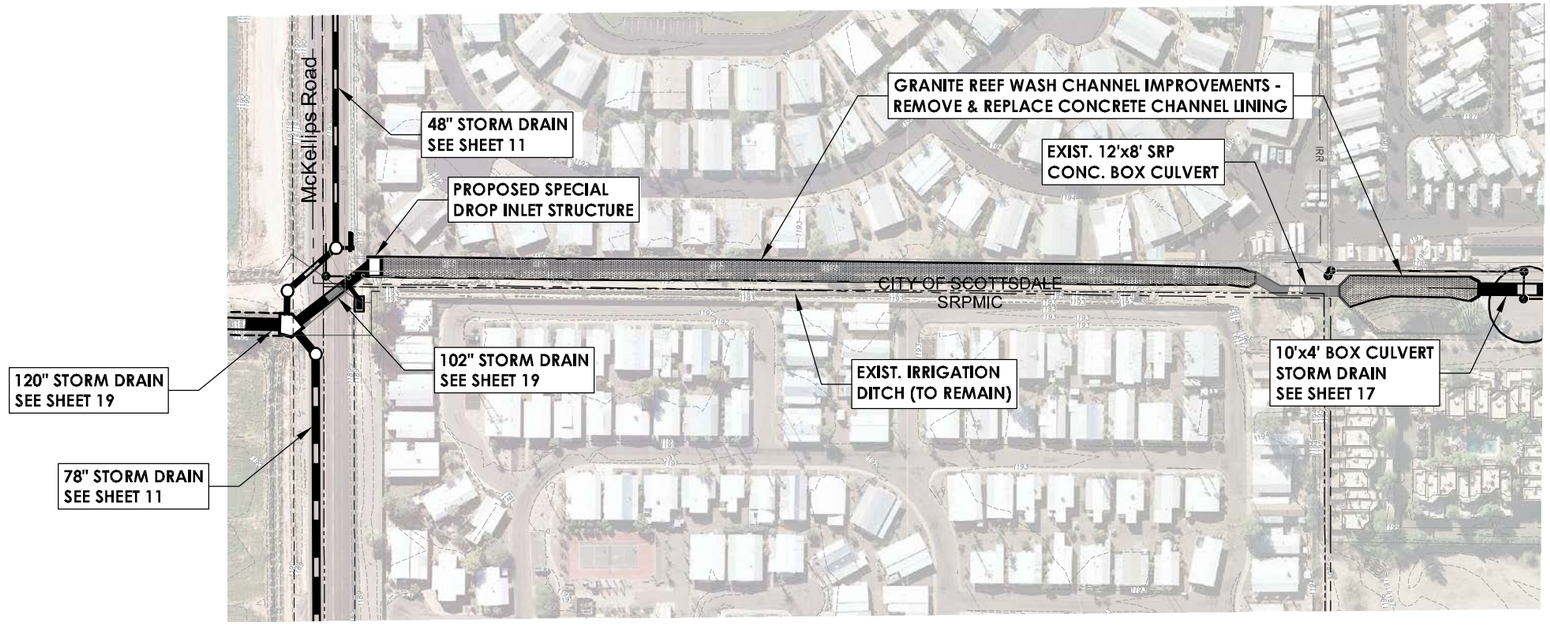
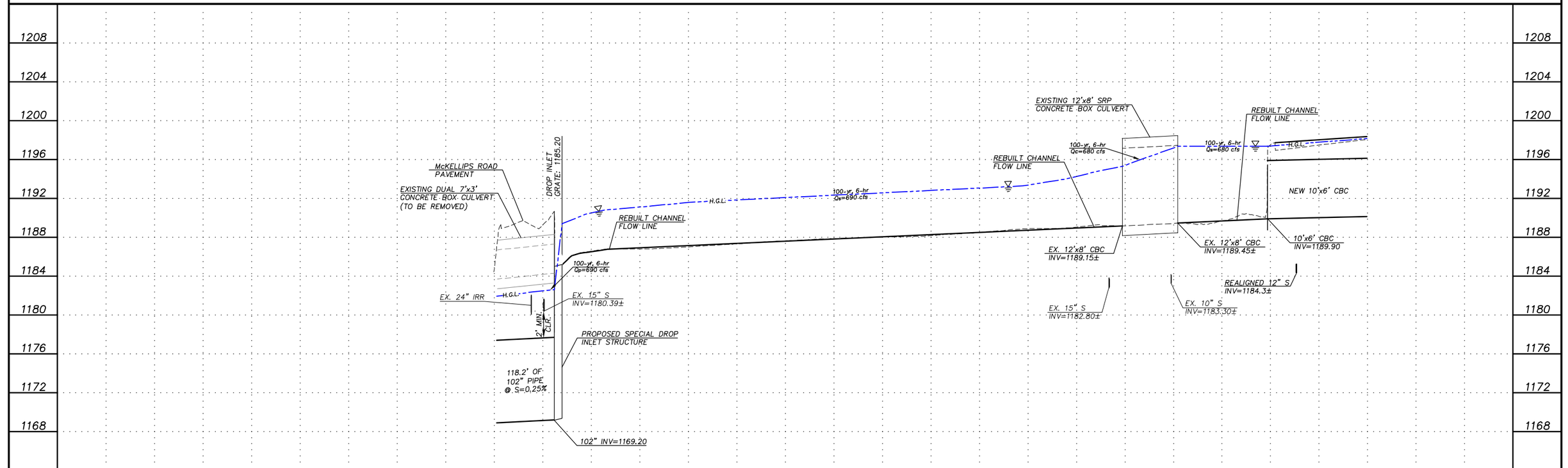




CITY OF SCOTTSDALE

Flood Control District of Maricopa County

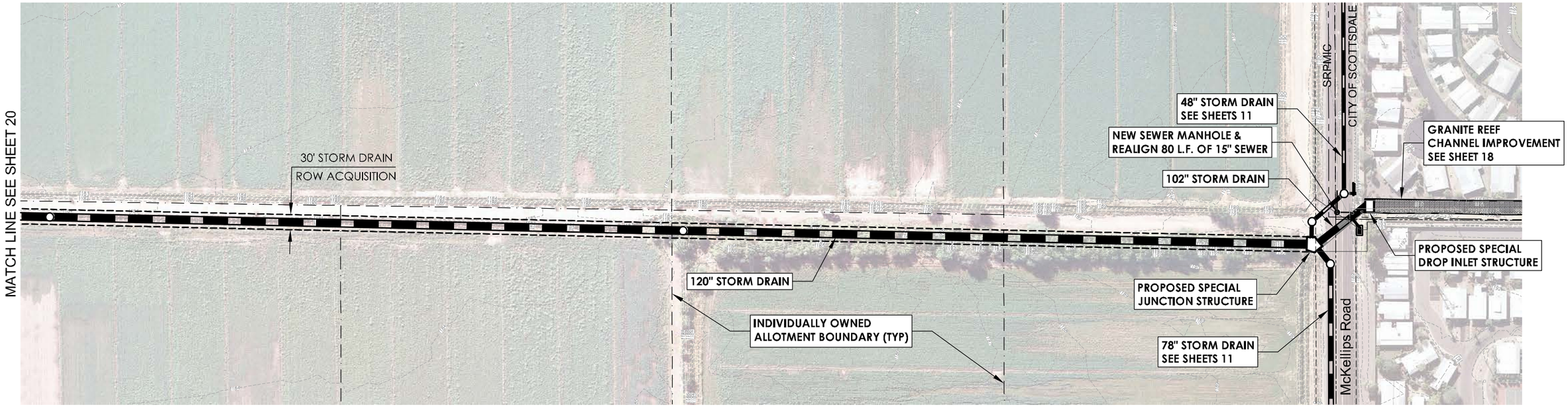
Gavan & Barker — Civil Engineering & Landscape Architecture
3030 North Central Avenue, Suite 1530
Phoenix, AZ 85012 Phone 602.200.0031

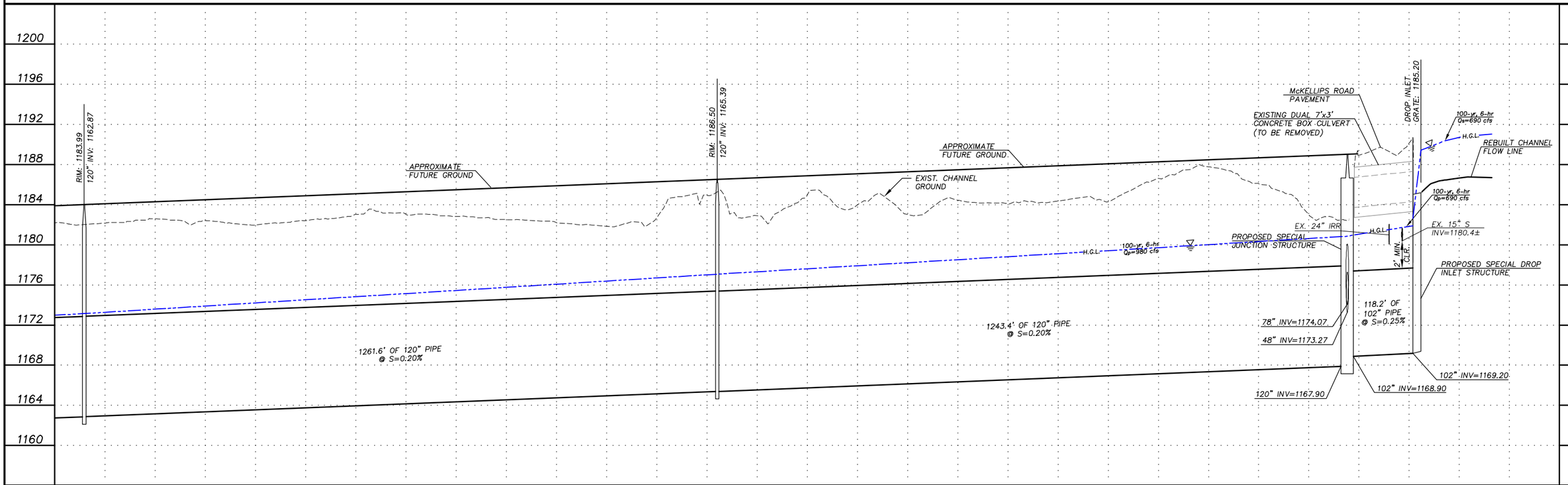
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

50 0 50 100
Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
GRANITE REEF WASH CHANNEL IMPROVEMENTS

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021



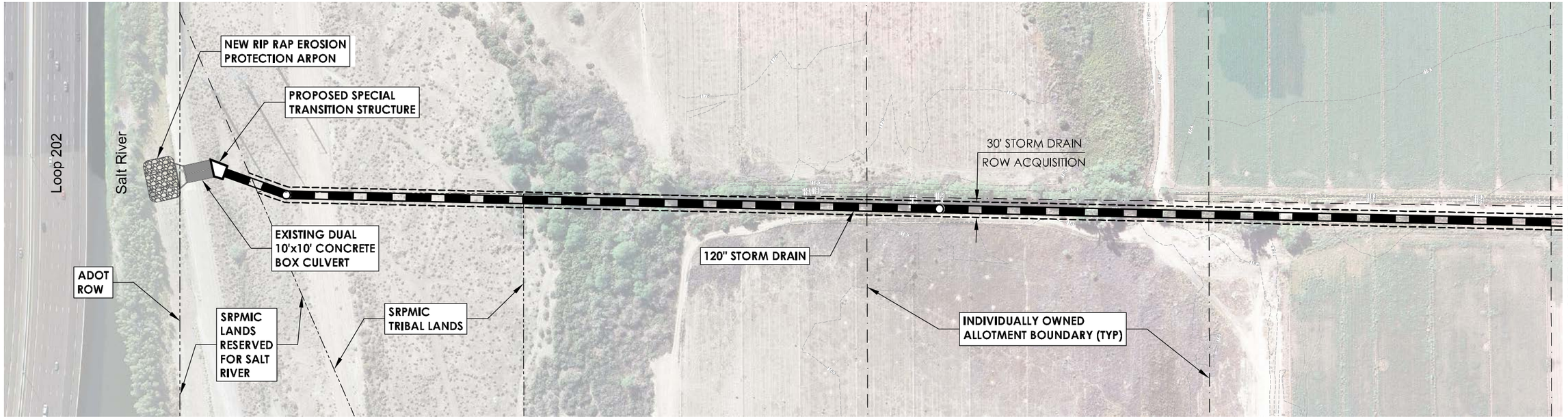


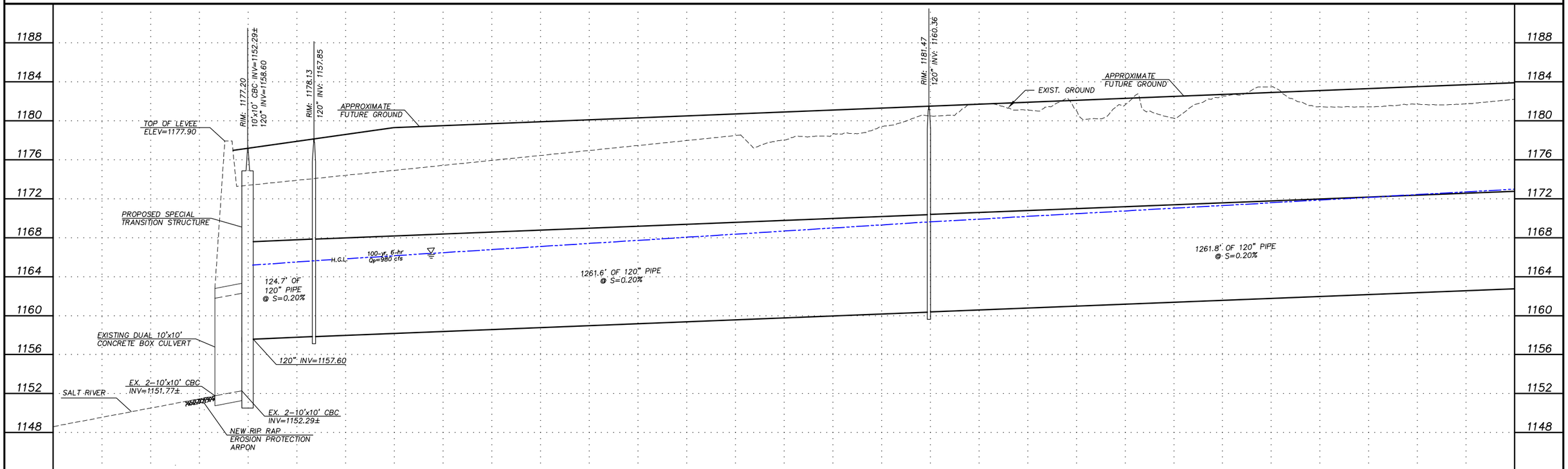
GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
SRPMIC SECTION 12
STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021





