Engineering Report (Final Draft)

NMSU Main Campus
Storm Drainage Masterplan

New Mexico State University
February 2024

Prepared for:

Prepared by:

New Mexico State University

<u>Main Campus Storm Drainage Master Plan</u>

Draft Report

February 26, 2024

Prepared for:

New Mexico State University

Facilities and Services Department

PO Box 30001, MSC 3545

Las Cruces, New Mexico 88003

Prepared By:

Molzen Corbin & Associates

1155 Commerce Dr #F

Las Cruces, NM 88011

Phone: (575) 522-0049

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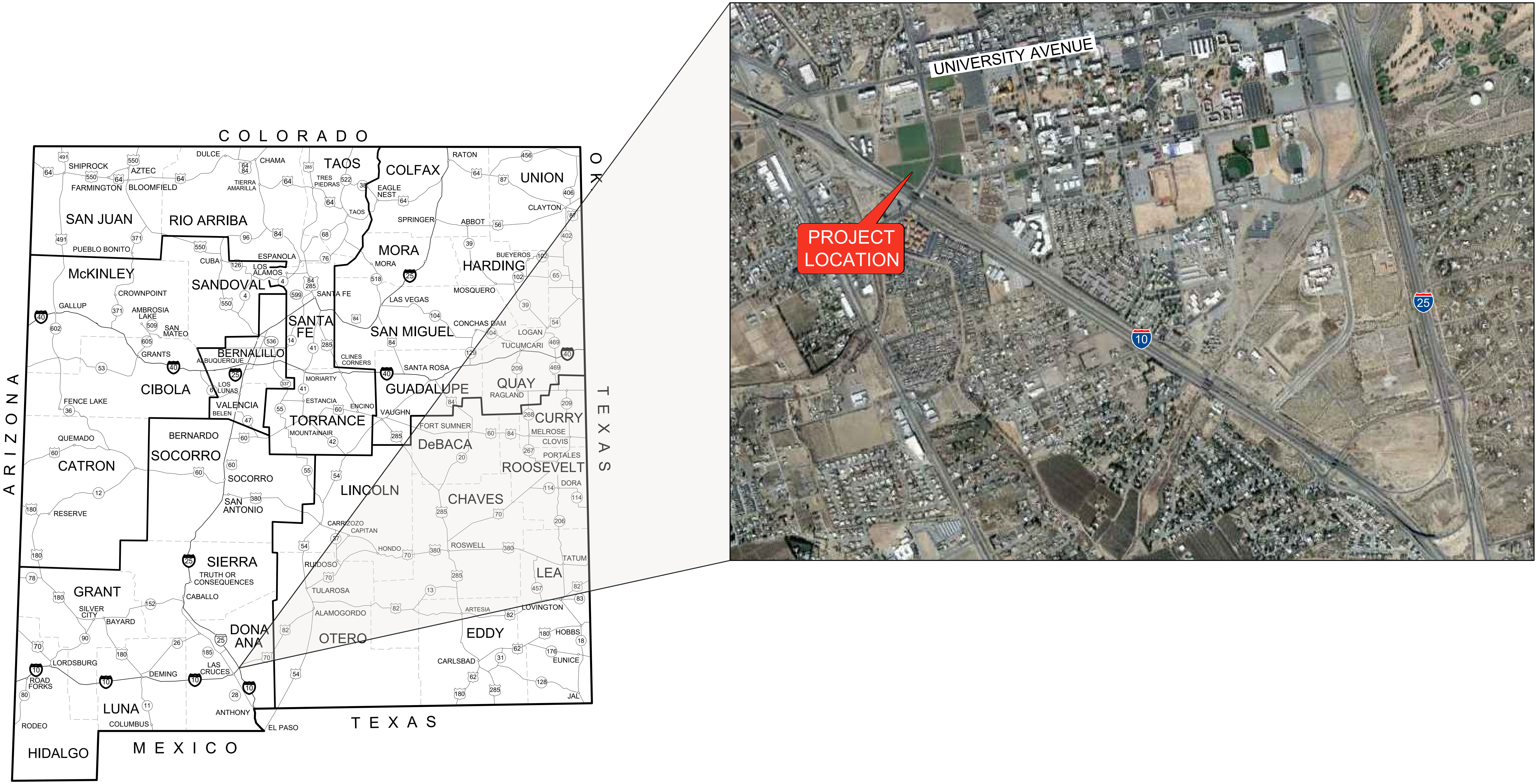
1.0 INTRODUCTION

Since its founding, the infrastructure of New Mexico State University (NMSU) has undergone significant development. As the campus continues to grow, so does the framework needed to support it. With the addition of new buildings, roads, parking lots and various other impervious surfaces, additional drainage infrastructure is required to maintain safe and effective drainage patterns throughout the campus.

Due to aging infrastructure and the campus being within several significant flow paths, there have been a number of drainage issues that warrant concern. Some of these problems have resulted in significant property damage, limitation of access by vehicles due to road flooding, as well as nuisance flows and ponding in various locations. NMSU has conducted Drainage Masterplans in the past, which have addressed these issues; however, as the campus continues to change and expand, a new study is warranted to maintain the integrity of NMSU's current drainage infrastructure and to ensure that the addition of new infrastructure will not significantly alter these drainage patterns.

1.1. Location

New Mexico State University lies between the crossroads of interstate highways I-25 and I-10, as seen in Figure 1-1 below.



Location Map

NEW MEXICO STATE UNIVERSITY DRAINAGE MASTERPLAN

Figure 1-1

2.0 GOALS

The goals set forth in this drainage masterplan are as follows:

1. Analyze existing drainage patterns and structures throughout the main campus (excluding Arrowhead Park) using hydrologic analysis and a comprehensive computer model to replicate various storms.
2. Identify existing drainage issues within the main campus, both visually observed by NMSU's Facilities and Services Team and/or exhibited in the model. Included in this is an assessment of NMSU's current Storm Water Management Program.
3. Provide direction and recommendations for improving the existing areas identified as having drainage issues.
4. Provide overall guidance to aid in the planning of future storm drainage actions and improvements for the next 30 years. Included in this is a prioritization list for short-term and long-term planning.
5. Provide a Capitol Improvements Program (CIP) for storm drainage projects and corresponding cost estimates

3.0 PREVIOUS REPORTS

To accurately provide a comprehensive study of the current drainage conditions at NMSU, previous studies were analyzed and used as references for this report. This is done for numerous reasons, for example: the review of these documents may highlight previously identified problems which may otherwise be overlooked. Naturally, these reports utilize programs that may be considered outdated by todays drainage standards, but the general methodology remains relatively similar and can be used as a reference for this study and for future studies. The previous reports mentioned below can be found in Appendix A.

3.1. NMSU Main Campus Storm Drainage Master Plan

The most significant of these past reports is the Drainage Masterplan (DMP) done for NMSU by Molzen Corbin in 1995. While there are more recent drainage reports that focus on specific sites or issues within NMSU, the 1995 report is the most recent DMP done for the entire campus. This DMP utilized the SCS Type II rainfall storm, with the rainfall amounts for this storm taken from the NOAA Atlas for New Mexico. Two modeling techniques were considered for the 1995 DMP, including HEC-1 and AHYMO. HEC-1, a Flood Hydrograph Package developed by the Army Corps of Engineers Hydrologic Engineering Center, developed hydrology based on SCS methods using SCS curve numbers, drainage areas, and lag times as input for hydrograph development. “AHYMO” is another computer model developed by SCS based off of the program HYMO. AHYMO had been enhanced by engineers in Albuquerque to specifically reflect the conditions of northern New Mexico. It was also used to prepare the 1981 Albuquerque DMP (referenced in the 1995 NMSU DMP). AHYMO was exclusively for projects done under the jurisdiction of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA).

For the 1995 MP, both HEC-1 and AHYMO were used to model NMSU and their respective results compared to determine the best approach. Ultimately, AHYMO was chosen as the ideal model for the master plan due to its superior routing techniques but adjusted to so that peak rates of discharge would represent those from HEC-1 (the peak rates produced by HEC-1 were thought to have reflected the drainage conditions on campus for that time). This allowed for the best parts of both programs to be used.

As the 1995 DMP is the most recent masterplan done for NMSU, it will be referenced in this 2023 master plan for comparison purposes only. While the general methodology of the previous report is consistent with some of the methodology used today, the modeling techniques used are considered outdated for today's standards. For various reasons, including the different modeling programs used and changes in weather patterns, it is expected that the results and conclusions presented in this report will differ from those in the 1995 report.

3.2. NMSU Storm Water Management Program for NPDES General Permit

In 2009 Martich Professional Services prepared at Storm Water Management Program (SWMP) for NPDES General Permit (NO. NMR040000). This document was provided in compliance with Small Municipal Separate Storm Water Systems (MS4s) standards set forth by the Environmental Protection Agency (EPA) in order to effectively reduce the discharge of pollutants to the maximum extent practicable. As NMSU is classified as an MS4 for its main campus (bordered by University Avenue, Interstate Highway 25 and Interstate Highway 10), NMSU must provide a SWMP in order to fulfill the requirements set forth to obtain the permit. The requirements of the SWMP include:

1. Determination that its discharges do not cause or have a reasonable potential to cause or contribute to water quality standards not being met in the waters receiving the discharges;
2. Determination that its discharges do not exceed any Total Maximum Daily Loads of pollutants established for waters receiving the discharges;
3. Determination that its discharges and discharge-related activities do not jeopardize a species listed as endangered or threatened under the Federal Endangered Species Act; and
4. Determination that its discharges and discharge-related activities do not affect a property that is listed or is eligible for listing on the National Register of Historic Places as maintained by the U.S. Secretary of the Interior.

This report serves as documentation that NMSU complies with these requirements and provides details of major aspects of the existing storm water management taking place. These aspects include the water quality standards in place, the control measures taken, the construction site storm water runoff controls, storm water management for future development, and pollution prevention for municipal operations. Also detailed in the document are the expected communications with the public to ensure transparency of the discharges taking place and to provide plans for storm water pollution prevention.

As this report provides detailed inventory of the discharge points, as well as the standards for discharge within campus, it will be used in this report as reference for proposed drainage conditions to ensure the criteria of the 2009 SWMP is met.

3.3. NMSU Auxiliary Services Drainage Concerns

An engineering report detailing the auxiliary drainage concerns for the NMSU campus was developed in 2013 by Parkhill Smith & Cooper Inc. (now Parkhill Inc.). This report evaluated causes of flooding and water damage, provided solutions to alleviate the drainage problems, and provided a cost estimate for the solutions recommended. The calculations used for analysis within this report were done using the Runoff Analysis Method (per Section 32-103 (B) of the City of Las Cruces Design Standards: Urban Drainage Criteria (2005)). There are 22 sections in this report that coincide with the 22 areas of concern around campus. Some of the drainage issued documented within this report have since been addressed, for example the issues around Monagle hall are obsolete considering it has since been demolished and replaced by Juniper Hall which retains its own discharge onsite. Though some issues were eradicated, other drainage issues mentioned are still existing today, such as the ponding that occurs within Cervantes Village.

The 2013 report provides a detailed inventory of the more localized drainage issues occurring at NMSU. While this 2023 masterplan analyzes the larger drainage patterns through campus, there are some outstanding issues detailed in the 2013 report that coincide with some of the larger scale problems occurring today. For this reason, the 2013 report will be used as a reference for those specific issues.

3.4. Arrowhead Park Drainage Study (2020)

The Arrowhead Park Drainage Study was completed by Molzen Corbin for NMSU and the Arrowhead Park development in 2020. It studied the existing and proposed drainage conditions for most of the major flowpaths for the Arrowhead Park portion of the NMSU campus. This included analysis and alternatives for most of the Tortugas Arroyo. An amendment to the report was completed in 2023 by Molzen Corbin for some additional planned development along Arrowhead Dr next to the Burrell College of Osteopathic Medicine. Given the recent nature of the Arrowhead Study, additional analysis and recommendations for that portion of NMSU was not included in this Masterplan.

4.0 <u>EXISTING CONDITIONS</u>

Establishing and analyzing the existing conditions is the first part of any drainage analysis. The results of this research and analysis effort is presented in the following sections.

4.1. FEMA Floodmaps

There are four FEMA floodmaps covering the NMSU main campus area: 35013C1092G, 35013C1094G, 35013C1111G, and 35013C1113G. These can be found in Appendix B. Within the main campus area, there are two areas identified as being inundated by the 1% change storm due to offsite flows moving through. The first, coming from the east as shown in Figure 4-1 below, is the flowpath associated with the Tortugas Arroyo. This flowpath was analyzed as part of the 2020 Arrowhead Drainage report with alternatives for maintaining the conveyance capacity as the area develops. There are currently no structures located within this floodplain.

FIGURE 4-1: FEMA FLOOD ZONES

The second flood zone is associated with the regional floodplain which passes through the western end of the campus. There are several structures located within the floodplain including the Las Cruces Convention Center, the NMSU police department, Skeen Hall, and Wooten Hall. Addressing the impacts of this floodplain may not be feasible and would require a large multi-agency coordination effort beyond the scope of this report.

4.2. Existing Basins

Consistent with the City of Las Cruces area, runoff generated from NMSU's campus generally flows from the East to the West side of campus towards the Rio Grande. Water is conveyed through campus by drainage structures of varying type and size, including culverts, arroyos, and drop inlets.

There is a total of 36 basins analyzed for this report. The basins analyzed are either within or near the main campus and their respective reaches generally contribute to the main flow paths throughout NMSU. These basins can be seen in Figure 4-2 below. Certain basins, specifically those with recent development, have onsite retainage for their generated flows. The runoff from remaining basins contribute to the larger flow paths mentioned in the next section.