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Flood Control District of Maricopa County

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GRANITE REEF WATERSHED PHASE II
DRAINAGE PLANNING AND STORM DRAIN DESIGN

50 0 50 100
Scale: 1"=200' Horizontal
1"=10' Vertical

PROPOSED IMPROVEMENTS:
SRPMIC SECTION 12 STORM DRAIN

	By	Date
Prepared	AJA	7/9/2021
Checked	MTG	7/9/2021

Sheet 20 Of 20

Appendix D: Granite Reef Wash Phase II Recommended Plan Cost Estimates

Thomas Rd Storm Drain & Pima Park Detention Basin
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
STORM DRAIN CATCH BASIN (cost includes new inlet, connector pipe & pavement replacement)	EA	8	$25,500	$204,000
18" LOW FLOW STORM DRAIN BYPASS PIPE (cost includes trenching, new pipe and pavement replacement)	LF	637	$150	$95,550
36" STORM DRAIN PIPE w/o PAVEMENT REPLACEMENT (cost only includes trenching, new pipe and backfill)	LF	456	$200	$91,200
36" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	612	$254	$155,448
42" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	560	$294	$164,640
48" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	765	$318	$243,270
54" STORM DRAIN PIPE w/o PAVEMENT REPLACEMENT (cost only includes trenching, new pipe and backfill)	LF	68	$280	$19,040
54" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1519	$352	$534,688
STORM DRAIN MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	14	$7,000	$98,000
NEW STORM DRAIN SPLITTER STRUCTURE (special structure diverting high flows from Pima Rd storm drain to detention basin)	EA	1	$30,000	$30,000
PIMA PARK DETENTION BASIN EXCAVATION (cost includes haul-off)	CY	49800	$25	$1,245,000
PIMA PARK DETENTION BASIN LANDSCAPING (cost includes park amenities and irrigation)	SF	320000	$3	$960,000
PIMA PARK DETENTION BASIN INLET/OUTLET HEADWALL (cost includes access grate and safety railing)	EA	3	$25,000	$75,000
PIMA PARK DETENTION BASIN DROP OUTLET STRUCTURE (cost includes access grate and safety railing)	EA	2	$30,000	$60,000
87th TERRACE STORM DRAIN CATCH BASIN GRATE IMPROVEMENT (cost includes elevating existing grated inlet on Pima Frontage Road and Earll Drive)	EA	1	$5,000	$5,000
87th TERRACE CONTAINMENT CURB (cost includes new containment curb to set spill elevation on 87th Terrace Pathway)	LF	50	$40	$2,000
87th TERRACE PATHWAY (cost includes removal and replacement of existing pathway)	SF	1000	$12	$12,000
86th STREET 8-FT WIDE SIDEWALK WITH A SERIES OF SCUPPERS (cost includes removal of existing sidewalk and 40 new 4-foot wide scuppers)	EA	40	$1,500	$60,000
86th STREET LOW-FLOW VALLEY GUTTER (cost includes removal of existing curb & gutter and pavement replacement)	LF	920	$40	$36,800
LOWER 24-INCH WATERLINE (cost includes lowering existing 24-inch Waterline at 86th Street and Thomas Road)	EA	1	$25,000	$25,000
8-INCH SEWER PIPE (cost includes lowering existing 8-inch Sewer at 86th Street and Thomas Road)	LF	40	$230	$9,200
8-INCH SEWER DROP MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	1	$10,000	$10,000

Sub-Total =	**$4,135,836**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$1,240,750.80
Construction Sub-Total =	**$5,376,587**
Contingency (20%) =	$1,075,317
Total =	**$6,451,904**
Design, Construction Administration, Plan Review, Permitting (25%) =	$1,612,976.04
Grand Total =	**$8,070,000**

Pima Road/McKellips Road Storm Drain
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
STORM DRAIN CATCH BASIN (cost includes new inlet, connector pipe & pavement replacement)	EA	16	$25,500	$408,000
30" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	111	$211	$23,421
42" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	136	$294	$39,984
48" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	720	$318	$228,960
54" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	2720	$352	$957,440
60" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1320	$375	$495,000
66" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1447	$407	$588,929
66" STORM DRAIN PIPE w/o PAVEMENT REPLACEMENT (cost only includes trenching, new pipe and backfill)	LF	2722	$320	$871,040
72" STORM DRAIN PIPE w/o PAVEMENT REPLACEMENT (cost only includes trenching, new pipe and backfill)	LF	2412	$350	$844,200
78" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	2612	$475	$1,240,700
STORM DRAIN MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	35	$7,000	$245,000
STORM DRAIN CONNECTION (cost includes penetrating ex. Manhole at McDowell Rd and plugging ex. 48" SD)	EA	1	$20,000	$20,000

Sub-Total =	**$5,962,674**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$1,788,802.20
Construction Sub-Total =	**$7,751,476**
Contingency (20%) =	$1,550,295
Total =	**$9,301,771**
Design, Construction Administration, Plan Review, Permitting (25%) =	$2,325,442.86
Grand Total =	**$11,630,000**

87th Street Storm Drain Improvements
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
STORM DRAIN CATCH BASIN (cost includes new inlet, connector pipe & pavement replacement)	EA	12	$25,500	$306,000
36" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	311	$254	$78,994
48" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1247	$318	$396,546
60" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	536	$375	$201,000
72" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1495	$441	$659,295
84" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	215	$513	$110,295
90" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	802	$557	$446,714
GRATED STORM DRAIN MANHOLE (cost includes grate inlet also acting as a manhole)	EA	13	$12,000	$156,000
STORM DRAIN MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	9	$7,000	$63,000
NEW STORM DRAIN SPLITTER STRUCTURE (special structure diverting low flows to McDowell Road and high flows to the channel)	EA	1	$30,000	$30,000
MASONARY RETAINING WALL (cost includes shoring and backfill)	SF	750	$60	$45,000
SUBGRADE PREPARATION (cost includes removal of existing concrete blocks, trees and AC pavement)	SY	690	$30	$20,700
NEW ASPHALT CONCRETE PAVEMENT (cost includes new AC pavement)	SY	690	$60	$41,400
CHANNEL ROCK RIP-RAP - BELLE RIVE CHANNEL (cost includes regrading and new channel rip-rap)	SY	2600	$70	$182,000
PERIMETER CHANNEL REVEGETATION - BELLE RIVE CHANNEL (cost includes landscaping and irrigation)	SF	15000	$2	$30,000

Sub-Total =	**$2,766,944**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$830,083
Construction Sub-Total =	**$3,597,027**
Contingency (20%) =	$719,405
Total =	**$4,316,433**
Design, Construction Administration, Plan Review, Permitting (25%) =	$1,079,108
20' Drainage Easement Acquisition Cost (2,000 sq.ft. @ $40 per sq.ft.) =	$80,000.00
Grand Total =	**$5,480,000**

84th Place/Granite Reef Road Storm Drain
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
STORM DRAIN CATCH BASIN (cost includes new inlet, connector pipe & pavement replacement)	EA	8	$25,500	$204,000
96" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	1884	$591	$1,113,444
108" STORM DRAIN PIPE (w/ CHANNEL GRADING) (cost includes trenching, new pipe, backfill and channel grading)	LF	977	$600	$586,200
10'x6' STORM DRAIN BOX CULVERT (w/o PAVEMENT REPLACEMENT) (cost includes trenching, new box culvert and backfill)	LF	915	$750	$686,250
10'x6' STORM DRAIN BOX CULVERT (cost includes trenching, new box culvert and pavement replacement)	LF	264	$892	$235,488
STORM DRAIN MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	4	$7,000	$28,000
STORM DRAIN BUBBLE-UP/JUNCTION STRUCTURE (bubble-up/transition structure at upstream and downstream side of the channel)	EA	2	$40,000	$80,000
STORM DRAIN TRANSITION STRUCTURE (special structure transitioning from 96" Pipe to 10'x6' Box Culvert in Granite Reef Rd)	EA	1	$35,000	$35,000
STORM DRAIN OUTLET HEADWALL (cost includes, access grate and safety railing)	EA	1	$25,000	$25,000
STORM DRAIN CONNECTION (includes connecting existing 54" Storm Drain to new 10'x6' Storm Drain Box Culvert)	EA	1	$20,000	$20,000
CHANNEL LANDSCAPING REVEGETATION (cost includes, rock lining, irrigation and landscaping existing channel)	SF	36000	$5	$180,000
GRANITE REEF ROAD REPAVING (cost includes subgrade preparation)	SY	1780	$140	$249,200
GRANITE REEF ROAD CUL-DE-SAC CURB & GUTTER (cost includes removal and replacement of existing curb and gutter)	LF	320	$70	$22,400
12-INCH SEWER PIPE (cost includes realigning existing 12-inch Sewer along Granite Reef Road)	LF	1370	$125	$171,250
12-INCH SEWER MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	8	$7,000	$56,000

Sub-Total =	**$3,692,232**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$1,107,670
Construction Sub-Total =	**$4,799,902**
Contingency (20%) =	$959,980
Total =	**$5,759,882**
Design, Construction Administration, Plan Review, Permitting (25%) =	$1,439,970
28.5' Drainage Easement Acquisition Cost (1,500 sq.ft. @ $40 per sq.ft.) =	$60,000.00
Grand Total =	**$7,260,000**

Granite Reef Wash Channel Improvements
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
REMOVE EXISTING CHANNEL LINING (no channel regrading is required)	SF	36000	$5	$180,000
NEW CHANNEL LININING (no channel regrading is required)	SF	36000	$12	$432,000

Sub-Total =	**$612,000**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$183,600
Construction Sub-Total =	**$795,600**
Contingency (20%) =	$159,120
Total =	**$954,720**
Design, Construction Administration, Plan Review, Permitting (25%) =	$238,680
Grand Total =	**$1,200,000**

SRPMIC Section 12 Storm Drain
Budgetary Cost Estimate

Description	Unit	Quantity	Unit Cost	Total Cost
SPECIAL DROP INLET STRUCTURE (cost includes channel grading, access grate and safety railing)	EA	1	$120,000	$120,000
102" STORM DRAIN PIPE (cost includes trenching, new pipe and pavement replacement)	LF	118	$616	$72,688
120" STORM DRAIN PIPE w/o PAVEMENT REPLACEMENT (cost includes trenching, new pipe and backfill)	LF	5153	$550	$2,834,150
STORM DRAIN MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	4	$7,000	$28,000
STORM DRAIN TRANSITION STRUCTURE (special structure at McKellips Road and at Salt River Levee)	EA	2	$60,000	$120,000
15-INCH SEWER PIPE (cost includes realigning existing 15-inch Sewer at McKellips Road)	LF	80	$170	$13,600
15-INCH SEWER MANHOLE (cost includes trenching, backfill and pavement replacement)	EA	1	$7,000	$7,000

Sub-Total =	**$3,195,438**
Removals, Utility Relocation, Surveying, Mobilization and Traffic Control (30%) =	$958,631
Construction Sub-Total =	**$4,154,069**
Contingency (20%) =	$830,814
Total =	**$4,984,883**
Design, Construction Administration, Plan Review, Permitting (25%) =	$1,246,220.82
30' Storm Drain Right-of-Way Acquisition Cost (153,400 sq.ft. @ $15 per sq.ft.) =	$2,301,000.00
Grand Total =	**$8,540,000**

Appendix E: Digital Data

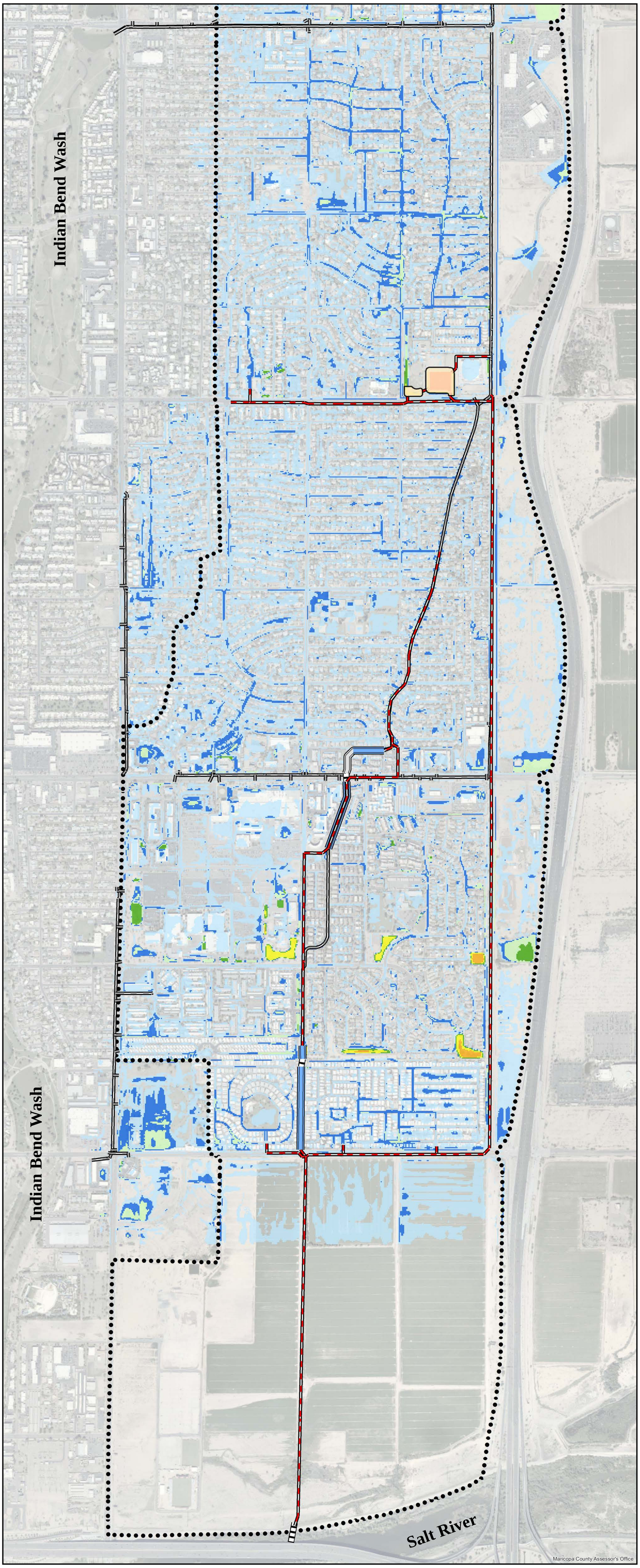
If pdf copy, click below for
Download of Digital Data
Digital Data

[Digital Data CD]

Appendix C: Granite Reef Watershed – CLOMR Results Exhibits

100-yr, 6-hour Model Results With Walls

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

100-YEAR, 6-HOUR

Max Depth Results
With Walls

EXHIBIT D.1-1

N

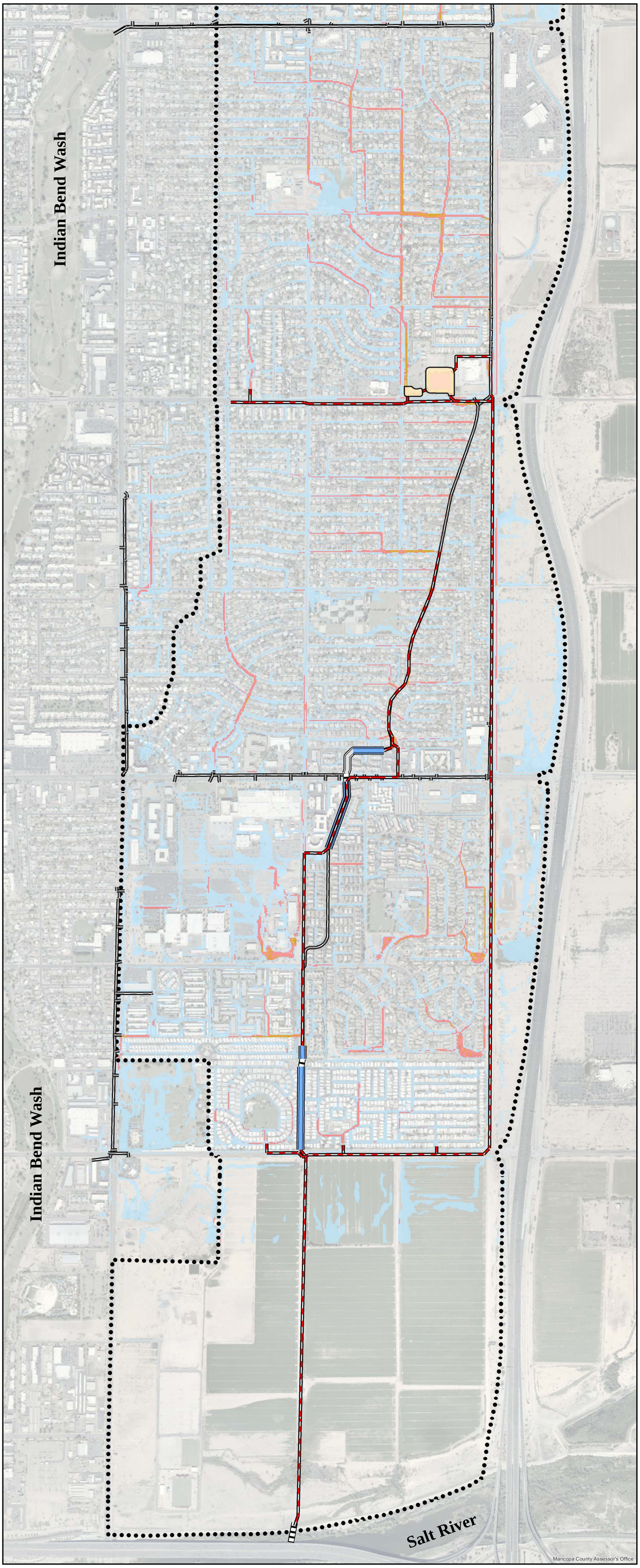
0 1/8 1/4

1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

100-YEAR, 6-HOUR

Max Discharge Results
With Walls

EXHIBIT D.2-1

N

0 1/8 1/4

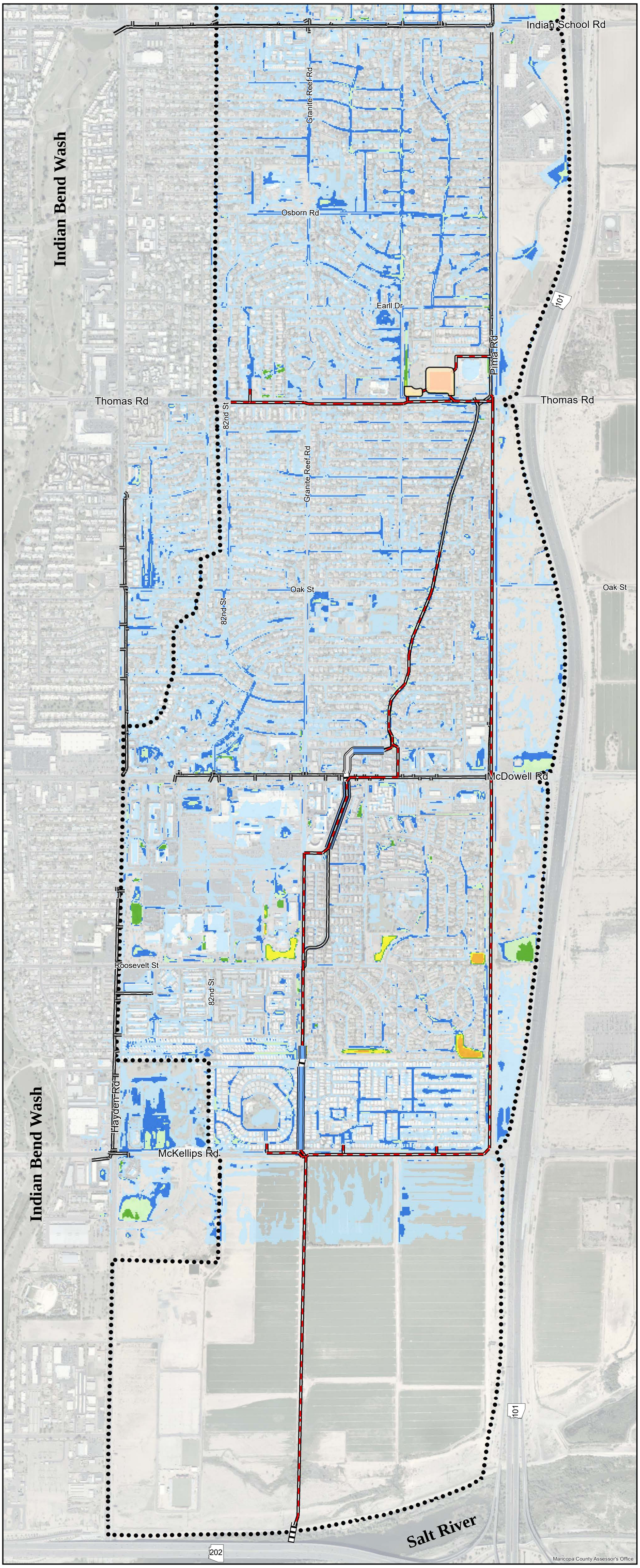
1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

100-yr, 6-hour Model Results Without Walls

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

100-YEAR, 6-HOUR

Max Depth Results
Without Walls

EXHIBIT D.1-2

N

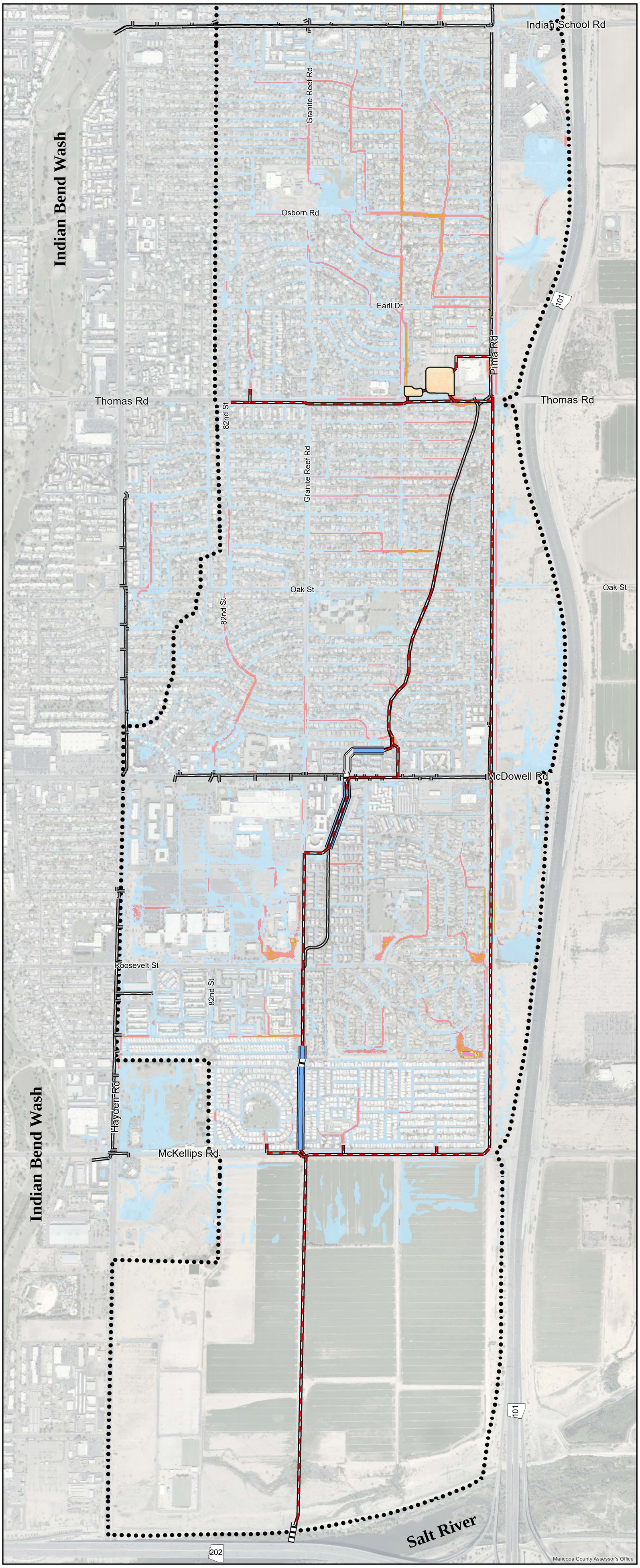
0 1/8 1/4

1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

100-YEAR, 6-HOUR

Max Discharge Results
Without Walls

EXHIBIT D.2-2

N

0 1/8 1/4

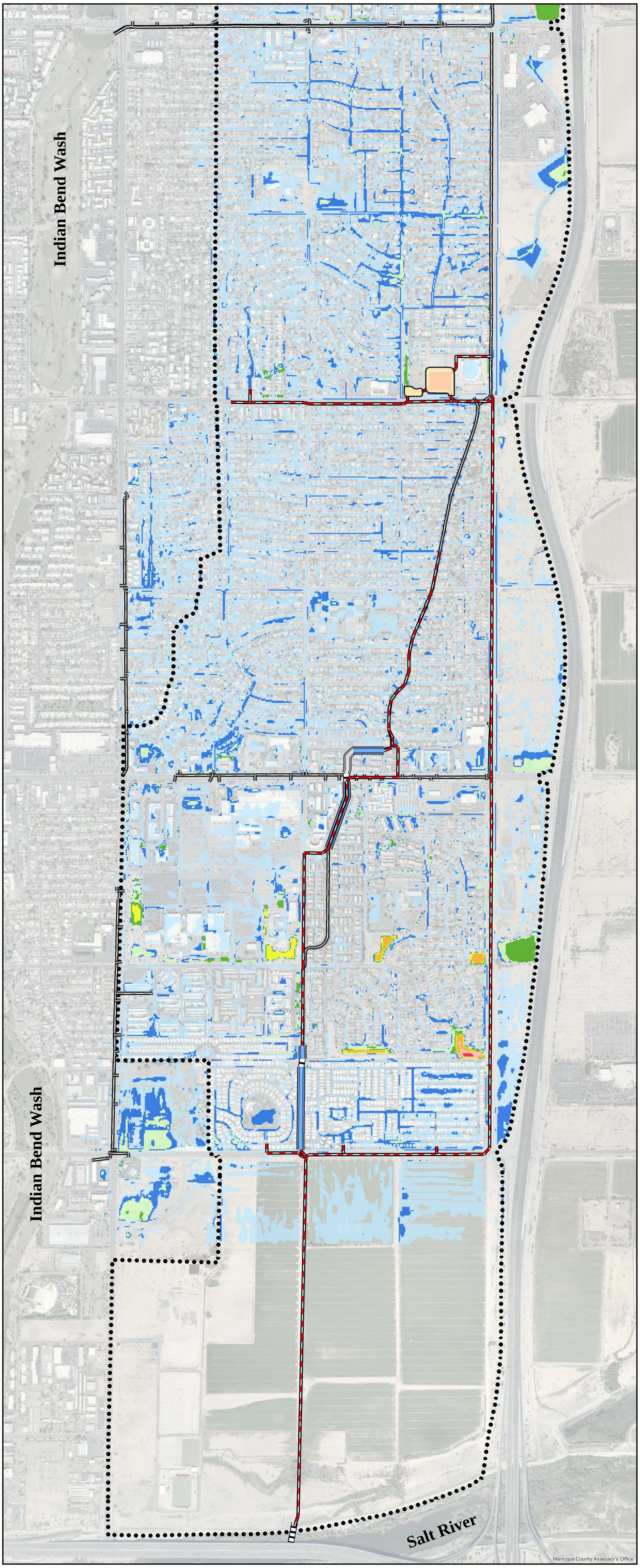
1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