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MOLZENCORBIN

NMSU DRAINAGE MASTER PLAN

FIGURE 4-2
EXISTING DRAINAGE CONDITIONS

4.3. Major Flow Paths

As previously mentioned, the runoff from the basins within or around NMSU main campus flow to one of the major flow paths, these flow paths have been determined through topographic mapping, physical investigation, aerial imagery, and historical flow data.

The most notable flow paths within the main campus are listed as follows:

- The Tortugas Arroyo, which conveys the outfall from the Tortugas Arroyo Dam and runs from northeast to southwest through the southeast quadrant of campus.
- College Arroyo, which runs along the east side of campus and conveys water from north of the University Interchange to the Tortugas Arroyo.
- Stewart Street conveys a significant amount of flow from surrounding basins. This has been visually observed and is evident within basin mapping.
- College Drive, which receives runoff directly from Espina Street, International Mall (I-Mall).
- Sam Steel Way receives flow from multiple basins, including some runoff from I-10. This flow moves from the street to a channel along its south side and back to the street at various points before finally entering a short channel on its north side where it eventually discharges into the NMSU Regional Pond.
- University also receives discharge from multiple basins within campus. From University, this flow discharges into the storm drain system that runs from El Paseo, under Union, and eventually discharges into the EBID Park Drain.

Most of the major flow paths listed (and additional smaller flow paths) are exhibited in the model and were used to determine the capacity of various structures throughout campus. Though the Tortugas Arroyo is one of the most notable flow paths, it has already been thoroughly analyzed as a part of the Arrowhead Final Drainage Report done in 2020 by Molzen Corbin (amended for Arrowhead Park in 2023). The arroyo also does not directly run through the urbanized portion of campus; therefore, it was not further analyzed within this report.

4.4. Major Drainage Structures and Conveyances

There are various structures throughout campus that transport the major flows listed in section 2.1, however; there are many flow path conveyances that are not considered drainage structures but were analyzed as such in order to identify any issues that may be occurring.

The most notable conveyances analyzed within this report are listed as follows:

- The basin for Stewart Street is one of the largest basins within campus. Stewart picks up water from various surrounding streets such as Locust Street and Williams Avenue before discharging into the NMSU Regional Pond.
- Wells Street picks up flow from the Cole Village housing development and discharges it onto Sam Steel Way.
- As previously mentioned, College Arroyo runs through campus and conveys a significant amount of flow through various channels. There are multiple structures within the arroyo, most significant being the two concrete culverts that carry the flow under Stewart Street, the channel that runs along the east side of the football practice field, and the storm drain along the westbound lane of Wells Street which discharges to a small reinforces concrete pipe on the other side.
- Frenger Street, between Espina Street and Zhul Library has been reported to convey significant flow in storm events. Frenger discharges flow onto Espina Street.
- As mentioned, Espina Street receives flow from Frenger Street, the International Mall area and from around the Horseshoe. The flow from Espina eventually discharges into the system along College Drive.
- There are multiple drainage structures along College Drive. There is a small pond at the corner of College Drive and Knox Street that has an outfall structure that discharges into a storm drainage system that conveys the flow westward towards Union Avenue.

5.0 DRAINAGE ISSUES AND CONCERNS

The NMSU Facilities and Services department has expressed concern over various drainage issues through campus. These issues are generally on a larger scale (differing from the localized issues outlined in the Auxiliary Services Drainage Concerns document) and come from the larger flow paths mentioned in the previous section. This master plan will provide analysis and recommendations based on the following issues:

- The NMSU Regional Pond is located at the corner of Stewart Street and Union Drive (shown in Figure 5-1 below). This pond receives a substantial amount of flow from campus and is a major discharge point for many basins. In severe weather events the pond has been observed to overflow and release water onto Union Drive. While the pond does have an 18-inch outfall pipe, it has a gate that must be manually opened meaning there is no outfall structure releasing flow during most storm events.

FIGURE 5-1: NMSU REGIONAL POND

- As mentioned, Stewart Street conveys water from one of the largest basins within NMSU. While most of the basin is developed, there are a number of large grass areas including the intramural field and Preciado Park. There is no inlet system along Stewart and it has been observed that the amount of surface flow on Stewart is a potential safety concern for the students and staff and NMSU, specifically within the intersection of Stewart and Espina Street.

FIGURE 5-2: STEWART ST

- College Drive receives flow from Espina Street and International Mall. This flow runs into the small pond at the intersection of Knox Street and College Dr before spilling onto the road and then into the storm drain system along College where it eventually flows into the storm drain system along Union Drive. Currently NMSU has observed that the pond and storm drain along College Dr is not functioning effectively, and large amounts of water are flowing on the surface of the road and various points of ponding along the street in the vicinity of the Police Station.

FIGURE 5-3: FLOODING ON COLLEGE DR (2007)

- There are various points along Arrowhead drive that warrant concern. At the intersection of Arrowhead and Stewart (exhibited below) there is a low water crossing where runoff from the parking lot east of Arrowhead, this crossing is a safety concern for students and staff. In addition to this, there is low point in the road near the intersection of Arrowhead and Wells where significant ponding can result in the road closure.

FIGURE 5-4: PONDING AT ARROWHEAD AND WELLS

- The drop inlet that conveys College Arroyo across Wells Street has been observed to experience capacity issues. As this is a low point in the road, large amounts of water cross on the street instead of flowing into the drop inlet.

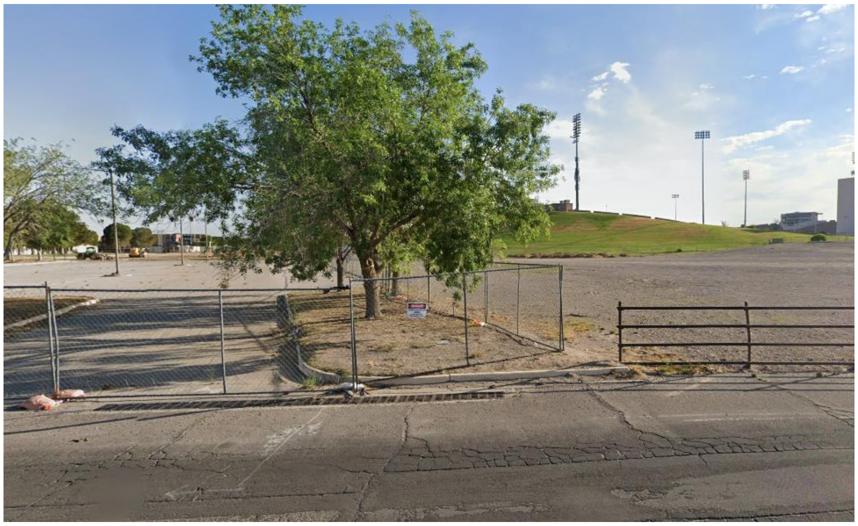

FIGURE 5-5: COLLEGE ARROYO AT WELLS

- Espina Road picks up surface flow from Frenger Street, International Mall and around the NMSU "Horseshoe". Due to limited longitudinal slope in Espina's profile, there are several places where nuisance ponding often occurs.
- Wells St generally has a fairly consistent slope along its length that helps facilitate effective conveyance of water toward Sam Steel Way. However, just before the intersection with Sam Steel the roadway profile experiences a slight dip that results in water ponding across especially the westbound lanes. Figure 5-6: Wells St near Sam SteelFigure 5-6 shows this location, although the flooding was not present at the time the photograph was taken.

FIGURE 5-6: WELLS ST NEAR SAM STEEL

- Sam Steel Way conveys flows that originate from Wells St, Williams St, and I-10 to the NMSU Regional Pond. These flows can accumulate to be quite significant and, due to the bare slopes on I-10, can include a heavy sediment load as well. The roadway itself is a NMDOT facility. But the adjacent channel, shown in Figure 5-7, is within NMSU property. Therefore, any improvements would need to be coordinated with the State.

FIGURE 5-7: SAM STEEL WAY CHANNEL

6.0 HYDROLOGIC ANALYSIS

The methodology used for this MP for the hydrologic and hydraulic analysis was heavily influenced by the methods suggested in the New Mexico Department of Transportation (NMDOT) Drainage Design Manual (DDM). The NMDOT manual provides a comprehensive guide on how to execute a detailed analysis of drainage conditions, typically for roadway improvements. This method is considered to be fairly reliable and widely accepted by engineering entities within the State of New Mexico. The methods described in the DDM are also consistent with those used in the 1995 MP, the major differences being the modeling programs used.

6.1. HEC-HMS

The National Resources Conservation Service Unit Hydrograph Method in HEC-HMS was used to model the existing drainage conditions across campus. This was the preferred method as it allows the complicated routing that occurs between the NMSU watersheds to be exhibited. HEC-HMS requires the input of the following parameters for each basin: drainage basin area, rainfall depth and distribution, time of concentration, lag time, and runoff curve numbers. The model was run using the 50-year and 100-year as the design and check storm. The components for the model were gathered using the methods listed below.

6.2. Watershed Mapping

The drainage basin areas for campus were mapped using topography from 2021 provided by NMSU. The overall basin map can be seen in Figure 4-2.

6.3. Rainfall Data

The rainfall intensity and frequency storm were modeled using rainfall data from the National Oceanic and Atmospheric Administration (NOAA) for the 24-hour duration. This information can be found in Appendix C. The design and the check floods chosen for this analysis were the 50-year and 100-year.

6.4. Time of Concentration

The Time of Concentration (Tc) is the time required for runoff to travel along the longest flow path within the watershed. Generally, the time of concentration equation is chosen based on the characteristics of the watershed. Since most of the basins for NMSU are developed, the Kirpich Method was used to calculate the time of concentrations for most watersheds. This is due to the fact the Kirpich Method is primarily used for basins where channelized flow occurs. Since the area is so heavily developed, it is expected and observed that most of the flow occurring is gullied.

The basic equation for the Kirpich Formula method is as follows:

$$T_c = 0.0078 \times L^{0.77} \times S^{-0.385} \quad (minutes)$$

where L is the length of the flow path (ft) and S is the average slope (ft/ft) of the flow path.

Although most basins could be analyzed using the Kirpich Method, some of the basins required the use of the Upland Method. The Upland method was used for the basins in which significant gullying was not apparent.

The equation for the Upland Method is as follows:

$$T_t = \frac{L}{3600 * V}$$

In which T_t is the travel time (hr), L is the flow length (ft), V is the average velocity (ft/s), and 3600 is the conversion factor from seconds to hours.

For this method, Tc is the sum of the travel time T_t values for the various consecutive flow segments.

Complete Time of Concentration calculations can be found in Appendix D.

6.5. <u>Lag Time</u>

The Lag Time for a basin is the time between the centroid of the runoff and the peak of the runoff hydrograph. Lag Time can be derived from the Time of Concentration with the following formula:

$$Lag = .6 * T_C \ (minutes)$$

6.6. <u>Soil Data and Curve Numbers</u>

The hydrologic soil group classifications of the watersheds within the project area were collected from the NRCS Web Soil Survey online. This soil data, as well as the United States Department of Agriculture (USDA) Urban Hydrology for Small Watersheds Manual, was used to determine the Curve Number (CN) for each individual basin. The Unit Hydrograph Methods Curve numbers are dependent on soil type and ground cover for the drainage area.

The Curve Number for each basin that can found in Appendix E

6.7. <u>Hydrologic Analysis Results</u>

The HEC-HMS model was ran using the components mentioned. The model then provided a peak flow and volume for each basin. The hydraulic elements of interest were modeled as individual reaches, with a peak flow rate given for each reach. The results of the analysis for the hydraulic elements of interest can be seen in Table 6-1 below. The data for each basin and reach can be found in Appendix F.

Table 6-1: Hydrologic Analysis Results

Drainage Structure Name	Description	Total Drainage Area	Q10	Q100	V10	V100
		ac	cfs	cfs	ac-ft	ac-ft
Arrowhead Stewart to Wells	Street Flow	23.41	15	28	0.8	2.0
College Arroyo	Arroyo	81.27	117	203	12.0	26.0
College Arroyo Inlet	Drop Inlet	81.27	123	222	12.8	28.6
College Dr	Street Flow	46.21	80	158	6.9	155.8
Espina Street	Street Flow	38.77	29	65	2.4	5.9
Frenger	Street Flow	35.69	35	75	2.4	6.0
I-Mall	Street Flow	38.51	53	102	4.5	9.9
NMSU Regional Pond	Pond	411.622	273	606	26.4	65.3
Stewart Street	Street Flow	172.13	56	169	6.4	20.3
Sam Steel Way	Street Flow	134.23	130	260	11.8	26.6
Union Storm Drain	48" RCP	52.84	88	177	8.3	18.3
Wells Street	Street Flow	38.71	45	86	3.8	8.3

7.0 HYDRAULIC ANALYSIS

There are many runoff conveyances within campus, the most notable being the street flow that occurs on various streets and the flow through inlets and culverts. For the major flow paths listed in section 2.3, hydraulic analyses were done on the significant structures within the path. The methods used for the hydraulic analyses of this project are described below.

7.1. Hydraulic Methodology

Various methods were used to analyze the capacities of the critical flowpaths for this report. For street flows, the Federal Highway Administration's Hydraulic Toolbox was used to determine the conveyance capacity before the water overtops the curb or the street becomes unnavigable, whichever is less.

For culvert crossings, the FHWA's HY-8 culvert analysis software was used to determine the capacity before the headwater overtops the roadway crest.