100-yr, 24-hour Model Results With Walls

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

100-YEAR, 24-HOUR

Max Depth Results
With Walls

EXHIBIT D.1-3

N

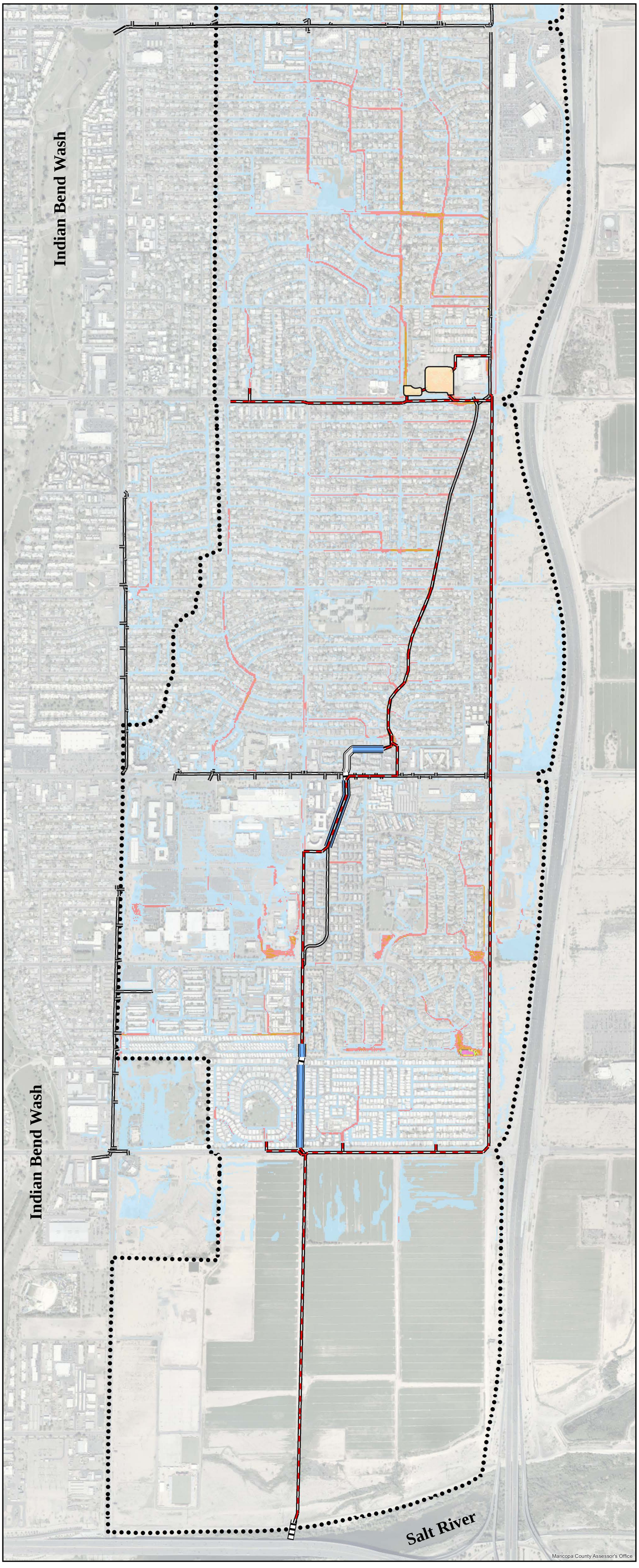
0 1/8 1/4

1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

100-YEAR, 24-HOUR

Max Discharge Results
With Walls

EXHIBIT D.2-3

N

0 1/8 1/4

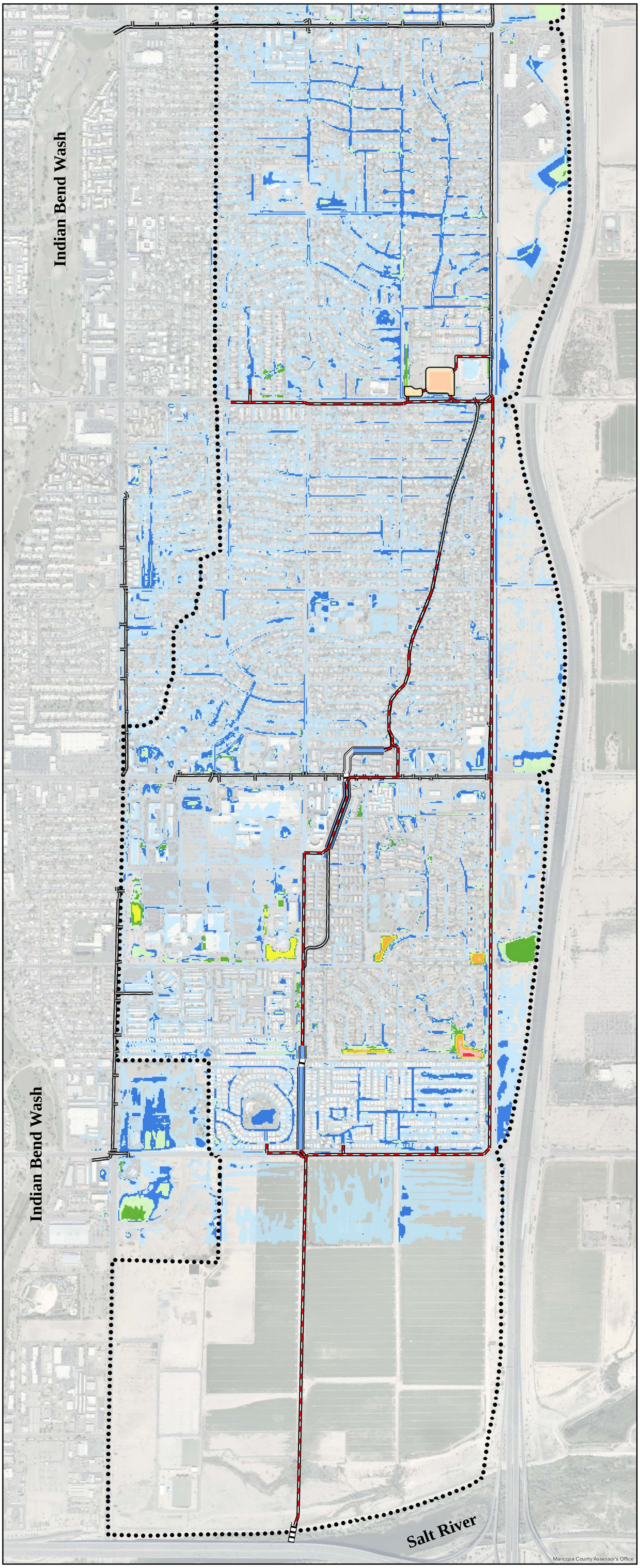
1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

100-yr, 24-hour Model Results Without Walls

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Max Depth (ft)

- 0.04 - 0.10
- 0.11 - 0.50
- 0.51 - 1.00
- 1.01 - 2.00
- 2.01 - 4.00
- 4.01 - 6.00
- 6.01 - 8.00
- 8.01 - 10.00
- 10.01 - 15.00
- 15.01 - 23.99

100-YEAR, 24-HOUR

Max Depth Results
Without Walls

EXHIBIT D.1-4

N

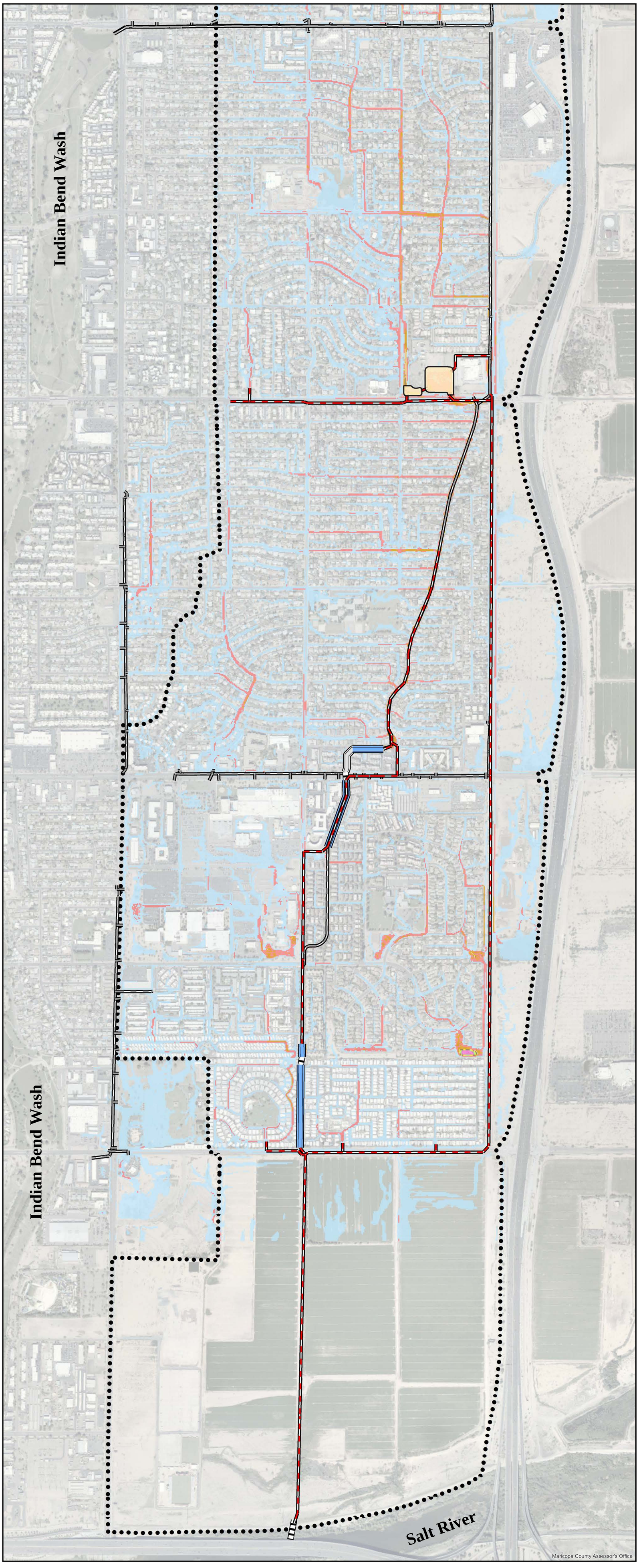
0 1/8 1/4

1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

GRANITE REEF WATERSHED
CLOMR RESULTS EXHIBITS



LEGEND

Existing Drainage Infrastructure

- Existing Drainge Channel
- Existing Culvert
- Existing Storm Drain
- Study Area Boundary

Proposed Drainage Infrastructure

- Proposed Storm Drain
- Proposed Channel Improvements
- Proposed Detention Basin

FLO-2D Results

Peak Discharge (cfs)

- 0.0 - 1.0
- 1.0 - 10.0
- 10.0 - 25.0
- 25.0 - 50.0
- 50.0 - 75.0
- 75.0 - 100.0
- 100.0 - 150.0
- 150.0 - 200.0
- > 200.0

100-YEAR, 24-HOUR

Max Discharge Results
Without Walls

EXHIBIT D.2-4

N

0 1/8 1/4

1 inch = 1/8 miles

Gavan & Barker Inc.
Civil Engineering & Landscape Architecture

CITY OF SCOTTSDALE
ARIZONA

Appendix D: Conditional Zone AE Flood Profiles

FLOOD PROFILE

GRANITE REEF WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SCOTTSDALE, AZ

MARICOPA COUNTY

APPENDIX D

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN MILES (FEET) ABOVE CONFLUENCE WITH SALT RIVER

1214 1210 1206 1202 1198 1194 1190 1186 1182 1178

0.9 (4,752) 1.0 (5,280) 1.1 (5,808) 1.2 (6,336) 1.3 (6,864) 1.4 (7,392) 1.5 (7,920) 1.6 (8,448) 1.7 (8,976) 1.8 (9,504) 1.9 (10,032) 2.0 (10,560) 2.1 (11,088) 2.2 (11,616)

BASE FLOOD ELEVATIONS BASED ON 100-YR, 6-HR STORM EVENT w/ WALLS (RIVER STA: 1.385)

BASE FLOOD ELEVATIONS BASED ON 100-YR, 6-HR STORM EVENT w/o WALLS (RIVER STA: 1.385)

Current Effective W.S. Elevation

SALT RIVER PIMA - MARICOPA INDIAN COMMUNITY (SRP-MIC)

CITY OF SCOTTSDALE

CURRENT EFFECTIVE ZONE 'AE' LIMIT OF DETAILED STUDY

DOWNSTREAM END OF ZONE AE (STORM DRAIN DROP INLET) RIVER STA: 1.053

McKellips Road

Roosevelt Street

Granite Reef Road

Portland Street

Belleview Street

McDowell Road

Salt River Project (SRP) 13'x7.5' Culvert (River STA: 1.29)

McDowell Road 12'x8' Culvert (River STA: 2.11)

84th Place 48" Storm Drain

Granite Reef Wash 108" Storm Drain

Granite Reef Road 96" Storm Drain

Granite Reef Road 10'x6' Concrete Box Culvert Storm Drain

Top of Storm Drain

SECTION 12 120" Storm Drain

McKellips Road 102" Culvert (River STA:1.05)

1.073 1.062 1.106 1.159 1.205 1.240 1.281 1.256 1.270 1.306 1.334 1.345 1.379 1.437 1.501 1.518 1.536 1.581 1.614 1.614 1.799 1.864 1.980 2.083 2.097 2.138 2.156

NOTE:
The Salt River Pima - Maricopa Indian Community (SRP-MIC) does not participate in the National Flood Insurance Program (NFIP).

Floodplain Management Note:
The revised Conditional Letter of Map Revision (CLOMR) Zone AE Floodplain is based on the two-dimensional FLO-2D model which revealed variations in Base Flood Elevations (BFEs) along Granite Reef Wash. The BFEs shown hereon provide a general depiction of the water surface elevations, but it is recommended that the user of this map obtain BFEs from the Maximum Water Surface Elevation (WSELMAX) raster contained in the GIS data. Use of the GIS data will allow for a more accurate determination of the BFE for any given location.

LEGEND

- GOVERNING 1.0% ANNUAL CHANCE W.S. ELEVATION (ZONE AE)
- STREAM BED
- BASE FLOOD ELEV. LOCATION

FLOOD PROFILE

GRANITE REEF WASH

BASE FLOOD ELEVATIONS BASED ON 100-YR, 6-HR STORM EVENT w/o WALLS (RIVER STA: 2.880)

BASE FLOOD ELEVATIONS BASED ON 100-YR, 24-HR STORM EVENT w/o WALLS (RIVER STA: 2.880)

Current Effective W.S. Elevation

Current Effective W.S. Elevation

Coronado Road

Coronado Road

Hubble Street

Hubble Street

Palm Lane

Dianna Drive

Holly Street

Monte Vista Road

Cypress Street

Oak Street

Vernon Avenue

Sheridan Street

Lewis Avenue

Wilshire Drive

Virginia Avenue

Cambridge Avenue

Windsor Avenue

Roanoke Avenue

Edgemont Avenue

Thomas Road

UPSTREAM END OF ZONE AE (MAX DEPTH LESS THAN 1.0 FOOT) RIVER STA: 3.255

2.259 2.281 2.298 2.325 2.359 2.475 2.549 2.626 2.724 2.797 2.896 2.958 3.030 3.122 3.196 3.255

Granite Reef Wash
72" Storm Drain

Low Flow
48" Storm Drain

87th Street
90" Storm Drain

Floodplain Management Note:

The revised Conditional Letter of Map Revision (CLOMR) Zone AE Floodplain is based on the two-dimensional FLO-2D model which revealed variations in Base Flood Elevations (BFEs) along Granite Reef Wash. The BFEs shown hereon provide a general depiction of the water surface elevations, but it is recommended that the user of this map obtain BFEs from the Maximum Water Surface Elevation (WSELMAX) raster contained in the GIS data. Use of the GIS data will allow for a more accurate determination of the BFE for any given location.

LEGEND

- GOVERNING 1.0% ANNUAL CHANCE W.S. ELEVATION (ZONE AE)
- STREAM BED
- BASE FLOOD ELEV. LOCATION

ELEVATION IN FEET (NAVD 88)

1200 1204 1208 1212 1216 1220 1224 1228 1232

2.2 (11,616) 2.3 (12,144) 2.4 (12,672) 2.5 (13,200) 2.6 (13,728) 2.7 (14,256) 2.8 (14,784) 2.9 (15,312) 3.0 (15,840) 3.1 (16,368) 3.2 (16,896) 3.3 (17,424) 3.4 (17,952)

STREAM DISTANCE IN MILES (FEET) ABOVE CONFLUENCE WITH SALT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SCOTTSDALE, AZ

MARICOPA COUNTY

APPENDIX D

Appendix E: Endangered Species Act (ESA) Clearance Letter

Kimley»Horn

June 25, 2021

Mark T. Gavan, P.E.
Gavan & Barker, Inc.
3030 North Central Avenue, Suite 700
Phoenix, Arizona 85012

Re: Endangered Species Act Compliance Letter and Biological Resources Memorandum
Granite Reef Wash
City of Scottsdale and Salt-River Pima Maricopa Indian Community, Maricopa County, Arizona

Dear Mr. Gavan:

The project is located along sections of Thomas Road, Pima Road, McDowell Road, McKellips Road, Granite Reef Road, 87th Street, and the 84th Street alignment in the City of Scottsdale and Salt-River Pima Maricopa Indian Community, Maricopa County, Arizona. The project includes proposed improvements to existing storm drains as well as new storm drains. The project limits primarily consist of existing paved and unpaved roadways, and existing storm drains, but also include Pima Park, the Thomas Water Treatment Facility, a retention basin, and the Granite Reef Wash. The lands surrounding the project limits primarily consist of commercial and residential development, with vacant land and agricultural land east of Pima Road and along the 84th Street alignment.

We have reviewed the threatened and endangered species for this area using the tools from U.S Fish and Wildlife Service (USFWS) and Arizona Game and Fish Department (AGFD). Based upon the USFWS Information for Planning and Consultation (IPaC) list, seven listed threatened, endangered, and candidate species should be reviewed for the project. These species included the California least tern (*Sterna antillarum browni*), Southwestern willow flycatcher (*Empidonax traillii extimus*), yellow-billed cuckoo (*Coccyzus americanus*), Yuma clapper rail (*Rallus longirostris yumanensis*), Sonoran Desert tortoise (*Gopherus morafkai*), roundtail chub (*Gila robusta*), and monarch butterfly (*Danaus plexippus*). The proposed project is not anticipated to impact ESA listed threatened, endangered, or candidate species or their habitat.

The AGFD on-line environmental review tool (OERT) listed American peregrine falcon (*Falco peregrinus anatum*), bald eagle (*Haliaeetus leucocephalus*), and lowland leopard frog (*Lithobates yavapaiensis*) as occurring within three miles of the project. The proposed project is not anticipated to impact any state sensitive species.

Based on report documents and tools used from USFWS and AGFD, as well as a site visit conducted by a qualified biologist on June 9 and 10, 2021, Kimley-Horn confirms that there is no potential for take to occur as a result of the project. Take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct, will not occur to threatened and endangered species as a result of the project.

Also, based upon the threatened and endangered species descriptions from the species list and documented site visit, the project site does not contain the following species or critical habitat for the California least tern, Southwestern willow flycatcher, yellow-billed cuckoo, Yuma clapper rail, Sonoran Desert tortoise, roundtail chub, or monarch butterfly.

Sincerely,

Jennifer Simpkins
Senior Biologist

Attachments:

- Biological Resources Memorandum

June 25, 2021

Mark T. Gavan, P.E.
Gavan & Barker, Inc.
3030 North Central Avenue, Suite 700
Phoenix, Arizona 85012

Re: Biological Resources Memorandum
Granite Reef Wash
City of Scottsdale and Salt-River Pima Maricopa Indian Community, Maricopa County, Arizona

Dear Mr. Gavan:

The project is located along Thomas Road from 82nd Street to Pima Road, along Pima Road from Thomas Road to McDowell Road, along the Pima Road alignment between McDowell Road and McKellips Road, along McKellips Road from the Pima Road alignment to the 84th Street alignment, and along the 84th Street alignment to the Salt River. The project limits also include Granite Reef Road from McKellips Road to McDowell Road, Granite Reef Wash, along 87th Street between McDowell Road and Sheridan Street, and Pima Park. The project includes proposed improvements to existing storm drains as well as new storm drains. The project limits primarily consist of existing paved and unpaved roadways, and existing storm drains, but also include Pima Park, the Thomas Water Treatment Facility, a retention basin, and the Granite Reef Wash. The lands surrounding the project limits primarily consist of commercial and residential development, with vacant land and agricultural land east of Pima Road and along the 84th Street alignment.

Kimley-Horn biologists conducted a site visit on June 9 and 10, 2021 to document onsite conditions. The project limits are primarily urban and agricultural lands that according to Biotic Communities were formerly the Lower Colorado River Subdivision of Sonoran Desertscrub.[1] Vegetation observed within the project limits was primarily landscaped and included velvet mesquite (*Prosopis velutina*), foothill paloverde (*Parkinsonia microphylla*), weeping fig (*Ficus benjamina*), shortleaf pine (*Pinus echinata*), shoestring acacia (*Acacia stenophylla*), palm tree (*Washingtonia* spp.), Mexican sage bush (*Salvia leucantha*), and red yucca (*Hesperaloe parviflora*). Native vegetation included Jerusalem thorn (*Parkinsonia aculeata*), desertbroom (*Baccharis sarothroides*), and cottonwood (*Populus fremontii*).

Wildlife observed in the field included mourning dove (*Zenaida macroura*), white-winged dove (*Zenaida asiatica*), killdeer (*Charadrius vociferous),* Gambel's quail (*Callipepla gambelii*), great-tailed grackle (*Quiscalus mexicanus*), red-tailed hawk (*Buteo jamaicensis*), round-tailed ground squirrel (*Xerospermophilus tereticaudus*), desert cottontail (*Sylvilagus audubonii*), and coyote (*Canis latrans*).

ENDANGERED SPECIES ACT (ESA) SPECIES

SPECIES IDENTIFICATION

Kimley-Horn obtained an official species list for the project area from the U.S. Fish and Wildlife Service (USFWS) Information, Planning, and Consultation (IPaC) system on June 22, 2021 (Consultation Code: 02EAAZ00-2021-SLI-0964). The list included seven threatened, endangered, or candidate species that should be evaluated for the project area. A qualified biologist reviewed the list to determine species that may occur in the project vicinity. Species included in the USFWS list but excluded from further evaluation

[1] Brown, David E. 1994. Biotic Communities. Southwestern United States and Northwestern Mexico.

are addressed in **Table 1**. This project will have no effect on the species listed in **Table 1.** Additionally, there is no federally designated Critical Habitat within the project vicinity.

Table 1 – ESA Species Exclusion Table

Species	Status	Habitat Requirements	Exclusion Justification
		Birds	
California Least Tern (*Sterna antillarum browni*)	ESA LE	Open, bare or sparsely vegetated sand, sandbars, or gravel pits. Exposed flats along shorelines of inland rivers, lakes, reservoirs, or drainage systems at elevations below 2,000 feet.[2]	Suitable habitat for this species is not present in the project area and the project limits are outside the historic, present, and potential distribution range for this species. No individuals were identified in the project vicinity in AGFD species occurrence data.
Southwestern Willow Flycatcher (*Empidonax traillii extimus*)	ESA LE	Dense riparian woodland communities along rivers, streams, lakesides, and wetlands below 8,500 feet elevation. Prefers dense canopy cover. Large volume of understory foliage, and surface water during mid-summer.[2]	Suitable habitat for this species is not present in the project area and the project limits are outside the historic, present, and potential distribution range for this species. No individuals were identified in the project vicinity in AGFD species occurrence data.
Yellow-Billed Cuckoo (*Coccyzus americanus*)	ESA LT	Uses large contiguous patches of multi-layered riparian habitat, such as cottonwood-willow gallery forests along rivers and streams below 6,600 feet in elevation.[2]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.
Yuma Ridgway's (clapper) Rail (*Rallus obsoletus yumanensis*)	ESA LE	Fresh water and brackish marshes, dense emergent riparian vegetation. Requires wet substrate (mudflat, sandbar) with dense herbaceous or woody vegetation for nesting and foraging.[2]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.
		Reptiles	
Sonoran Desert Tortoise (*Gopherus morafkai*)	ESA C	Rocky, steep slopes and bajadas (lower mountain slopes), and in paloverde-mixed cacti associations. Incised washes are important for sheltering in lower elevation habitat.[3] Inter-mountain valleys and basins are used for dispersal.[4]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.

Table 1 – ESA Species Exclusion Table (continued)

Fish			
Roundtail Chub (*Gila robusta*)	ESA C	Cool to warm waters, often occupying the deepest pools and eddies within large rivers and streams at elevations between 1,000 and 7,500 ft.[2]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.
Insects			
Monarch Butterfly (*Danaus plexippus*)	ESA C	Open grasslands and meadows consisting of a variety of flowering plants.[5] Greatly dependent upon the presence of asclepiad flora (milkweeds).[6]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.
Status Definitions: ESA = Endangered Species Act; LE = Listed Endangered, LT = Listed Threatened, C = Candidate			

OTHER FEDERAL AND STATE SENSITIVE SPECIES

SPECIES IDENTIFICATION

Kimley-Horn also accessed AGFD online environmental review tool report (OERT) on June 9, 2021 (Project ID: HGIS-13703). The OERT included three other special status species that should be evaluated for the project limits. Species included in the OERT but excluded from further evaluation are addressed in **Table 2**. This project will have no effect on the species listed in **Table 2.**

Table 2 – Federal and State Sensitive Species Exclusion Table

Species	Status	Habitat Requirements	Exclusion Justification
American Peregrine Falcon (*Falco peregrinus anatum*)	USFWS SC SGCN 1A	Rocky, steep cliffs, primarily near water where prey concentrations are higher. Nests are typically on cliff ledges but can include tall office buildings or bridge abutments.[7] Found at elevations between 400 ft and 9,000 ft.[8]	Suitable habitat for this species is not present in the project area. No individuals were identified in the project vicinity in AGFD species occurrence data.

[2] USFWS. 2016. All Arizona Species.
[3] AGFD. 2015. *Gopherus morafkai*. Unpublished abstract compiled and edited by the Heritage Data Management System, AGFD, Phoenix, AZ. 10 pp.
[4] USFWS. 2015. Species Status Assessment for the Sonoran Desert Tortoise. Version 1.0, September 2015. US Fish and Wildlife Service, Southwest Region, Albuquerque, NM.
[5] USFSW. 2020. Monarch (*Danaus plexippus*) Species Status Assessment Report. V2.1. 96 pp.
[6] Morris, G. M., Kline, C., & Morris, S. M. (2015). Status of *Danaus plexippus* population in Arizona. The Journal of the Lepidopterists' Society, 69(2), 91-107.
[7] USFWS. 2016. All Arizona Species.
[8] AGFD. 2002. *Falco peregrinus anatum*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, AZ. 6 pp

Table 2 – Federal and State Sensitive Species Exclusion Table (continued)

Common Chuckwalla (*Sauromalus ater*)	USFWS SC	Cliffs, boulders, and rocky slopes, as well as lava flows, hillsides, or outcrops. Basking sites and crevices for shelter are important. Elevations between 1,040 and 2,410 ft.[9]	Suitable habitat for this species is not present in the project area.
Lowland Leopard Frog (*Lithobates yavapaiensis*)	USFWS SC SGCN 1A	Habitat generalists, breeding in a variety of natural and man-made aquatic systems, from desert grasslands to pinyon-juniper woodlands at elevations ranging from 480 to 6,200 ft.[10]	Suitable habitat for this species is not present in the project area.
Status Definitions: SC = Species of Concern; BGA = Bald and Golden Eagle Protection Act; SGCN = Species of Greatest Conservation Need (1A, 1B Tiers)			

MIGRATORY BIRD TREATY ACT

Migratory birds may nest on the ground, on structures, or in trees, shrubs, or other vegetation within the project limits. Active nests were observed during the site visit and trees and shrubs suitable for nesting will be removed during construction. The following mitigation measures should be implemented:

- **If clearing, grubbing, or tree/limb removal will take place during breeding season (March 1 to August 31) the Engineer will contact the SRP-MIC Senior NEPA Specialist (480.955.1388) to arrange for a qualified biologist to conduct active nest surveys 10 (ten) days prior to vegetation removal. During the non-breeding season (September 1 to February 31) clearing, grubbing, or tree/limb removal activities are not subject to this restriction.**

- **If active bird nests are identified within the project limits, construction activities will avoid disturbing any active nest. Avoidance areas, if necessary, will be marked in the field with temporary fencing or t-posts with flagging by the approved biologist. The engineer will confer with the SRP-MIC Senior NEPA Specialist (480.955.1388) to determine the appropriate avoidance strategies until the nestlings have fledged from the nest and the nest is no longer active.**

Western burrowing owl (*Athene cunicularia hypugaea*)

The western burrowing owl is listed as a species of concern by the USFWS and they are also protected federally by the Migratory Bird Treaty Act (MBTA) and Arizona state law (ARS Title 17). According to the AGFD, the western burrowing owl utilizes well-drained grasslands, steppes, deserts, prairies, and agricultural lands, often associated with burrowing mammals. Western burrowing owls are known to occupy vacant lots near human habitation, golf courses, or airports.[11]

[9] AGFD. 2009. *Sauromalus ater*. Unpublished abstract compiled and edited by the Heritage Data Management System. Arizona Game and Fish Department, Phoenix, AZ. 8 pp.
[10] AGFD. 2006. *Rana yavapaiensis*. Unpublished abstract compiled and edited by the Heritage Data Management System. Arizona Game and Fish Department, Phoenix, AZ. 10 pp.
[11] AGFD. 2001. *Athene cunicularia hypugaea*. Unpublished abstract compiled and edited by the Heritage Data Management System, AGFD, Phoenix, AZ. 10 pp.

During field reconnaissance, no western burrowing owls or suitable burrows were observed within or adjacent to the project limits; however, there is suitable habitat (vacant lands, agricultural lands and agricultural irrigation canals) within the action area so mitigation measures will be required.