Storage capacity was determined using the existing topography and Civil 3D if necessary.

7.2. Hydraulic Results

For the street flow that occurs on campus, the Federal Highway Administration Hydraulic Toolbox was used to analyze the capacity before water overtops the curb. For street flows, the estimated roadway cross section was used with the capacity being limited by the depth at the curb or the depth at which the street cannot be navigated safely, whichever was less. The results from Hydraulic Toolbox for the conveyances being analyzed can be seen in Table 7-1.

Table 7-1: Hydraulic Analysis Results

Drainage Structure Name	Description	Estimated Capacity	10-yr*	100-yr*
College Arroyo Inlet Across Wells St	Low Water Crossing	None	117 cfs	203 cfs
Espina Street	Street Flow	74 cfs	31 cfs	65 cfs
Frenger	Street Flow	85 cfs	35 cfs	75 cfs
Stewart Street	Street Flow	66 cfs	56 cfs	169 cfs
Wells Street	Street Flow	154 cfs	45 cfs	86 cfs
College Dr	12" Culvert	7 cfs	80 cfs	158 cfs
Sam Steel Way	Channel + Street Flow	138 cfs	130 cfs	260 cfs
Sam Steel Driveway Culvert	(2) 18" Culverts	21	130 cfs	260 cfs
NMSU Police Station Pond	Pond	4 ac-ft	0.27 ac-ft	0.64 ac-ft
Frenger St Pond	Pond	4 ac-ft	1.6 ac-ft	2.9 ac-ft
NMSU Regional Pond	Pond	18 ac-ft	26 ac-ft	65 ac-ft

*yellow indicates demand beyond the available capacity

As shown in the table, there are several street conveyances that are deemed insufficient for handling both the design (50-year) and the check flood (100-year). This can be attributed to several factors including the lack of drainage infrastructure along the roadways and a general increase of impervious area since the design of these roadways. The following points discuss the areas shown as lacking sufficient capacity.

- The results for the College Arroyo crossing Wells St show that the inlet at that location (see Figure 5-5) is likely intended for the adjacent parking lot rather than the arroyo flows. Therefore, this is functionally a low-water crossing for the Arroyo over Wells.
- Stewart St has capacity for the 10-yr storm, but the 100-yr is expected to overtop the curb at certain locations.
- College Drive's existing storm drain is significantly undersized for the expected demand. This results in the ponding and flooding that has often been reported in the vicinity of the NMSU Police Station.
- The results for Sam Steel Way include the capacity of the street plus the capacity of the adjacent channel since both elements convey flows. Both together meet the demand for the 10-yr storm, but fail the 100-yr. This computed capacity is for the eastern half of the

channel where the cross section is about 18-ft wide compared to the western half where it is nearly 30-ft wide.

- There are two driveway culverts crossing the Sam Steel Way channel. Both appear to be significantly undersized. As a result, water may be pushed from the channel into the roadway creating a point where the road experiences more flooded conditions prior to water being able to reenter the channel.
- The NMSU Regional Pond does not have the required storage capacity given its current condition and operation to contain either the 10-yr or 100-yr storm. Note that this analysis considers the pond to be functionally without an outfall since current policy requires the outfall to be opened by hand following permission from the City of Las Cruces.

8.0 DRAINAGE IMPROVEMENTS

The proposed drainage improvements outlined in this masterplan will focus on the issues identified in Section 4.3 relating the major flowpaths through the campus. Minor drainage improvements identified in the 2013 Parkhill Report will not be duplicated in this section.

8.1. Maintenance Recommendations

There are several existing drainage systems that, over the course of the site visits performed for this study, were observed to be in need of maintenance. Generally, it is expected that all drainage infrastructure requires maintenance over time to ensure the systems efficiency. It is recommended that a complete inventory and maintenance plan for the campus's drainage infrastructure be completed. Critical elements related to the major flowpaths would benefit from an annual inspection prior to the summer monsoon season to ensure they can operate effectively. These include:

Table 8-1: Maintenance Recommendations

Drainage Structure Name	Observed Condition	Recommendation
College Arroyo	No issues observed	Annual inspection of roadway crossings to ensure culverts are not obstructed
College Dr	Pond, inlets, culverts found to be clogged	Annual inspection of pond, inlets, and culverts to remove sediment and obstructions. Elevation rod in pond to establish normal design bottom.
NMSU Police Station Pond	No issues observed	Annual inspection of pond, to remove sediment and obstructions. Elevation rod in pond to establish normal design bottom.
Frenger St Pond	No issues observed	Annual inspection of pond, to remove sediment and obstructions. Elevation rod in pond to establish normal design bottom.
Stewart Street	No issues observed	Annual inspection of inlet and culvert leading to the regional pond to remove sediment and obstructions.
Sam Steel Way Channel	Sediment and debris in channel	Annual inspection of channel leading to the regional pond to remove sediment and obstructions.
NMSU Regional Pond	Significant sedimentation reducing capacity.	Annual inspection of pond, to remove sediment and obstructions. Elevation rod in pond to establish normal design bottom.

8.2. Storage Capacity Recommendations

The most significant storage capacity issue facing the NMSU Main Campus is the lack of capacity at the NMSU Regional Pond. Currently, the pond has an estimated capacity of 18 ac-ft. However, according to the hydrologic analysis the total volume entering the pond for a 100-yr storm is approximately 65 ac-ft. Therefore, the demand is over three times the current capacity. These results are validated by reports of Stewart St and Wells St flooding during large storm events.

While the total volume reaching the pond is 65 ac-ft, NMSU is permitted to discharge a certain amount of historical flow. For the purposes of this report, it is assumed that the runoff volume exceeding the originally designed capacity of the NMSU Regional Pond is considered the historic discharge volume. As-built drawings and reports from NMSU Facility Staff indicate that the original storage capacity of the pond was 30 ac-ft.

If it is possible to expand the storage capacity beyond the 30 ac-ft demand, any additional storage could be used to account for runoff generated by future impervious services such as new buildings or parking areas. The following recommendations will explore several options for reaching or exceeding the 30 ac-ft benchmark.

8.2.1. Storage Alternative 1: Restore the NMSU Regional Pond

The first and most easily achievable recommendation is to excavate the sedimentation in the NMSU Regional Pond. Record Drawings indicate that the original storage volume was approximately 30 ac-ft. By simply re-excavating the pond to restore the original intended capacity, the existing pond has the capacity to meet the 10-year storm demand. Additionally, there is the potential for collaboration with the City of Las Cruces and/or the New Mexico Department of Transportation in these maintenance efforts since the pond receives water and sediment from their facilities as well. Figure 8-1 shows a plan and profile view of how this alternative may look.

Estimated Construction Cost: $763,357.50

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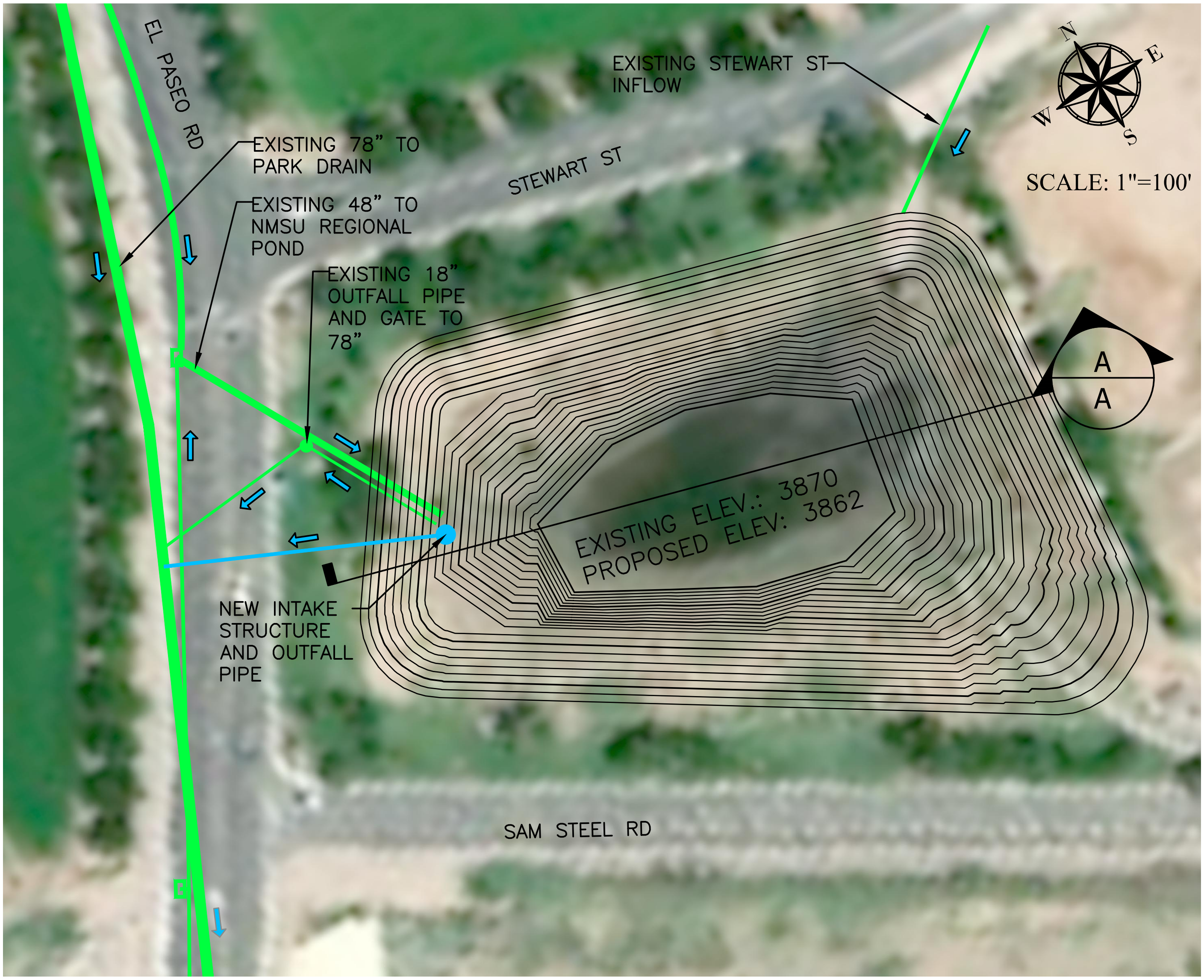
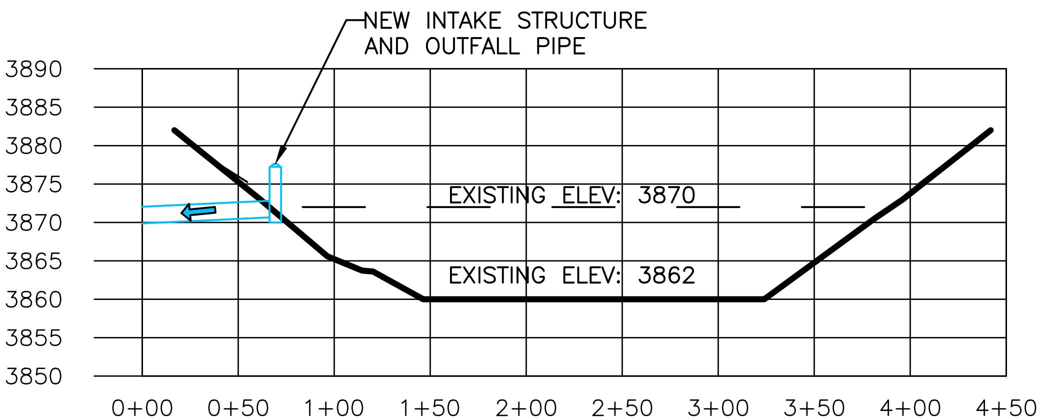


1 NMSU REGIONAL POND IMPROVEMENTS PLAN



A NMSU REGIONAL POND IMPROVEMENTS SECTION

NMSU DRAINAGE MASTERPLAN

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FIGURE 8-1
REGIONAL POND IMPROVEMENTS

8.2.2. Storage Alternative 2: Construct Automatic Outfall for the NMSU Regional Pond

The existing outfall for the NMSU Regional Pond is an 18” pipe with a valve that must be manually opened with permission from the City of Las Cruces so that it can discharge into the City’s 78” culvert in Union. As a result, during large storms the pond can fill quickly due to the lack of an automatic outfall.

According to preliminary conversations with City of Las Cruces Public Works engineers, if it could be demonstrated that having an automatic outfall structure does not negatively impact the operations of the 78” Union storm drain, it is possible that NMSU could be allowed to install such a structure at the NMSU Regional Pond.

This automatic outfall would have to be designed with an elevated outfall structure to ensure that the pond would not be able to release water until the peak for the 78” Union storm drain has dissipated. Figure 8-1 shows a plan and profile view of how this alternative may look.

Estimated Construction Cost: $128,573.39

8.2.3. Storage Alternative 3: Cole Village Pond

According to NMSU Facilities Staff, Cole Village, located at the intersection of Wells St and Espina St, is to be demolished. While there are several other potential plans for the newly available real estate, this would also be an excellent location for a new regional pond to supplement the NMSU Regional Pond at Sam Steel. There is currently approximately 8 ac-ft of water volume on Wells and Sam Steel for the 100-yr storm that could be intercepted at this location. A one acre pond approximately 8-ft deep (8 ac-ft) would capture the entirety of these flows and reduce that demand on the NMSU Regional Pond. Figure 8-2 shows how a pond at Cole Village may look.