Contractor Responsibilities:

- **Prior to construction, all personnel who will be on-site, including, but not limited to, contractors, Contractors' employees, supervisors, inspectors, and subcontractors shall review the attached "Western Burrowing Owl Awareness" flyer.**
- **If any burrowing owls or active burrows are identified the contractor shall notify the Engineer immediately. No construction activities shall take place within 100 feet of any active burrow.**
- **If the Engineer in cooperation with the SRP-MIC Senior NEPA Specialist (480.955.1388) determines that burrowing owls cannot be avoided, the contractor shall employ a qualified biologist holding a permit from the US Fish & Wildlife Service to relocate burrowing owls from the project area, as appropriate.**

BALD AND GOLDEN EAGLE PROTECTION ACT

The AGFD OERT listed the bald eagle (*Haliaeetus leucocephalus*) as occurring within three miles of the project vicinity. According to AGFD data, the Riverside BA, also known as Riverside Ruin BA, #68 along the Salt River is approximately 500 feet from the project limits (Sabra Tonn, AGFD, pers. comm. 2020). No nests are present in the project limits; therefore, the project will not disturb or result in take of bald or golden eagles.

PROTECTED NATIVE PLANTS

Protected native plants located within the project limits include velvet mesquite, foothill paloverde, and Jerusalem thorn. Native plants will be removed as part of the project; therefore, the following mitigation measure should be implemented.

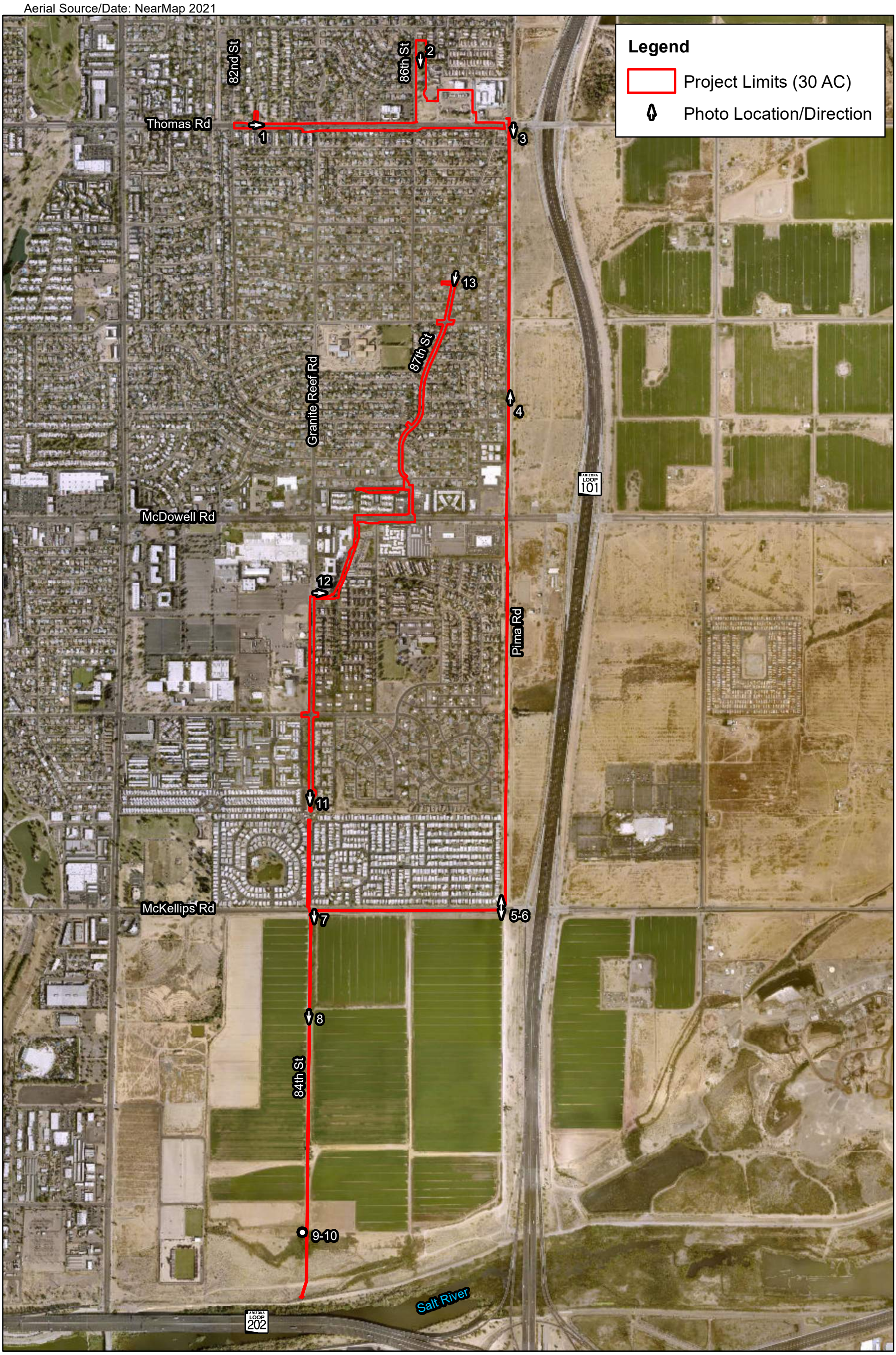
Contractor Responsibility:

- **Protected native plants within the project limits may be impacted by this project; therefore, the contractor will send the notification at least 30 (thirty) calendar days prior to the start of construction.**

Attachments:

- Figure 1. Photo Location Map
- Ground Photographs
- USFWS IPaC
- AGFD OERT
- Western Burrowing Owl Awareness Flyer

Aerial Source/Date: NearMap 2021



Kimley»Horn
Expect More. Experience Better.

Figure 1. Photo Location Map
Granite Reef Wash
Biological Resource Memorandum

0 600 1,200 2,400 Feet
Scale: 1"= 1,200'

N
W E
S

Photo No. 1

View from the project limits looking east along Thomas Road at developed corridor (typical).

Photo No. 2

View from the project limits looking toward Pima Park.

Photo No. 3

View from the project limits at the intersection of Pima Road and Thomas Road, looking south along Pima Road.

Photo No. 4

View from Pima Road north of McDowell Road looking north along agricultural ditch (typical). No burrowing owls or suitable burrows were observed.

Photo No. 5

View from the project limits on McKellips Road looking north along the Pima Road alignment.

Photo No. 6

View from the project limits at the intersection of Pima Road and McKellips Road looking south toward a vacant lot and agricultural fields (typical). No burrowing owls or suitable burrows were observed.

Photo No. 7

View of GRW looking south from McKellips Road.

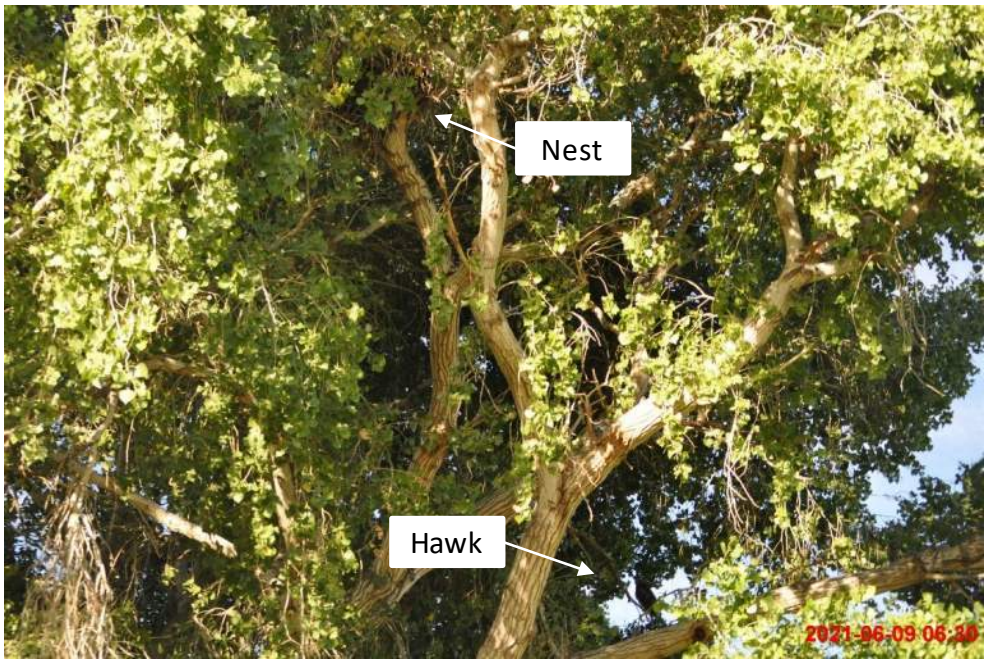
Photo No. 8

View of 84th Street alignment looking south.

Photo No. 9

Red-tailed hawk observed approximately 900 feet north of the levee , 45 feet from the project limits.

Photo No. 10



Red-tailed hawk and nest observed approximately 900 feet north of the levee, 45 feet from the project limits.

Photo No. 11

View from the south end of Granite Reef Road looking south along GRW.

Photo No. 12

View from Granite Reef Road, south of McDowell Road, looking east along retention basin (typical).

Photo No. 13

View from the intersection of 87th Street and Sheridan Street looking south along 87th Street at developed corridor (typical).

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
Phone: (602) 242-0210 Fax: (602) 242-2513
http://www.fws.gov/southwest/es/arizona/
http://www.fws.gov/southwest/es/EndangeredSpecies_Main.html

In Reply Refer To: June 22, 2021
Consultation Code: 02EAAZ00-2021-SLI-0964
Event Code: 02EAAZ00-2021-E-02558
Project Name: Granite Reef Wash Drainage Improvements

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The Fish and Wildlife Service (Service) is providing this list under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). The list you have generated identifies threatened, endangered, proposed, and candidate species, and designated and proposed critical habitat, that may occur within one or more delineated United States Geological Survey 7.5 minute quadrangles with which your project polygon intersects. Each quadrangle covers, at minimum, 49 square miles. In some cases, a species does not currently occur within a quadrangle but occurs nearby and could be affected by a project. Please refer to the species information links found at:
http://www.fws.gov/southwest/es/arizona/Docs_Species.htm
http://www.fws.gov/southwest/es/arizona/Documents/MiscDocs/AZSpeciesReference.pdf .

The purpose of the Act is to provide a means whereby threatened and endangered species and the habitats upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of Federal trust resources and to consult with us if their projects may affect federally listed species and/or designated critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, we recommend preparing a biological evaluation similar to a Biological Assessment to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If the Federal action agency determines that listed species or critical habitat may be affected by a federally funded, permitted or authorized activity, the agency must consult with us pursuant to 50 CFR 402. Note that a "may affect" determination includes effects that may not be adverse and that may be beneficial, insignificant, or discountable. You should request consultation with us even if only one individual or habitat segment may be affected. The effects analysis should include the entire action area, which often extends well outside the project boundary or "footprint." For example, projects that involve streams and river systems should consider downstream effects. If the Federal action agency determines that the action may jeopardize a proposed species or adversely modify proposed critical habitat, the agency must enter into a section 7 conference. The agency may choose to confer with us on an action that may affect proposed species or critical habitat.
Candidate species are those for which there is sufficient information to support a proposal for listing. Although candidate species have no legal protection under the Act, we recommend considering them in the planning process in the event they become proposed or listed prior to project completion. More information on the regulations (50 CFR 402) and procedures for section 7 consultation, including the role of permit or license applicants, can be found in our Endangered Species Consultation Handbook at:
http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF.

We also advise you to consider species protected under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) and the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668 et seq.). The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the Service. The Eagle Act prohibits anyone, without a permit, from taking (including disturbing) eagles, and their parts, nests, or eggs. Currently 1026 species of birds are protected by the MBTA, including species such as the western burrowing owl (Athene cunicularia hypugea). Protected western burrowing owls are often found in urban areas and may use their nest/burrows year-round; destruction of the burrow may result in the unpermitted take of the owl or their eggs.

If a bald eagle (or golden eagle) nest occurs in or near the proposed project area, you should evaluate your project to determine whether it is likely to disturb or harm eagles. The National Bald Eagle Management Guidelines provide recommendations to minimize potential project impacts to bald eagles:
https://www.fws.gov/migratorybirds/pdf/management/nationalbaldeaglenanagementguidelines.pdf
https://www.fws.gov/birds/management/managed-species/eagle-management.php.

The Division of Migratory Birds (505/248-7882) administers and issues permits under the MBTA and Eagle Act, while our office can provide guidance and Technical Assistance. For more information regarding the MBTA, BGEPA, and permitting processes, please visit the following: https://www.fws.gov/birds/policies-and-regulations/incidental-take.php. Guidance for minimizing impacts to migratory birds for communication tower projects (e.g. cellular, digital television, radio, and emergency broadcast) can be found at:
https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/communication-towers.php.

Activities that involve streams (including intermittent streams) and/or wetlands are regulated by the U.S. Army Corps of Engineers (Corps). We recommend that you contact the Corps to determine their interest in proposed projects in these areas. For activities within a National Wildlife Refuge, we recommend that you contact refuge staff for specific information about refuge resources.
If your action is on tribal land or has implications for off-reservation tribal interests, we encourage you to contact the tribe(s) and the Bureau of Indian Affairs (BIA) to discuss potential tribal concerns, and to invite any affected tribe and the BIA to participate in the section 7 consultation. In keeping with our tribal trust responsibility, we will notify tribes that may be affected by proposed actions when section 7 consultation is initiated.

We also recommend you seek additional information and coordinate your project with the Arizona Game and Fish Department. Information on known species detections, special status species, and Arizona species of greatest conservation need, such as the western burrowing owl and the Sonoran desert tortoise (Gopherus morafkai) can be found by using their Online Environmental Review Tool, administered through the Heritage Data Management System and Project Evaluation Program https://www.azgfd.com/Wildlife/HeritageFund/.

For additional communications regarding this project, please refer to the consultation Tracking Number in the header of this letter. We appreciate your concern for threatened and endangered species. If we may be of further assistance, please contact our following offices for projects in these areas:

Northern Arizona: Flagstaff Office 928/556-2001
Central Arizona: Phoenix office 602/242-0210
Southern Arizona: Tucson Office 520/670-6144

Sincerely,
/s/ Jeff Humphrey Field Supervisor

Attachment

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

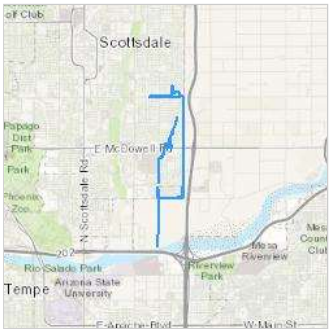
This species list is provided by:

Arizona Ecological Services Field Office
9828 North 31st Ave
#c3
Phoenix, AZ 85051-2517
(602) 242-0210

Project Summary

Consultation Code: 02EAAZ00-2021-SLI-0964
Event Code: 02EAAZ00-2021-E-02558
Project Name: Granite Reef Wash Drainage Improvements
Project Type: STREAM / WATERBODY / CANALS / LEVEES / DIKES
Project Description: Granite Reef Wash Drainage Improvements
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@33.48184465,-111.89572151542376,14z



Counties: Maricopa County, Arizona

Endangered Species Act Species

There is a total of 7 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
California Least Tern *Sterna antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Southwestern Willow Flycatcher *Empidonax traillii extimus* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/6749	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened
Yuma Ridgways (clapper) Rail *Rallus obsoletus [=longirostris] yumanensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3505	Endangered

Reptiles

NAME	STATUS
Sonoran Desert Tortoise *Gopherus morafkai* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9289	Candidate

Fishes

NAME	STATUS
Roundtail Chub *Gila robusta*	Candidate

Population: Lower Colorado River Basin DPS
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2782

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus*	Candidate

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/9743

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Arizona Environmental Online Review Tool Report

Arizona Game and Fish Department Mission
To conserve Arizona's diverse wildlife resources and manage for safe, compatible outdoor recreation opportunities for current and future generations.

Project Name:
Granite Reef Wash Phase II Drainage Improvements

Project Description:
Granite Reef Wash Phase II Drainage Improvements

Project Type:
Water Use, Transfer, and Channel Activities, Water diversion/channelization

Contact Person:
Cheyenne Herzog

Organization:
Kimley-Horn

On Behalf Of:
CONSULTING

Project ID:
HGIS-13703

Please review the entire report for project type and/or species recommendations for the location information entered. Please retain a copy for future reference.

Disclaimer:

1. This Environmental Review is based on the project study area that was entered. The report must be updated if the project study area, location, or the type of project changes.
2. This is a preliminary environmental screening tool. It is not a substitute for the potential knowledge gained by having a biologist conduct a field survey of the project area. This review is also not intended to replace environmental consultation (including federal consultation under the Endangered Species Act), land use permitting, or the Departments review of site-specific projects.
3. The Departments Heritage Data Management System (HDMS) data is not intended to include potential distribution of special status species. Arizona is large and diverse with plants, animals, and environmental conditions that are ever changing. Consequently, many areas may contain species that biologists do not know about or species previously noted in a particular area may no longer occur there. HDMS data contains information about species occurrences that have actually been reported to the Department. Not all of Arizona has been surveyed for special status species, and surveys that have been conducted have varied greatly in scope and intensity. Such surveys may reveal previously undocumented population of species of special concern.
4. HabiMap Arizona data, specifically Species of Greatest Conservation Need (SGCN) under our State Wildlife Action Plan (SWAP) and Species of Economic and Recreational Importance (SERI), represent potential species distribution models for the State of Arizona which are subject to ongoing change, modification and refinement. The status of a wildlife resource can change quickly, and the availability of new data will necessitate a refined assessment.

Locations Accuracy Disclaimer:
Project locations are assumed to be both precise and accurate for the purposes of environmental review. The creator/owner of the Project Review Report is solely responsible for the project location and thus the correctness of the Project Review Report content.

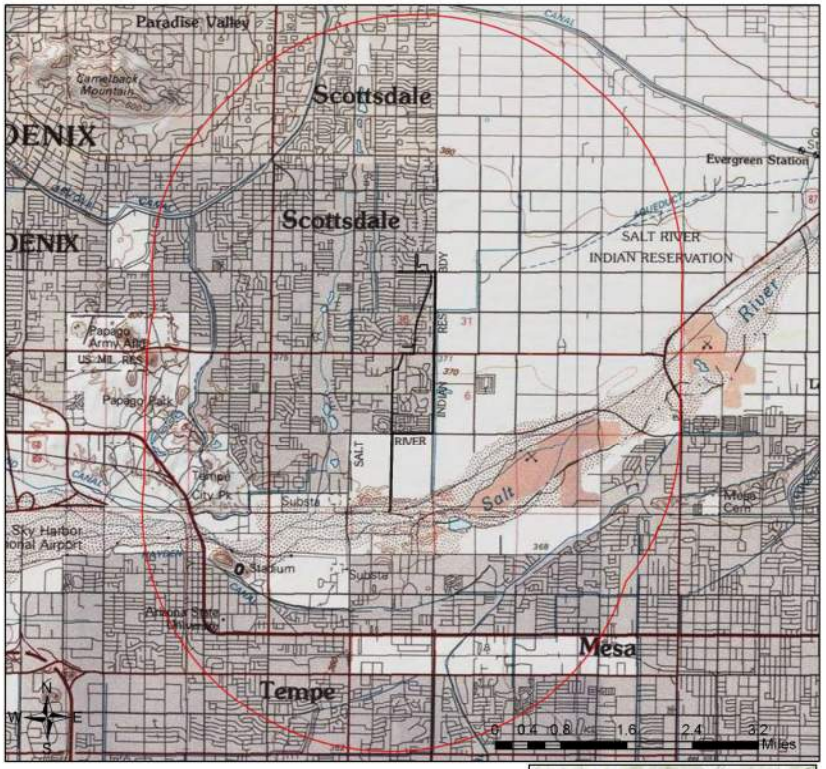
Recommendations Disclaimer:

1. The Department is interested in the conservation of all fish and wildlife resources, including those species listed in this report and those that may have not been documented within the project vicinity as well as other game and nongame wildlife.
2. Recommendations have been made by the Department, under authority of Arizona Revised Statutes Title 5 (Amusements and Sports), 17 (Game and Fish), and 28 (Transportation).
3. Potential impacts to fish and wildlife resources may be minimized or avoided by the recommendations generated from information submitted for your proposed project. These recommendations are preliminary in scope, designed to provide early considerations on all species of wildlife.
4. Making this information directly available does not substitute for the Department's review of project proposals, and should not decrease our opportunity to review and evaluate additional project information and/or new project proposals.
5. Further coordination with the Department requires the submittal of this Environmental Review Report with a cover letter and project plans or documentation that includes project narrative, acreage to be impacted, how construction or project activity(s) are to be accomplished, and project locality information (including site map). Once AGFD had received the information, please allow 30 days for completion of project reviews. Send requests to:
   Project Evaluation Program, Habitat Branch
   Arizona Game and Fish Department
   5000 West Carefree Highway
   Phoenix, Arizona 85086-5000
   Phone Number: (623) 236-7600
   Fax Number: (623) 236-7366
   Or
   PEP@azgfd.gov
6. Coordination may also be necessary under the National Environmental Policy Act (NEPA) and/or Endangered Species Act (ESA). Site specific recommendations may be proposed during further NEPA/ESA analysis or through coordination with affected agencies

Arizona Game and Fish Department
Project ID: HGIS-13703
project_report_granite_reef_wash_phase_ii__43392_44772.pdf
Review Date: 6/9/2021 04:54:21 AM

Granite Reef Wash Phase II Drainage Improvements

USA Topo Basemap With Locator Map



Project Boundary

Buffered Project Boundary

Project Size (acres): 48.93

Lat/Long (DD): 33.4513 / -111.8941

County(s): Maricopa

AGFD Region(s): Mesa

Township/Range(s): T1N, R4E; T1N, R5E; T2N, R4E +

USGS Quad(s): TEMPE

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap

Granite Reef Wash Phase II Drainage Improvements

Web Map As Submitted By User

- Project Boundary
- Buffered Project Boundary

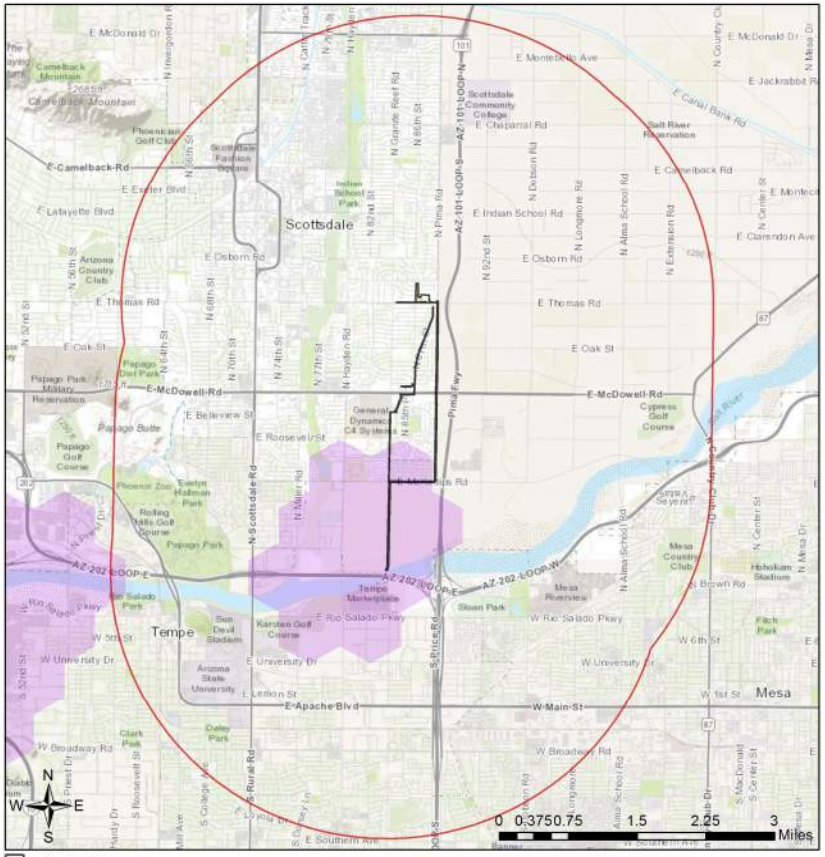
Project Size (acres): 48.93
Lat/Long (DD): 33.4513 / -111.8941
County(s): Maricopa
AGFD Region(s): Mesa
Township/Range(s): T1N, R4E; T1N, R5E; T2N, R4E +
USGS Quad(s): TEMPE

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Arizona Game and Fish Department
Project ID: HGIS-13703
project_report_granite_reef_wash_phase_ii__43392_44772.pdf
Review Date: 6/9/2021 04:54:21 AM

Granite Reef Wash Phase II Drainage Improvements

Important Areas



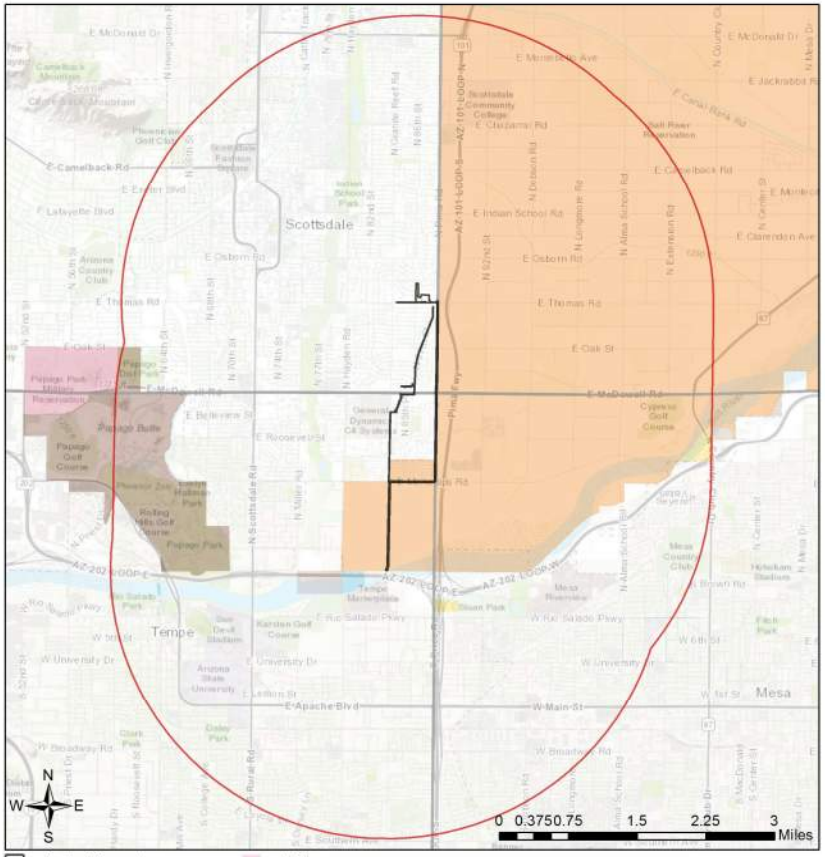
- Project Boundary
- Buffered Project Boundary
- Wildlife Connectivity
- Important Connectivity Zones
- Pinal County Riparian
- Critical Habitat
- Important Bird Areas

Project Size (acres): 48.93
Lat/Long (DD): 33.4513 / -111.8941
County(s): Maricopa
AGFD Region(s): Mesa
Township/Range(s): T1N, R4E; T1N, R5E; T2N, R4E +
USGS Quad(s): TEMPE

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Granite Reef Wash Phase II Drainage Improvements

Township/Ranges and Land Ownership



- Project Boundary
- Buffered Project Boundary
- Township/Ranges

Land Ownership

- AZ Game & Fish Dept.
- BLM
- BOR
- Indian Res.
- Military
- Mixed/Other
- National Park/Mon.
- Private
- State & Regional Parks
- State Trust
- US Forest Service
- Wildlife Area/Refuge

Project Size (acres): 48.93

Lat/Long (DD): 33.4513 / -111.8941

County(s): Maricopa

AGFD Region(s): Mesa

Township/Range(s): T1N, R4E; T1N, R5E; T2N, R4E +

USGS Quad(s): TEMPE

Special Status Species Documented within 3 Miles of Project Vicinity

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Bat Colony						
Falco peregrinus anatum	American Peregrine Falcon	SC	S	S		1A
Haliaeetus leucocephalus (wintering pop.)	Bald Eagle - Winter Population	SC, BGA	S	S		1A
Lithobates yavapaiensis	Lowland Leopard Frog	SC	S	S		1A
Sauromalus ater	Common Chuckwalla	SC				

Note: Status code definitions can be found at https://www.azgfd.com/wildlife/planning/wildlifeguidelines/statusdefinitions/

.

Special Areas Documented that Intersect with Project Footprint as Drawn

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Important Connectivity Zone	Wildlife Connectivity					
Salt River - Saguaro Lake to Gila River	Maricopa County Wildlife Movement Area - Riparian/Wash					
Salt River Pima Maricopa Indian Community	Salt River Pima Maricopa Indian Community					

Note: Status code definitions can be found at https://www.azgfd.com/wildlife/planning/wildlifeguidelines/statusdefinitions/

.