Estimated Construction Cost: $867,140.95

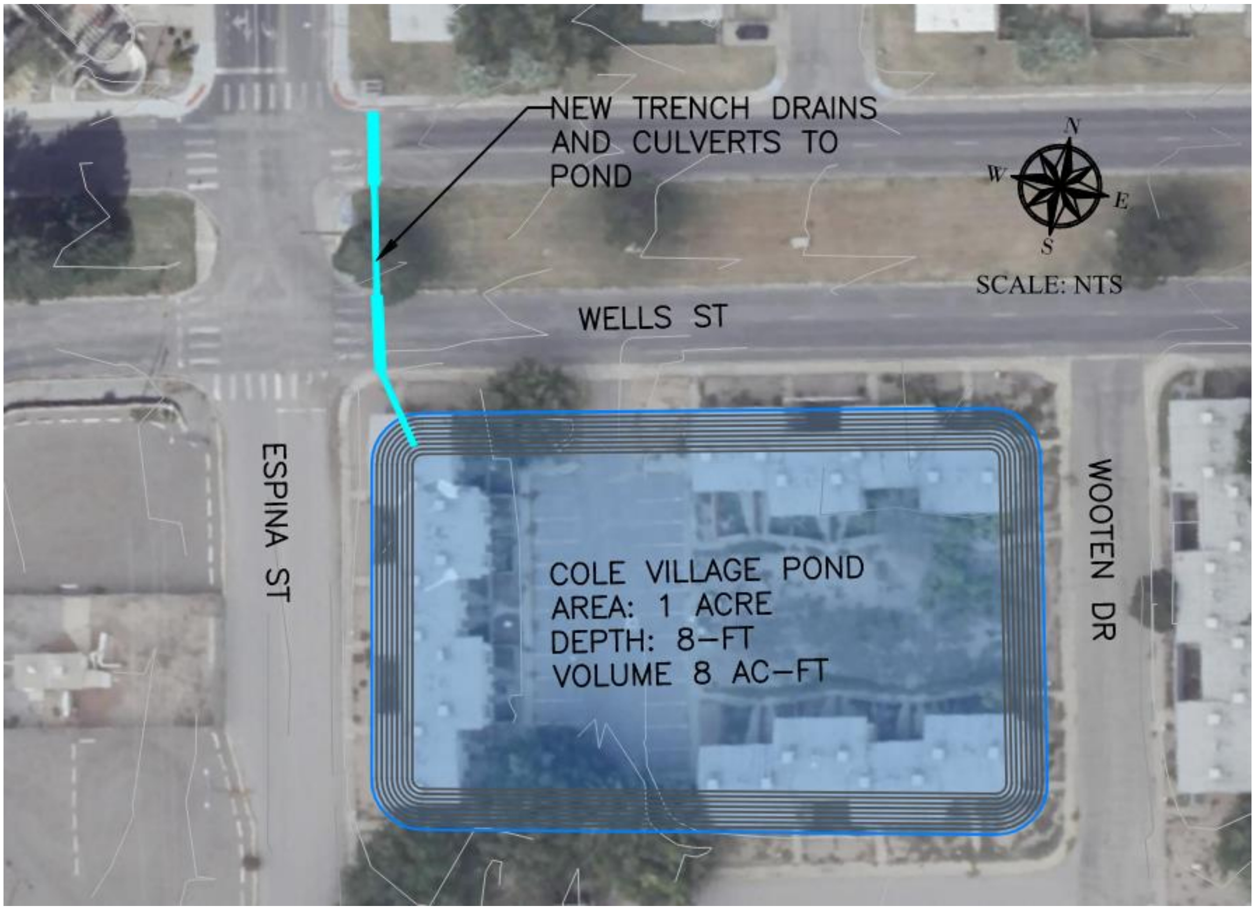

FIGURE 8-2: COLE VILLIAGE POND

8.2.4. Storage Alternative 4: Central Heating Plant Underground Storage

According to NMSU Operations Staff, the 3 million gallon underground water storage facility at the Central Heating Plan is no longer needed for its original purpose and could potentially be converted into a storm water storage facility. This would equate to approximately 8 ac-ft of storage. Further investigations will be needed to determine the feasibility of this alternative.

The alternative would depend on the installation of storm drain in Stewart Street. The storm drain would divert into the Central Heating Plan Underground Storage. Once the underground storage reaches capacity, the water would automatically continue discharging down the Stewart St storm drain. Naturally, several modifications to the facility would be needed to accommodate this new purpose. Figure 8-3 shows a layout of this alternative.

Given the greater depth of the underground storage facility relative to the proposed storm drain in Stewart, the water in the underground storage facility would not be able to drain by gravity. Several options could be explored for draining the stored water. The simplest option would be to install sump pumps to pump the water back into the Stewart storm drain once the storm peak has passed. This option would enable the facility to provide the temporary storage needed, but it would not directly gain any advantage from the stored water.

A second alternative, if the soil conditions are conducive to percolation, would be to drill drainage wells in the bottom of the storage facility to allow the water to slowly infiltrate over time, recharging the aquifer. This would enable NMSU, who's water supply is dependent on the aquifer below, to extend the viability of this crucial natural resource. Additionally, this option would not require electricity consumption to remove the water from the storage facility.

Another sustainable option would be to install pumps that could be connected to the irrigation systems in nearby green spaces such as Preciado Park or the Horseshoe Park. This would require some sort of treatment process within the storage facility to ensure sediment and debris do not enter the system, as well as measures to prevent contamination of the potable water system currently feeding the irrigation systems. The benefit of this option would be to utilize the stored stormwater to reduce the water demand. One large storm in July could have the potential to fully irrigate one of the nearby parks for the remainder of the summer months.

Estimated Construction Cost (pump option): $849,056.05

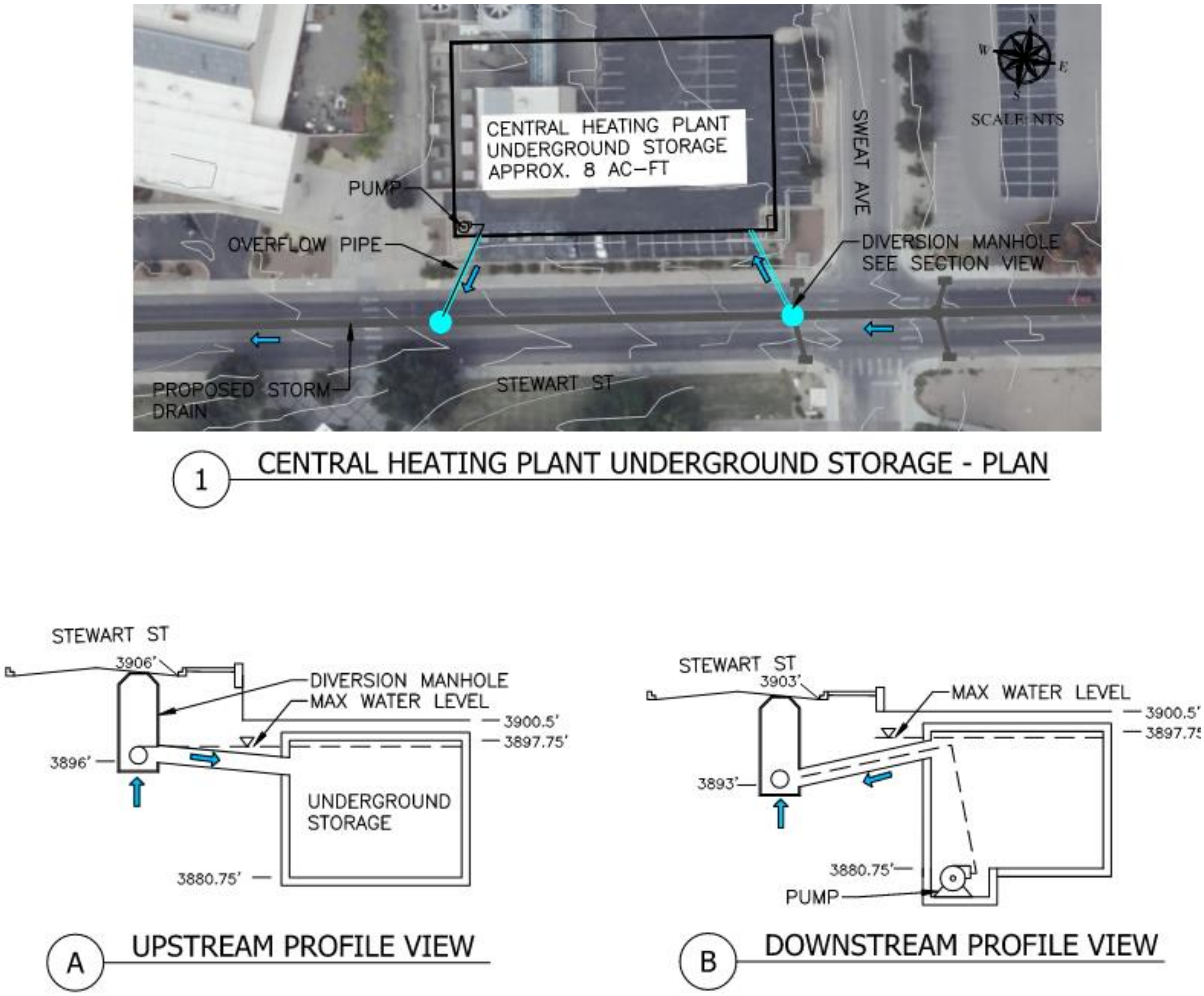

FIGURE 8-3: CENTRAL HEATING PLANT UNDERGROUND STORAGE

8.2.5. Storage Alternative 5: Dispersed Green Stormwater Infrastructure

This alternative is a little more general. There are numerous areas around campus where shallow ponds, curb cuts, and landscaping modifications would provide rainwater harvesting, address local flooding issues, and provide additional storage, relieving the demand on the NMSU Regional Pond. It is recommended that any time a roadway resurfacing or modification project is planned, an analysis be done regarding the potential for green stormwater infrastructure. Several areas particularly suited for such improvements are identified in Figure 8-4 and in the list below:

- College Dr near Zuhl Museum (approximately 2.4 ac-ft) ($130,000)
- College Dr and Knox St near Skeen Hall (approximately 0.26 ac-ft) ($15,000)
- Wells St median (approximately 0.3 ac-ft) ($17,000)
- Horseshoe Perimeter (approximately 0.4 ac-ft) ($22,500)
- Intermural Fields along Locust St (Sidewalk culverts toward athletic fields) ($10,000)
- Preciado Park (Sidewalk culverts along Gregg St and Williams St) ($15,000)
- Hardman Residence tree grove (Sidewalk culvert on Espina St) ($5,000)
- Bioswale near University and Jordan Rd to direct flowpath through trees and address erosion ($9,000)
- Bioswales in pine tree grove west of duck pond ($9,000)

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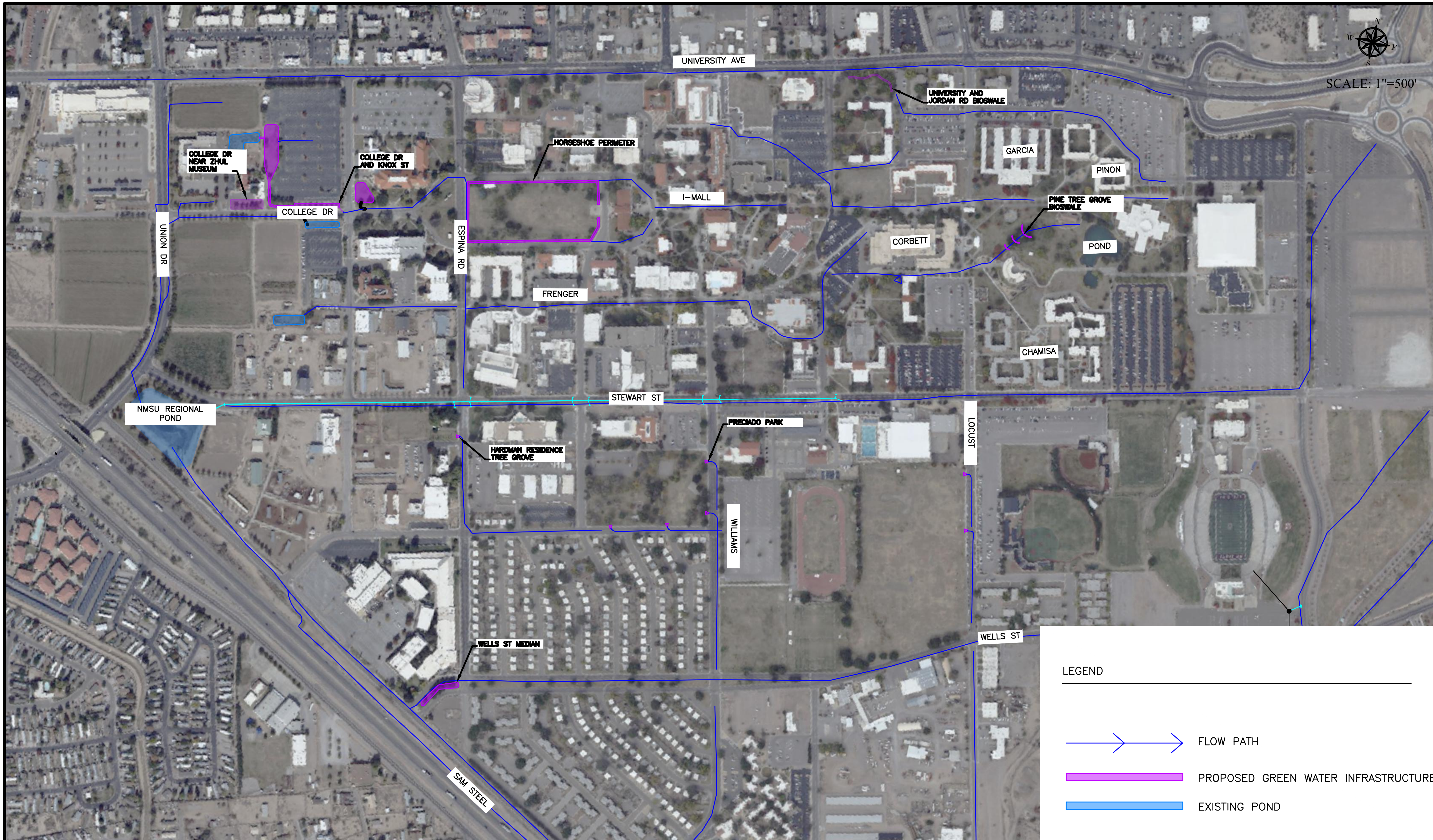

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FIGURE 8-4

DISPERSED GREEN STORMWATER INFRASTRUCTURE

8.3. Conveyance Capacity Recommendations

The conveyance capacity recommendations will focus on the issues highlighted in Table 7-2 as well as the issues highlighted in Section 5.0.

8.3.1. Conveyance Alternative 1: Stewart Street Storm Drain

The most significant conveyance issue facing the NMSU main campus is the large peak flows on Stewart St compared to its limited conveyance capacity. Stewart St begins conveying water westward at the crossing of the College Arroyo near the Aggie Memorial Stadium. It collects runoff from much of the adjacent areas via Locus St, Williams Ave, Sweet Ave, and Espina St. Naturally, the peak flows are highest toward the western end of the street. It is near the Stewart and Espina intersection, where the slope of Stewart is only 1.5%, that the road has an estimated carrying capacity of approximately 66 cfs. While this should be sufficient for the 10-yr storm, the 100-yr storm may be expected to exceed the depth of the 6-inch curb causing flooding at adjacent properties, not to mention the impact to traffic due to such deep and fast flowing water.

Conveyance Alternative 1, as shown in Figure 8-5, would be to install a storm drain system from Breland Dr to the NMSU Regional Pond outfall. This would likely need to be at least a 4-ft diameter trunk line at the western end tapering off to an approximately 3-ft diameter line at the eastern end. Water would be captured at each of the intersections using curb drop inlets and 24-in connecting pipes. *Estimated Construction Cost: $2,378,654.55*

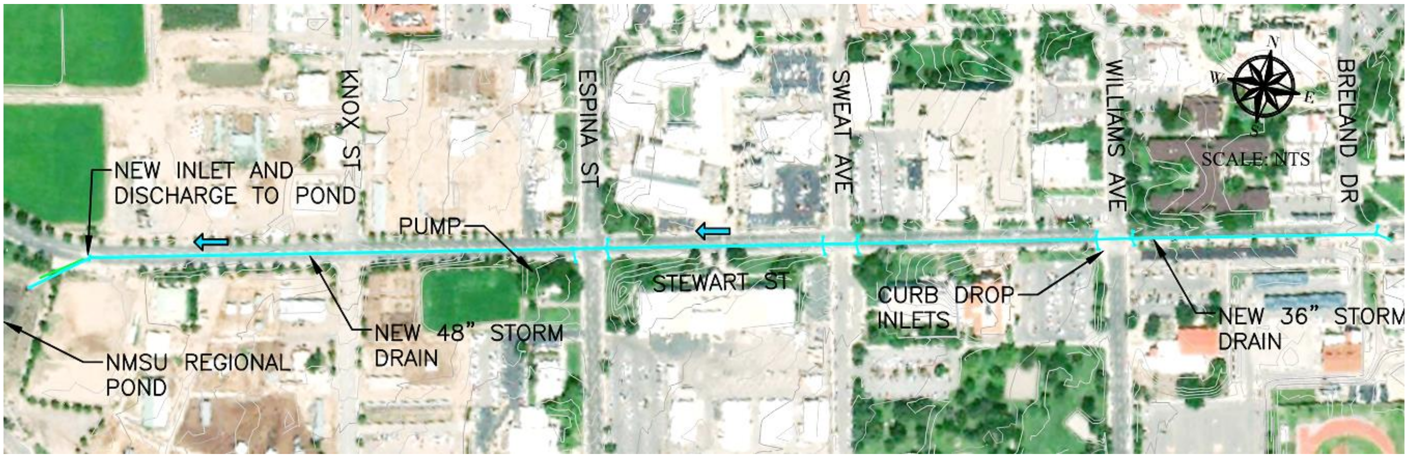

FIGURE 8-5: STEWART ST STORM DRAIN

8.3.2. Conveyance Alternative 2: Stewart St Channel and Pedestrian Corridor

The NMSU Planning Department has discussed the possibility of closing Stewart St to vehicular traffic and turning it into a pedestrian corridor. If this project was to be completed, there would be significant opportunities for green stormwater infrastructure. As shown in Figure 8-6, the existing roadway width would provide be ample space for a 20-ft pedestrian path, a 10-ft sidewalk, and a 24-ft wide by 3-ft deep channel capable of conveying the peak flows while capturing rainwater for landscaping. Many other layouts are possible as well with dedicated bicycle paths, bus-lanes, or park ponding areas all genuine options depending on the needs of the corridor users and the aesthetic vision of the NMSU architects.

Estimated Construction Cost: $4,086,941.10 including channel and pedestrian improvements from Locust St to Espina St and new storm drain from Espina to NMSU Regional Pond.

It should be mentioned that, while this alternative may be more expensive that installing storm drain in Stewart St, it provides transportation and quality of life benefits beyond drainage improvements alone. Therefore it may align better with the sustainability and design goals of the NMSU campus masterplan.

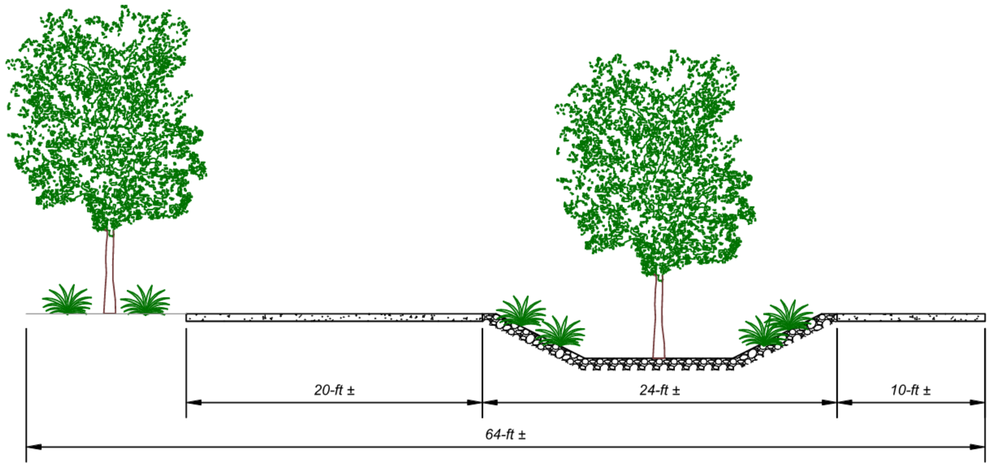

FIGURE 8-6: STEWART ST CHANNEL AND PEDESTRIAN CORRIDOR

8.3.3. Conveyance Alternative 3: College Drive Storm Drain Improvements

The existing storm drain in College Dr is approximately 12-in in diameter which only has the capacity to convey less than 10 cfs compared to the 158 cfs 100-yr peak expected. Additionally, this is one of the areas reported to have experienced significant flooding in the past.

While the Green Stormwater Infrastructure recommendations relating to the area would help alleviate some of these flooding concerns, it is also recommended to expand the existing storm drain system. The existing storm drain at the intersection of Union and College is 48-in diameter reinforced concrete pipe. It is recommended to replace the existing inlets and culverts in College Dr with 42in diameter pipe and standard curb drop inlets that are less susceptible to clogging. Additionally, sediment control structures, in the form of mulch socks, rock check dams, or landscaping should be installed along the south side of College Dr because it appears that significant amounts of sediment currently run off the adjacent dirt shoulder and into the storm drain system. Figure 8-7 below shows this Alternative.

Estimated Construction Cost: $489,793.67

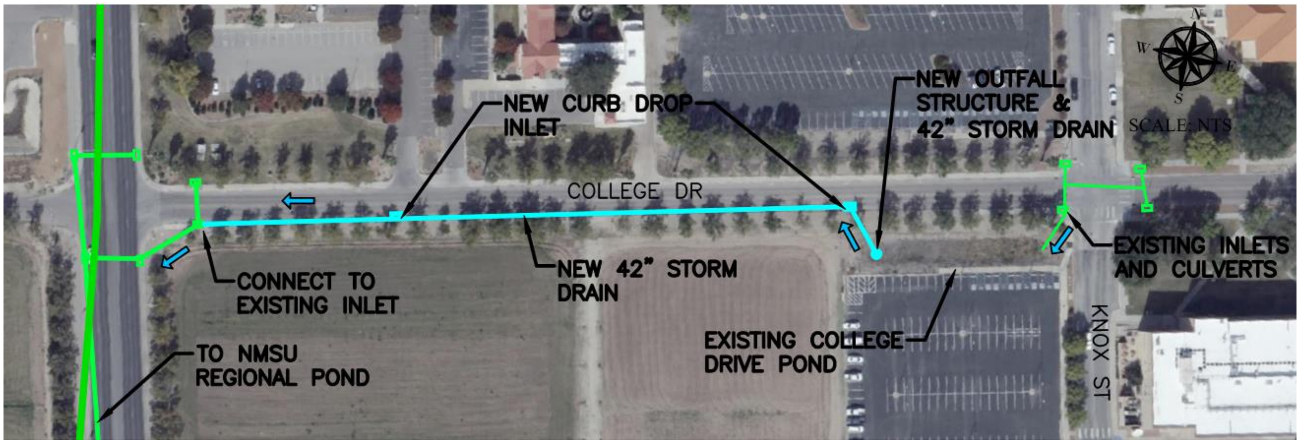

FIGURE 8-7: COLLEGE DR STORM DRAIN IMPROVEMENTS

8.3.4. Conveyance Alternative 4: College Arroyo at Wells St

The College Arroyo, which crosses campus from the University/Triviz intersection south to the Tortugas Arroyo, has a crossing at Wells St just south of the Aggie Memorial Stadium that is insufficient. While there is an inlet and small culvert conveying water across Wells, it appears to be sized more for the adjacent parking lot rather than the high flows coming from the College Arroyo. It is recommended, at this location, to add a new culvert crossing under Wells St. It may be difficult to construct a crossing with the capacity for the full 100-yr peak flow of 203 cfs given the topography. However, as shown in Figure 8-8, three 30-in culverts seem feasible and should be able meet the 10-yr storm and mitigate the worst impacts of larger storms.

Estimated Construction Cost: $246,882.48

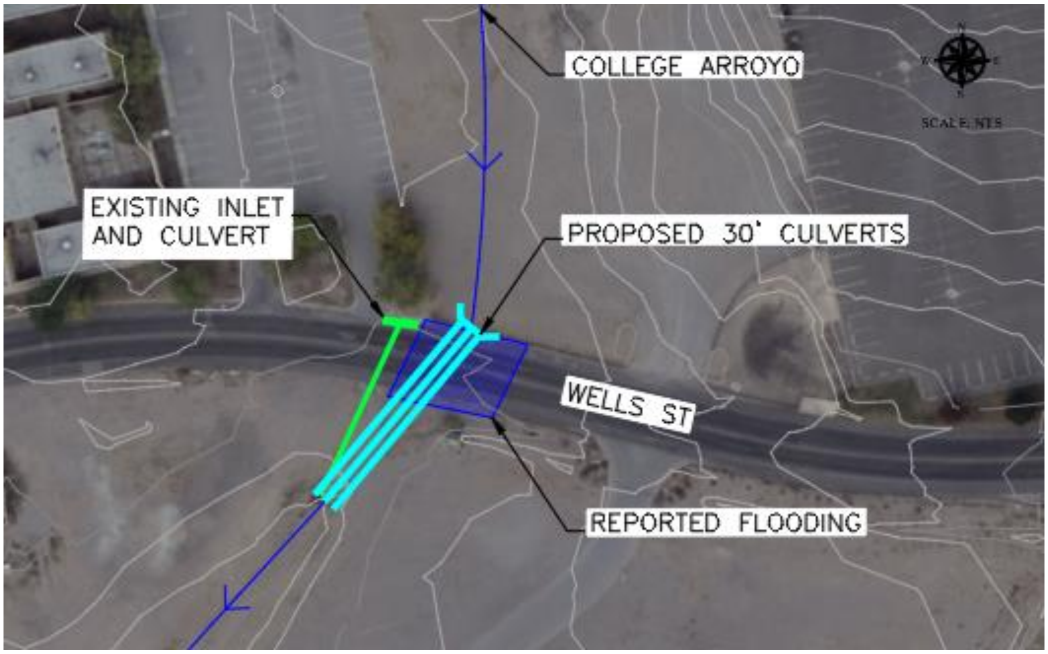

FIGURE 8-8: COLLEGE ARROYO CROSSING AT WELLS ST

8.3.5. Conveyance Alternative 5: Arrowhead Drive Curb and Gutter

One of the areas repeatedly mentioned as a flooding concern is Arrowhead Dr between Triviz and Wells. This section of Arrowhead does not include curb and gutter, and therefore has difficulty conveying water effectively. Additionally, the intersection of Arrowhead and Wells, there is a depression in the roadway profile that results in fairly deep standing water across the entire road necessitating closures at times.