Species of Greatest Conservation Need Predicted that Intersect with Project Footprint as Drawn, based on Predicted Range Models

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Agosia chrysogaster	Longfin Dace	SC		S		1B
Aix sponsa	Wood Duck					1B
Ammospermophilus harrisii	Harris' Antelope Squirrel					1B
Anthus spragueii	Sprague's Pipit	SC				1A
Athene cunicularia hypugaea	Western Burrowing Owl	SC	S	S		1B
Botaurus lentiginosus	American Bittern					1B
Buteo regalis	Ferruginous Hawk	SC		S		1B
Calypte costae	Costa's Hummingbird					1C
Castor canadensis	American Beaver					1B
Catostomus clarkii	Desert Sucker	SC	S	S		1B
Catostomus insignis	Sonora Sucker	SC	S	S		1B
Catostomus latipinnis	Flannelmouth Sucker	CCA		S		1A
Catostomus sp. 3	Little Colorado Sucker	CCA	S	S		1A
Chilomeniscus stramineus	Variable Sandsnake					1B
Chionactis annulata	Resplendent Shovel-nosed Snake	SC				1C
Cistothorus palustris	Marsh Wren					1C
Coccyzus americanus	Yellow-billed Cuckoo (Western DPS)	LT	S			1A
Colaptes chrysoides	Gilded Flicker			S		1B

Species of Greatest Conservation Need Predicted that Intersect with Project Footprint as Drawn, based on Predicted Range Models

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Corynorhinus townsendii pallescens	Pale Townsend's Big-eared Bat	SC	S	S		1B
Crotalus tigris	Tiger Rattlesnake					1B
Cyprinodon macularius	Desert Pupfish	LE				1A
Empidonax wrightii	Gray Flycatcher					1C
Euderma maculatum	Spotted Bat	SC	S	S		1B
Eumops perotis californicus	Greater Western Bonneted Bat	SC		S		1B
Falco peregrinus anatum	American Peregrine Falcon	SC	S	S		1A
Gila elegans	Bonytail Chub	LE				1A
Gila robusta	Roundtail Chub	SC	S	S		1A
Gopherus morafkai	Sonoran Desert Tortoise	C	S	S		1A
Haliaeetus leucocephalus	Bald Eagle	SC, BGA	S	S		1A
Heloderma suspectum	Gila Monster					1A
Incilius alvarius	Sonoran Desert Toad					1B
Ixobrychus exilis	Least Bittern					1C
Kinosternon sonoriense sonoriense	Desert Mud Turtle			S		1B
Lasiurus blossevillii	Western Red Bat		S			1B
Lasiurus xanthinus	Western Yellow Bat		S			1B
Leptonycteris yerbabuenae	Lesser Long-nosed Bat	SC				1A
Lithobates yavapaiensis	Lowland Leopard Frog	SC	S	S		1A
Macrotus californicus	California Leaf-nosed Bat	SC		S		1B
Melanerpes uropygialis	Gila Woodpecker					1B
Melospiza lincolnii	Lincoln's Sparrow					1B
Melozone aberti	Abert's Towhee		S			1B
Micrathene whitneyi	Elf Owl					1C
Micruroides euryxanthus	Sonoran Coralsnake					1B
Myiarchus tyrannulus	Brown-crested Flycatcher					1C
Myotis velifer	Cave Myotis	SC		S		1B
Myotis yumanensis	Yuma Myotis	SC				1B
Nyctinomops femorosaccus	Pocketed Free-tailed Bat					1B
Oreoscoptes montanus	Sage Thrasher					1C
Oreothlypis luciae	Lucy's Warbler					1C
Panthera onca	Jaguar	LE				1A
Passerculus sandwichensis	Savannah Sparrow					1B
Phrynosoma solare	Regal Horned Lizard					1B
Phyllorhynchus browni	Saddled Leaf-nosed Snake					1B
Poeciliopsis occidentalis occidentalis	Gila Topminnow	LE				1A
Ptychocheilus lucius	Colorado Pikeminnow	LE,XN				1A

Species of Greatest Conservation Need Predicted that Intersect with Project Footprint as Drawn, based on Predicted Range Models

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Rallus obsoletus yumanensis	Yuma Ridgway's Rail	LE				1A
Setophaga petechia	Yellow Warbler					1B
Sphyrapicus nuchalis	Red-naped Sapsucker					1C
Spizella breweri	Brewer's Sparrow					1C
Tadarida brasiliensis	Brazilian Free-tailed Bat					1B
Toxostoma lecontei	LeConte's Thrasher			S		1B
Troglodytes pacificus	Pacific Wren					1B
Vireo bellii arizonae	Arizona Bell's Vireo					1B
Vulpes macrotis	Kit Fox	No Status				1B
Xyrauchen texanus	Razorback Sucker	LE				1A

Species of Economic and Recreation Importance Predicted that Intersect with Project Footprint as Drawn

Scientific Name	Common Name	FWS	USFS	BLM	NPL	SGCN
Callipepla gambelii	Gambel's Quail					
Zenaida asiatica	White-winged Dove					
Zenaida macroura	Mourning Dove					

Project Type: Water Use, Transfer, and Channel Activities, Water diversion/channelization

Project Type Recommendations:
During the planning stages of your project, please consider the local or regional needs of wildlife in regards to movement, connectivity, and access to habitat needs. Loss of this permeability prevents wildlife from accessing resources, finding mates, reduces gene flow, prevents wildlife from re-colonizing areas where local extirpations may have occurred, and ultimately prevents wildlife from contributing to ecosystem functions, such as pollination, seed dispersal, control of prey numbers, and resistance to invasive species. In many cases, streams and washes provide natural movement corridors for wildlife and should be maintained in their natural state. Uplands also support a large diversity of species, and should be contained within important wildlife movement corridors. In addition, maintaining biodiversity and ecosystem functions can be facilitated through improving designs of structures, fences, roadways, and culverts to promote passage for a variety of wildlife. Guidelines for many of these can be found at: https://www.azgfd.com/wildlife/planning/wildlifeguidelines/.

Minimize the potential introduction or spread of exotic invasive species, including aquatic and terrestrial plants, animals, insects and pathogens. Precautions should be taken to wash and/or decontaminate all equipment utilized in the project activities before entering and leaving the site. See the Arizona Department of Agriculture website for a list of prohibited and restricted noxious weeds at https://www.invasivespeciesinfo.gov/unitedstates/az.shtml and the Arizona Native Plant Society https://aznps.com/invas for recommendations on how to control. To view a list of documented invasive species or to report invasive species in or near your project area visit iMapInvasives - a national cloud-based application for tracking and managing invasive species at https://imap.natureserve.org/imap/services/page/map.html.

- To build a list: zoom to your area of interest, use the identify/measure tool to draw a polygon around your area of interest, and select "See What's Here" for a list of reported species. To export the list, you must have an account and be logged in. You can then use the export tool to draw a boundary and export the records in a csv file.

Minimization and mitigation of impacts to wildlife and fish species due to changes in water quality, quantity, chemistry, temperature, and alteration to flow regimes (timing, magnitude, duration, and frequency of floods) should be evaluated. Minimize impacts to springs, in-stream flow, and consider irrigation improvements to decrease water use. If dredging is a project component, consider timing of the project in order to minimize impacts to spawning fish and other aquatic species (include spawning seasons), and to reduce spread of exotic invasive species. We recommend early direct coordination with Project Evaluation Program for projects that could impact water resources, wetlands, streams, springs, and/or riparian habitats.

Based on the project type entered, coordination with State Historic Preservation Office may be required (http://azstateparks.com/SHPO/index.html).

Consider incorporating project components that may allow for the inclusion to promote, enhance, create, or restore wildlife habitat. Contact Project Evaluation Program for further information and opportunities, PEP@azgfd.gov or (623) 236-7600 or https://www.azgfd.com/agency/offices/

Based on the project type entered, coordination with Arizona Department of Water Resources may be required (https://new.azwater.gov/).

Based on the project type entered, coordination with U.S. Army Corps of Engineers may be required (http://www.usace.army.mil/)

Based on the project type entered, coordination with County Flood Control district(s) may be required.

Based on the project type entered, coordination with U.S. Fish and Wildlife Service (Fish and Wildlife Coordination Act) may be required (http://www.fws.gov/southwest/es/arizona/).

Project Location and/or Species Recommendations:
Analysis indicates that your project is located in the vicinity of an identified ***wildlife habitat connectivity feature***. The **County-level Stakeholder Assessments** contain five categories of data (Barrier/Development, Wildlife Crossing Area, Wildlife Movement Area- Diffuse, Wildlife movement Area- Landscape, Wildlife Movement Area- Riparian/Washes) that provide a context of select anthropogenic barriers, and potential connectivity. The reports provide recommendations for opportunities to preserve or enhance permeability. Project planning and implementation efforts should focus on maintaining and improving opportunities for wildlife permeability. For information pertaining to the linkage assessment and wildlife species that may be affected, please refer
to: https://www.azgfd.com/wildlife/planning/habitatconnectivity/identifying-corridors/.
Please contact the Project Evaluation Program (pep@azgfd.gov) for specific project recommendations.

HDMS records indicate that one or more **Listed, Proposed, or Candidate** species or **Critical Habitat** (Designated or Proposed) have been documented in the vicinity of your project. The Endangered Species Act (ESA) gives the US Fish and Wildlife Service (USFWS) regulatory authority over all federally listed species. Please contact USFWS Ecological Services Offices at http://www.fws.gov/southwest/es/arizona/ or:

Phoenix Main Office
9828 North 31st Avenue #C3
Phoenix, AZ 85051-2517
Phone: 602-242-0210
Fax: 602-242-2513

Tucson Sub-Office
201 N. Bonita Suite 141
Tucson, AZ 85745
Phone: 520-670-6144
Fax: 520-670-6155

Flagstaff Sub-Office
SW Forest Science Complex
2500 S. Pine Knoll Dr.
Flagstaff, AZ 86001
Phone: 928-556-2157
Fax: 928-556-2121

Analysis indicates that your project is located in the vicinity of an identified ***wildlife habitat connectivity feature***.
The **Statewide Wildlife Connectivity Assessment's Important Connectivity Zones** (ICZs) represent general areas throughout the landscape which contribute the most to permeability of the whole landscape. ICZs may be used to help identify, in part, areas where more discrete corridor modeling ought to occur. The reports provide recommendations for opportunities to preserve or enhance permeability. Project planning and implementation efforts should focus on maintaining and improving opportunities for wildlife permeability. For information pertaining to the linkage assessment and wildlife species that may be affected, please refer
to: https://s3.amazonaws.com/azgfd-portal-wordpress/azgfd.wp/wp-content/uploads/0001/01/23120719/ALIWCA_Final_Report_Perkl_2013_lowres.pdf.
Please contact the Project Evaluation Program (pep@azgfd.gov) for specific project recommendations.

Tribal Lands are within the vicinity of your project area and may require further coordination. Please contact:
Salt River Pima-Maricopa Indian Community
10005 E Osborn Road
Scottsdale, AZ 85256
(480) 850-8000
(480) 850-8014 (fax)

Western Burrowing Owl Awareness

The purpose of this flyer is to provide contractors working on projects with basic knowledge to reduce the risk of incidental take of Western Burrowing Owls.

Legal Status:

Western Burrowing Owls (*Athene cunicularia*) are protected under the Federal Migratory Bird Treaty Act of 1918. All migratory birds and their parts are fully protected. They are also protected under Arizona State Law in Title 17-101, Title 17-235, and Title 17-236.

What to look for:

- Description– small, ground-dwelling owl.
- Length– 19.5-25.0 cm (7.68-9.85 inches)
- Wingspan– 58.42 cm (23.0 inches)
- Mass– about 150 grams
- Males are typically slightly larger than females.
- Round head, lacks ear tufts.
- Distinct oval facial ruff, framed by a broad, puffy white eyebrow.
- Eyes contain a bright yellow iris.

Where are owls found?

- Dry, open, short grass, treeless plains.
- Dependent on fossorial mammals. (ground squirrels, prairie dogs, badgers, etc.) to construct burrows.
- Human dominated landscapes: golf courses, airports, agricultural fields.

Identifying an active burrow:

- Owls use burrows constructed by ground squirrels, badgers, coyotes and tortoises. They can also use pipes, culverts, and ditches.
- Presence of excrement (whitewash) near entrance to burrow.
- Burrowing owls frequently decorate entrance of burrows with cow or horse manure, feathers, vegetation and trash items.

How to avoid them:

- Scan ahead prior to arriving at a sign location.
- If burrowing owls are observed within the project area, stop and move at least 100 feet beyond the owl or occupied burrow before resuming work.

If you think your work may potentially impact a Burrowing Owl or active burrow, please stop.
Move at least 100 feet from the animal or burrow before resuming work.

Source: Arizona Game and Fish Department Animal Abstract: Western Burrowing Owl. Heritage Data Management System

Appendix F: Public Notification Clearance Letter

August 6, 2020

Attention: FEMA Reviewer

Re: Public Notification in Support of the Granite Reef Wash (GRW) Conditional Letter of Map Revision (CLOMR)
Community: City of Scottsdale, AZ
Community No.: 045012

The intent of this letter is to provide justification for the absence of a public notice as part of this Granite Reef Wash (GRW) Conditional Letter of Map Revision (CLOMR).

The proposed floodplain associated with this CLOMR application does not widen the effective floodplain boundary nor increase the effective Base Flood Elevations (BFEs). Therefore, no new properties are mapped into the floodplain nor are there any properties that are otherwise negatively impacted. The proposed floodplain does extend beyond the limits of the current effective floodplain, but the added segment is completely contained within the City of Scottsdale right-of-way; no private property is impacted by the proposed floodplain extension. The current effective GRW floodplain terminates at the Granite Reef Road cul-de-sac approximately 1/5th of a mile south of Roosevelt Street, but there is an existing concrete lined channel south of the cul-de-sac that conveys the GRW flows south to the City boundary at McKellips Road. The proposed conditional floodplain redelineation incorporates the existing concrete lined channel and extends the proposed floodplain boundary south about 1,500 feet to McKellips Road. However, the floodplain is completely contained within the existing channel which is owned and maintained by the City of Scottsdale for the sole purpose of flood control.

Since the proposed floodplain does not map in any new private property or raise the BFEs on any private property, no individual notices, public meetings, or public notices were published in the local newspaper as part of this CLOMR submittal.

If you have any questions please feel free to contact Omer Karovic, PE by email at okarovic@gavanbarker.com or by phone at 602-200-0031 ext. 5 or Mark Gavan, PE by email at mgavan@gavanbarker.com or by phone at 602-200-0031 ext. 3.

Sincerely,
Gavan & Barker, Inc.

Mark T. Gavan, PE
Principal Civil Engineer

Appendix G: Digital Data

If this is a pdf copy of the report:
Click HERE to download the Digital Data

[Digital Data CD]