The recommendation for Arrowhead is to reconstruct the roadway with curb and gutter, as seen in the Figure 8-9. With increasing foot, vehicular, and bicycle traffic in this portion of campus, a redesign of the road may be justified for numerous reasons. As discussed previously, this reconstruction could include rainwater harvesting swales along the roadway as well to help address local flooding and improve sustainability, as shown in Figure 8-10.

Estimated Construction Cost: $1,281,206.20. While this cost is relatively high compared to other projects in this report, it is important to note that it includes roadway and pedestrian improvements beyond simply the drainage improvements.

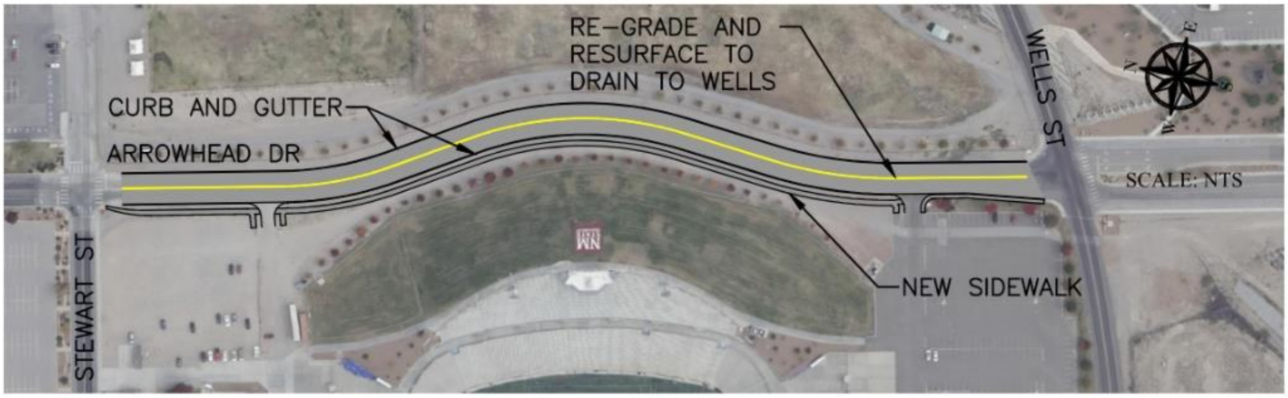

FIGURE 8-9 ARROWHEAD DR CURB AND GUTTER -PLAN

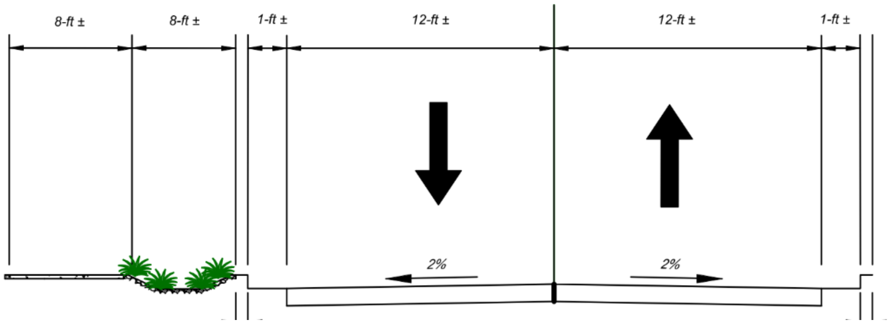

FIGURE 8-10 ARROWHEAD DR CURB & GUTTER - SECTION

8.3.6. Conveyance Alternative 6: Arrowhead and Wells St Inlet

Regarding the flooding at Arrowhead and Wells, the roadway reconstruction would create the opportunity to modify the roadway profile and enable the curb and gutter to convey water to the Tortugas Arroyo. In the short term, however, there is an existing drainage culvert for the Aggie Memorial Stadium's internal drainage system that passes immediately adjacent to the low spot on its way to the Tortugas Arroyo. Installing a drop inlet at this location and connecting it to the culvert, as shown in Figure 8-11 would be a cost-effective and quick way to address much of the flooding concerns.

Estimated Construction Cost: $71,990.65

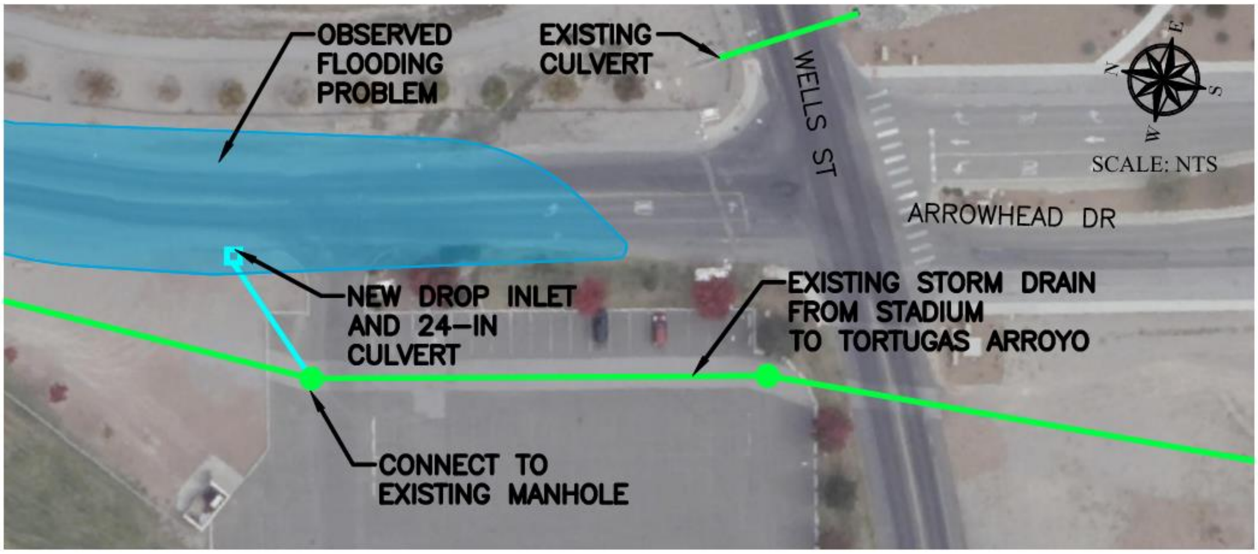

FIGURE 8-11: ARROWHEAD AND WELLS INTERSECTION IMPROVEMENTS

8.3.7. Conveyance Alternative 7: Wells St at Sam Steel Way

As described in Section 7.2, Wells St generally has sufficient conveyance to meet the required demand. However, as water reaches the intersection with Sam Steel Way, there is a flat area that often experiences ponding. There are several options for alleviating this problem depending on whether or not the Cole Village Pond previously described is implemented.

- Option 7A: Cole Village Pond and Median Pond in Wells St. If the Cole Village Pond is constructed, the flows reaching the end of Wells St will be greatly reduced. This option would address what would then be a relatively minimal amount of water by excavating storage volume in the median of Wells St. While there are several mature pine trees currently in the median, it's possible that several of these could be saved and may even benefit from the rainwater harvesting occurring in the depressed median.

  Estimated Construction Cost: $15,000.00
- Option 7B: Cole Village Pond and New Inlet to 12-in Storm Drain to DACC. There is an existing 12-in diameter storm drain through the adjacent DACC parking lot that should be able to be connected to by a new inlet in the westbound lanes of Wells St. Given the limited capacity of this existing culvert, this connection would also depend on the construction of the Cole Village Pond to be effective.

  Estimated Construction Cost: $25,000.00
- Option 7C: If the Cole Village Pond is not to be considered, addressing the flooding at this location becomes more challenging. The most comprehensive option would be to construct new inlets at the eastbound and westbound lanes and construct a new 3-ft diameter culvert through the DACC parking lot to beginning of the Sam Steel Channel at Gregg St. The DACC parking lot is currently scheduled for resurfacing so this project could be included combined with that effort.

  Estimated Construction Cost: $648,971.01

The total cost of Alternative 7C reveals how much more difficult this issue will be to address if the Cole Village Pond is not constructed.

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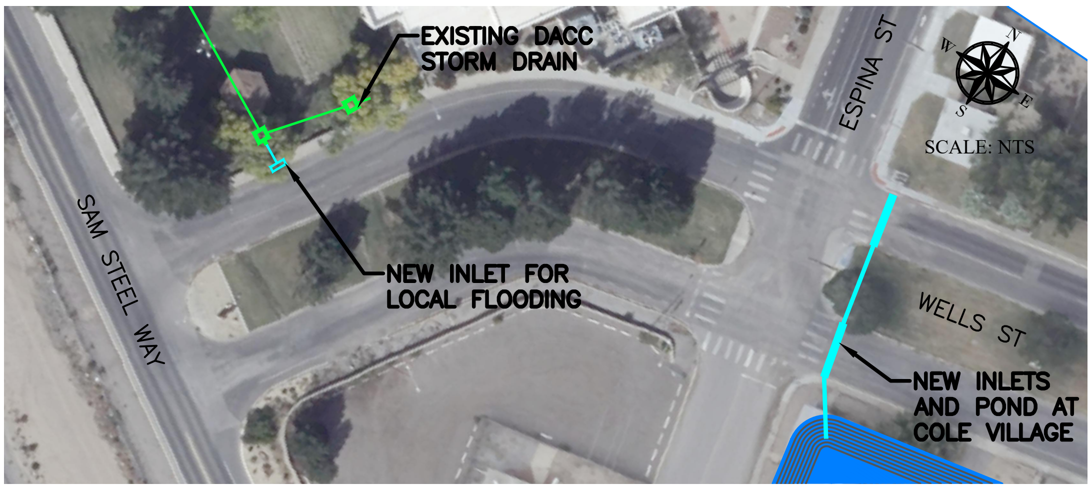
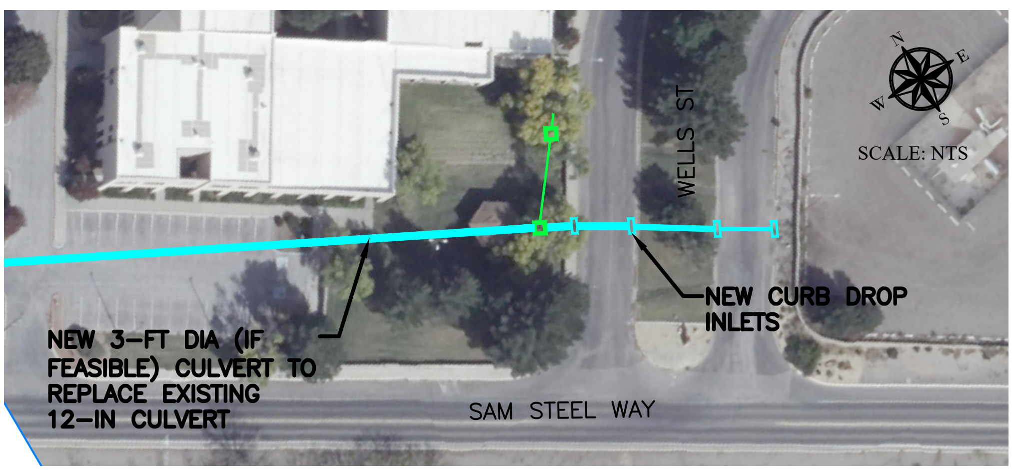
A WELLS STREET AT SAM STEEL ALTERNATIVE A



B WELLS STREET AT SAM STEEL ALTERNATIVE B



C WELLS STREET AT SAM STEEL ALTERNATIVE C

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FIGURE 8-12

WELLS ST AT SAM STEEL ALTERNATIVES

8.3.8. Conveyance Alternative 8: Sam Steel Way Channel Improvements

The current conveyance capacity of Sam Steel Way (118 cfs channel + 18 cfs street flow) is below the required demand. If the Cole Village Pond is constructed, this demand will decrease, but the 100-yr storm may still exceed the estimated capacity. Additionally, the driveway culverts for the both driveways significantly limit the capacity of the channel at those locations. The recommendations for improving the carrying capacity for Sam Steel Way are as follows:

- Widen the eastern half of the channel to at least 20-ft wide at the top.
- Replace the two 18-in culverts at the eastern driveway culvert crossing with two 36-in culverts
- Modify to western driveway crossing with concrete or rock cladding to allow flows to overtop and run down in the channel while mitigating erosion.

Estimated Construction Cost: $95,197.23

FIGURE 8-13: SAM STEEL WAY IMPROVEMENTS

8.4. Water Quality Recommendations

One issue brought up during discussions with NMSU Facilities Staff was the issue of runoff from the livestock corrals flowing into the NMSU Regional Pond and causing potential water quality concerns. A student-lead study completed in 2013 proposed a conceptual design involving the use of swales and filter strips to limit the amount of contaminants flowing off the corrals and into the NMSU Regional Pond. This concept seems valid and as an effective, low-cost, low-maintenance solution. There is already a row of pecan trees along the perimeter of the corrals. It is recommended to deepen and connect the tree wells to create a continuous swale. This will capture much of the runoff and reuse it for the existing trees. On the outer edge of a swale, it is recommended to install a 4-ft wide by 1-ft tall berm to further ensure water does not escape.

Estimated Construction Cost: $45,872.56

See Figure 8-14 and Figure 8-15 below:

FIGURE 8-14: CORRALS RUNOFF MITIGATION

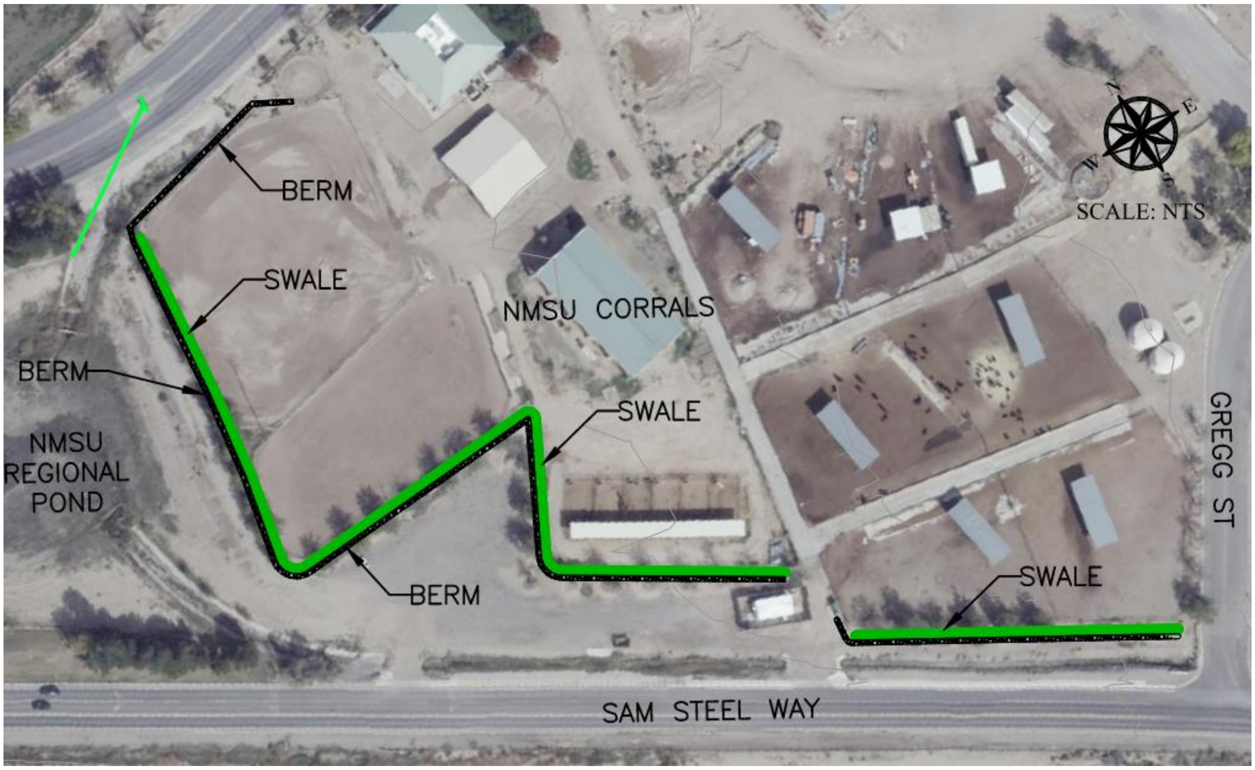

FIGURE 8-15: CORRALS RUNOFF MITIGATION – PLAN

9.0 RECOMMENDATIONS SUMMARY

The alternatives presented in the previous section were developed to address the most significant drainage issues facing the NMSU Main Campus. As described in Section 7, the NMSU Regional Pond currently lacks the storage capacity to manage the high volume of water expected for the 10-yr and 100-yr storms. Storage Alternative 1, Restoring the NMSU Regional Pond, would bring the capacity up to meet the 10-yr storm event as well as meeting the benchmark for what can be considered the historic expected storage volume.

The Cole Village Pond, which would intercept up to 8 ac-ft on Wells St, would improve the operations of the NMSU Regional Pond to the point where it could be expected to meet the demand of the 50-yr storm. And the subsequent addition of the Central Heating Plan Underground Storage would bring the cumulative storage capacity to the level of the 100-yr storm.

Regarding conveyance capacity, one of the most impactful projects is the College Dr Storm Drain Project which would address the major flooding that has been reported to occur in the vicinity of the NMSU Police Department. The current 12-in pipe and inlets are simply unable to convey the high demand and are very susceptible to clogging. Replacing them with standard curb drop inlets and new 42-in diameter culverts would significantly improve the operations.

The most expensive conveyance project is the Stewart St Storm Drain due to the total length and size of the culverts proposed. However, such improvements would remove the majority of the water that can be a frequent obstruction to the users of Stewart St and reduce the flooding concerns that have also been reported. An alternative to storm drain at this location would be the Stewart St Channel and Pedestrian Corridor. While this alternative would be significantly more expensive, much of the additional cost is due to the fact that the entire corridor would be redesigned for pedestrians, water harvesting, and landscaping and would provide benefits beyond just drainage.

10.0 CAPITAL IMPROVEMENT PLAN

The prioritization of the recommended improvements depends on several factors. Naturally, due to budgetary limitations, cost must be one of the most significant considerations. Based on the cost estimates generated for each alternative, the projects vary in cost from test of thousands to several million dollars. It is expected that there will be a need to space out the large cost projects over a longer period of time if possible.

Another consideration is the positive impact of the project. In this evaluation, a high impact rating was assigned to projects that have the potential to mitigate drainage issues that impact people and property in a serious or long-term sort of way. An example of a high impact project would be the College Drive Storm Drain project because flooding in that location has been observed to be extensive, damage adjacent properties, completely blocks traffic and takes a while to dissipate.

A medium impact rating was assigned to projects that address issues that are somewhat less severe or more limited in their potential to impact people or property. An example of a medium impact project would be the College Arroyo crossing at Wells St. This crossing has the potential to make Wells St temporarily impassible and to cause some damage over time to the roadway. However, the worst effects of the drainage crossing will dissipate quickly as the storm passes, and the associated flooding is not expected to damage any neighboring properties.

A low impact rating was assigned to projects that still have value but that address a more localized issue or provide long-term type benefits. An example of a low impact project could be the Corrals Runoff Mitigation which provide water quality benefits and localized erosion control benefits. Another example is the Cole Village Pond which provides benefits for the largest storm events and could be used as additional water storage "credit" for future developments on campus.

The final prioritization consideration is that certain projects have other projects as prerequisites. For example, the Central Heating Plant Storage project cannot be implemented unless the Stewart St storm drain is constructed.

Using these factors, a project prioritization list was developed to conceptualize the budgetary requirements and phasing of all the proposed improvements as shown in Table 10-1. All costs are in 2024 dollars and must be inflated as necessary for future years.

Table 10-1: Project Prioritization List

Project	Cost	Impact
Phase I		
NMSU Pond Restoration	$763,357.50	High
NMSU Pond Outfall	$128,573.39	Medium
College Dr Storm Drain	$489,793.67	High
Arrowhead Dr Inlet at Wells St	$71,990.65	Medium
Corrals Runoff Mitigation	$45,872.56	Low
Total Phase I	***$1,499,587.77***	
Phase II		
Stewart St Storm Drain*	$2,378,654.55	High
College Arroyo at Wells St	$246,882.48	Medium
Total Phase II	***$2,625,537.04***	
Phase III		
Central Heating Plant Storage	$849,056.05	Low
Cole Village Pond	$867,140.95	Low
Dispersed GSI	$237,688.80	Low
Arrowhead Dr Curb & Gutter**	$1,281,206.20	Medium
Wells St at Sam Steel Way***	$25,000.00	Medium
Sam Steel Way Improvements	$95,197.23	Low
Total Phase III	***$3,355,289.24***	

*Could be exchanged for the Stewart St Channel and Pedestrian Corridor ($4.1M)
**Includes Roadway and Pedestrian Improvements
***Dependent on Cole Village Pond

Two out of the three High Impact projects, namely the NMSU Pond Restoration and the College Dr Storm Drain, were prioritized for Phase I. Upon completion of the NMSU Pond Restoration project, it is expected that the stormwater retention requirements for the NMSU Main Campus will be fulfilled. This means any additional storage projects can accommodate new runoff resulting from future developments. The inclusion of the NMSU Pond Outfall in Phase I is logical since it can be most effectively integrated with the NMSU Pond Restoration project. Additionally, Phase I encompasses the Arrowhead Dr Inlet at Wells St and the Corrals Runoff Mitigation projects, both of which are lower-cost initiatives offering immediate benefits to the University.

The primary Phase II project is the Stewart St Storm Drain, which presents an option to be exchanged with the Stewart St Channel and Pedestrian Corridor project, albeit at a higher cost of $4,086,941.10. The only additional Phase II project is the crossing of the College Arroyo at Wells St.

Most of the cost of Phase III is comprised of the Cole Village Pond, the Central Heating Plant's Underground Storage, and the Arrowhead Dr Curb & Gutter improvements. The Arrowhead Dr Curb & Gutter is priced as a full roadway reconstruction from Stewart St to Wells St including new sidewalk on the westside of the road. Therefore, much of the cost of those improvements are related to non-drainage elements. Another notable aspect of Phase III is that the Wells St at Sam Steel Intersection Improvements are dependent on the construction of the Cole Village Pond. If the Cole Village Pond is not constructed, then the improvements at the Wells St/Sam Steel intersection become much more expensive in order to manage the much higher peak flows.

Naturally, outside circumstances such as funding availability and other development on the NMSU campus may accelerate or delay various projects on this prioritization list. However, the completion of these projects should be able to position NMSU to be able to manage storm water, provide a more functional and beautiful environment, and facilitate future development well into the future.

11.0 APPENDICES

Appendix A – Previous Reports

Appendix B – FEMA Floodmaps

Appendix C – Basin and Drainage Infrastructure Figures

Appendix D – Rainfall Data

Appendix E – Time of Concentration Calculations

Appendix F – Curve Number Calculations

Appendix G – Hydrological Results

Appendix H – Hydraulic Results

Appendix I – Cost Estimates

APPENDIX A

Previous Reports

Appendix B

FEMA Flood Maps

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was New Mexico State Plane, Central Zone (FIPS 3002). The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided by the Dona Ana County Flood Commission, 2004 and 2010; Bureau of Land Management, 2004; U.S. Geological Survey, 1989 and 2005; NGS, 2004; and U.S. Census Bureau, 2009. Additional information was compiled from U.S. Department of Agriculture aerial photography, 2009 at a scale of 1:12,000.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for the Flood Insurance Study report may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A Cross section line
23 - - - - 23 Transect line
97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{42}76^{000m}$E — 1000-meter Universal Transverse Mercator grid values, zone 13N
600000 FT — 5000-foot grid ticks: New Mexico State Plane coordinate system, Central zone (FIPSZONE 3002), Transverse Mercator
DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
SEPTEMBER 27, 1991

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
SEPTEMBER 3, 1992 - to add Base Flood Elevations, to change Special Flood Hazard Areas, to change zone designations, and to relfect updated topographic information.
SEPTEMBER 6, 1995 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Aresa, to change Special Flood Hazard Areas, to change zone designations, to advance the sufix, to add roads and road names, and to relfect updated topographic information.
JULY 6, 2016 - to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to add roads and road names, to incorporate previously issued Letters of Map Change, and to update map format.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

N

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1092G

FIRM
FLOOD INSURANCE RATE MAP
DONA ANA COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 1092 OF 1925

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DONA ANA COUNTY (UNINCORPORATED AREAS)	350012	1092	G
LAS CRUCES, CITY OF	355332	1092	G
MESILLA, TOWN OF	350113	1092	G

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

MAP NUMBER
35013C1092G

MAP REVISED
JULY 6, 2016

Federal Emergency Management Agency

NOTES TO USERS

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To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

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Silver Spring, Maryland 20910-3282
(301) 713-3242

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Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for the Flood Insurance Study report may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

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LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
97° 07' 30", 32° 22' 30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4276000mE	1000-meter Universal Transverse Mercator grid values, zone 13N
600000 FT	5000-foot grid ticks: New Mexico State Plane coordinate system, Central zone (FIPSZONE 3002), Transverse Mercator
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD
INSURANCE RATE MAP PANEL
SEPTEMBER 27, 1991

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

SEPTEMBER 3, 1992 - to add Base Flood Elevations, to change Special Flood Hazard Areas, to change zone designations, and to relfect updated topographic information.
SEPTEMBER 6, 1995 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Aresa, to change Special Flood Hazard Areas, to change zone designations, to advance the sufix, to add roads and road names, and to relfect updated topographic information.
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To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 1094G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
DONA ANA COUNTY, NEW MEXICO
AND INCORPORATED AREAS

PANEL 1094 OF 1925

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DONA ANA COUNTY (UNINCORPORATED AREAS)	350012	1094	G
LAS CRUCES, CITY OF	355332	1094	G
MESILLA, TOWN OF	350113	1094	G

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

MAP NUMBER
35013C1094G

MAP REVISED
JULY 6, 2016

Federal Emergency Management Agency

NOTES TO USERS

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Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was New Mexico State Plane, Central Zone (FIPS 3002). The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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LEGEND

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- **ZONE AE** Base Flood Elevations determined.
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- **ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
(A)—(A) Cross section line
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97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
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● M1.5 — River Mile

MAP REPOSITORIES
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EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL
SEPTEMBER 27, 1991

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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N

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250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1111G

FIRM
FLOOD INSURANCE RATE MAP
DONA ANA COUNTY, NEW MEXICO AND INCORPORATED AREAS

PANEL 1111 OF 1925

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DONA ANA COUNTY (UNINCORPORATED AREAS)	350012	1111	G
LAS CRUCES, CITY OF	355332	1111	G

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MAP NUMBER
35013C1111G

MAP REVISED
JULY 6, 2016

Federal Emergency Management Agency

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Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was New Mexico State Plane, Central Zone (FIPS 3002). The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit their website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided by the Dona Ana County Flood Commission, 2004 and 2010; Bureau of Land Management, 2004; U.S. Geological Survey, 1989 and 2005; NGS, 2004; and U.S. Census Bureau, 2009. Additional information was compiled from U.S. Department of Agriculture aerial photography, 2009 at a scale of 1:12,000.

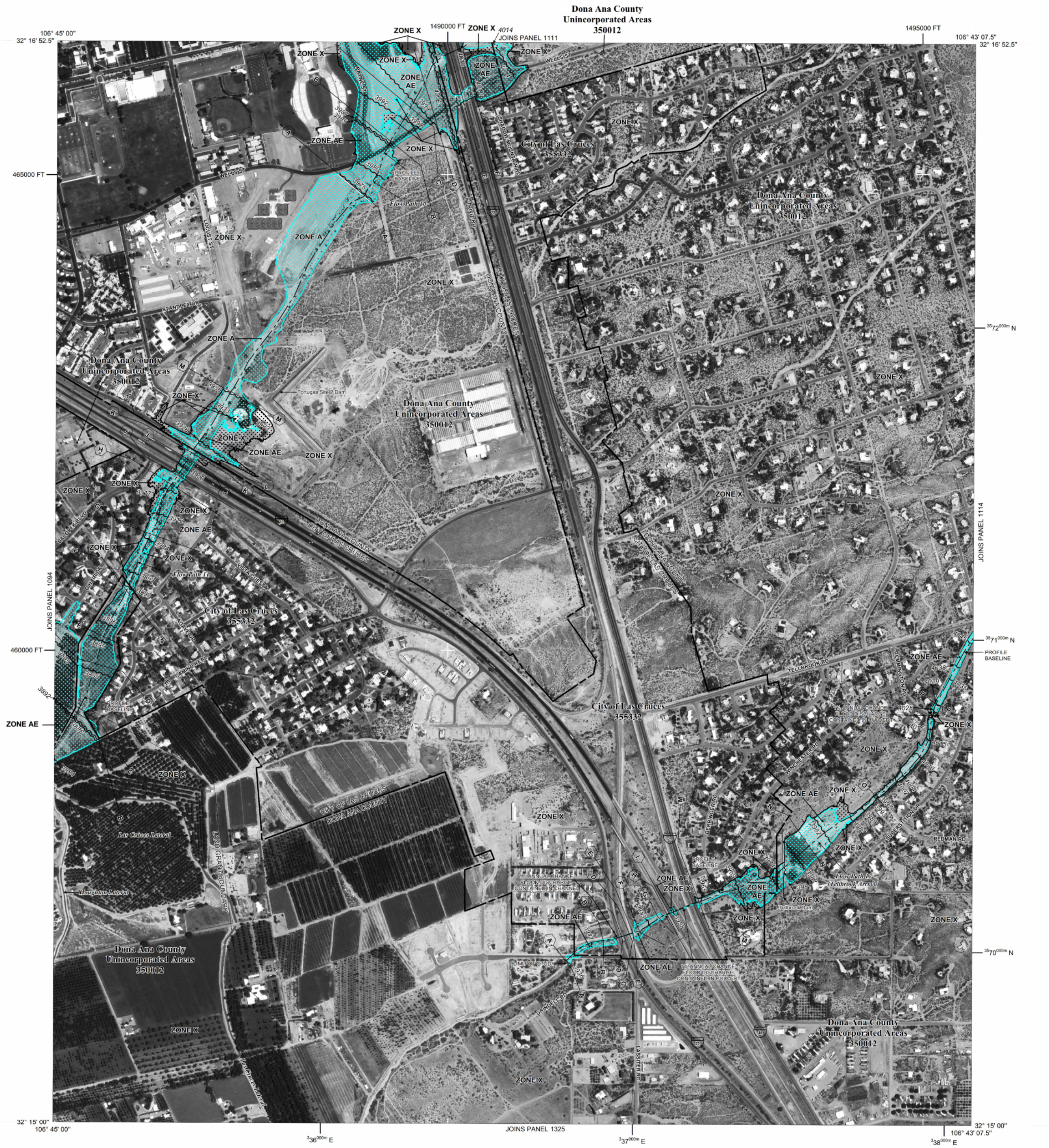
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for the Flood Insurance Study report may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/national-flood-insurance-program



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA Boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*
*Referenced to the North American Vertical Datum of 1988
A — A: Cross section line
23 - - - 23: Transect line
97° 07' 30", 32° 22' 30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{42}76^{000m}$E — 1000-meter Universal Transverse Mercator grid values, zone 13N
600000 FT — 5000-foot grid ticks: New Mexico State Plane coordinate system, Central zone (FIPSZONE 3002), Transverse Mercator
DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD
INSURANCE RATE MAP PANEL
SEPTEMBER 27, 1991

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

SEPTEMBER 3, 1992 - to add Base Flood Elevations, to change Special Flood Hazard Areas, to change zone designations, and to relfect updated topographic information.
SEPTEMBER 6, 1995 - to update corporate limits, to change Base Flood Elevations, to add Base Flood Elevations, to add Special Flood Hazard Aresa, to change Special Flood Hazard Areas, to change zone designations, to advance the sufix, to add roads and road names, and to relfect updated topographic information.
JULY 6, 2016 - to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to add roads and road names, to incorporate previously issued Letters of Map Change, and to update map format.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1113G

FIRM
FLOOD INSURANCE RATE MAP
DONA ANA COUNTY, NEW MEXICO
AND INCORPORATED AREAS

PANEL 1113 OF 1925

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DONA ANA COUNTY (UNINCORPORATED AREAS)	350012	1113	G
LAS CRUCES, CITY OF	355332	1113	G

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

MAP NUMBER
35013C1113G

MAP REVISED
JULY 6, 2016

Federal Emergency Management Agency

Appendix C

Basin and Drainage Infrastructure Figures

LAST MODIFIED: Dec 15, 2023 - 8:59am BY USER: LMarquez
DWG. LOCATION: I:\nmsu\NMS203-13_NMSU Drainage Master Plan\DWGS\
DWG. NAME: BASIN MAP2.dwg

MOLZENCORBIN

NMSU DRAINAGE MASTER PLAN

FIGURE 4-2
EXISTING DRAINAGE CONDITIONS

NM STATE UNIVERSITY

Appendix C

Rainfall Data

MOLZENCORBIN

NOAA Atlas 14, Volume 1, Version 5
Location name: Las Cruces, New Mexico, USA*
Latitude: 32.279°, Longitude: -106.747°
Elevation: 3957 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.218** (0.190-0.248)	**0.283** (0.248-0.322)	**0.381** (0.333-0.432)	**0.457** (0.398-0.518)	**0.559** (0.485-0.632)	**0.642** (0.553-0.725)	**0.727** (0.623-0.821)	**0.816** (0.695-0.923)	**0.939** (0.792-1.06)	**1.04** (0.871-1.18)
10-min	**0.332** (0.289-0.378)	**0.430** (0.378-0.490)	**0.579** (0.507-0.658)	**0.696** (0.606-0.788)	**0.851** (0.738-0.962)	**0.977** (0.842-1.10)	**1.11** (0.949-1.25)	**1.24** (1.06-1.40)	**1.43** (1.20-1.62)	**1.58** (1.32-1.79)
15-min	**0.412** (0.358-0.468)	**0.533** (0.468-0.607)	**0.718** (0.629-0.815)	**0.862** (0.752-0.977)	**1.06** (0.914-1.19)	**1.21** (1.04-1.37)	**1.37** (1.18-1.55)	**1.54** (1.31-1.74)	**1.77** (1.49-2.00)	**1.96** (1.64-2.22)
30-min	**0.554** (0.482-0.630)	**0.718** (0.630-0.818)	**0.967** (0.847-1.10)	**1.16** (1.01-1.32)	**1.42** (1.23-1.60)	**1.63** (1.40-1.84)	**1.85** (1.58-2.09)	**2.07** (1.77-2.34)	**2.38** (2.01-2.70)	**2.64** (2.21-2.99)
60-min	**0.686** (0.597-0.780)	**0.889** (0.779-1.01)	**1.20** (1.05-1.36)	**1.44** (1.25-1.63)	**1.76** (1.52-1.99)	**2.02** (1.74-2.28)	**2.29** (1.96-2.58)	**2.57** (2.19-2.90)	**2.95** (2.49-3.34)	**3.27** (2.74-3.70)
2-hr	**0.786** (0.692-0.890)	**1.02** (0.900-1.16)	**1.38** (1.21-1.56)	**1.66** (1.45-1.87)	**2.04** (1.77-2.30)	**2.34** (2.02-2.63)	**2.66** (2.28-2.98)	**2.99** (2.54-3.36)	**3.45** (2.89-3.87)	**3.82** (3.16-4.29)
3-hr	**0.828** (0.736-0.936)	**1.07** (0.948-1.21)	**1.42** (1.26-1.61)	**1.70** (1.50-1.92)	**2.09** (1.83-2.34)	**2.40** (2.08-2.68)	**2.72** (2.34-3.04)	**3.05** (2.61-3.42)	**3.52** (2.96-3.94)	**3.89** (3.24-4.37)
6-hr	**0.944** (0.843-1.06)	**1.20** (1.08-1.35)	**1.58** (1.41-1.77)	**1.87** (1.66-2.09)	**2.26** (2.00-2.52)	**2.57** (2.25-2.86)	**2.88** (2.51-3.21)	**3.21** (2.77-3.58)	**3.66** (3.12-4.09)	**4.02** (3.40-4.50)
12-hr	**1.03** (0.926-1.15)	**1.32** (1.18-1.47)	**1.71** (1.53-1.90)	**2.00** (1.79-2.22)	**2.40** (2.13-2.66)	**2.70** (2.38-2.99)	**3.01** (2.64-3.34)	**3.32** (2.90-3.69)	**3.74** (3.23-4.17)	**4.08** (3.49-4.56)
24-hr	**1.07** (0.998-1.16)	**1.36** (1.26-1.48)	**1.79** (1.64-1.96)	**2.17** (1.94-2.40)	**2.72** (2.36-3.12)	**3.20** (2.68-3.80)	**3.74** (3.00-4.64)	**4.34** (3.33-5.64)	**5.24** (3.80-7.33)	**6.03** (4.15-8.97)
2-day	**1.15** (1.07-1.25)	**1.46** (1.35-1.58)	**1.92** (1.76-2.09)	**2.30** (2.07-2.54)	**2.87** (2.50-3.26)	**3.34** (2.83-3.92)	**3.87** (3.15-4.75)	**4.45** (3.49-5.68)	**5.31** (3.93-7.41)	**6.11** (4.33-9.06)
3-day	**1.23** (1.14-1.34)	**1.57** (1.45-1.70)	**2.07** (1.90-2.25)	**2.47** (2.24-2.72)	**3.05** (2.68-3.45)	**3.53** (3.02-4.11)	**4.04** (3.35-4.89)	**4.60** (3.68-5.76)	**5.47** (4.16-7.44)	**6.28** (4.58-9.10)
4-day	**1.31** (1.21-1.43)	**1.68** (1.56-1.83)	**2.22** (2.03-2.41)	**2.64** (2.40-2.90)	**3.24** (2.86-3.65)	**3.71** (3.21-4.29)	**4.22** (3.54-5.03)	**4.75** (3.86-5.84)	**5.63** (4.38-7.48)	**6.44** (4.83-9.15)
7-day	**1.51** (1.40-1.64)	**1.94** (1.79-2.10)	**2.55** (2.35-2.77)	**3.04** (2.77-3.33)	**3.71** (3.29-4.16)	**4.25** (3.69-4.90)	**4.82** (4.07-5.71)	**5.42** (4.44-6.61)	**6.25** (4.90-8.01)	**6.92** (5.26-9.28)
10-day	**1.69** (1.56-1.84)	**2.17** (2.00-2.36)	**2.87** (2.64-3.13)	**3.42** (3.11-3.75)	**4.17** (3.70-4.67)	**4.77** (4.14-5.47)	**5.40** (4.57-6.35)	**6.04** (4.96-7.34)	**6.94** (5.48-8.79)	**7.64** (5.86-10.1)
20-day	**2.15** (1.99-2.34)	**2.77** (2.55-3.00)	**3.60** (3.32-3.90)	**4.23** (3.87-4.61)	**5.06** (4.54-5.61)	**5.70** (5.03-6.46)	**6.35** (5.48-7.35)	**6.99** (5.90-8.31)	**7.86** (6.41-9.70)	**8.53** (6.78-10.9)
30-day	**2.57** (2.38-2.78)	**3.27** (3.03-3.53)	**4.20** (3.88-4.54)	**4.91** (4.50-5.34)	**5.85** (5.26-6.48)	**6.57** (5.80-7.42)	**7.29** (6.30-8.42)	**8.00** (6.76-9.51)	**8.96** (7.31-11.1)	**9.71** (7.74-12.4)
45-day	**3.12** (2.89-3.37)	**3.97** (3.69-4.28)	**5.04** (4.69-5.43)	**5.83** (5.39-6.31)	**6.82** (6.21-7.49)	**7.55** (6.78-8.42)	**8.26** (7.30-9.38)	**8.94** (7.75-10.4)	**9.81** (8.28-11.8)	**10.4** (8.67-12.9)
60-day	**3.58** (3.31-3.86)	**4.55** (4.23-4.91)	**5.77** (5.37-6.21)	**6.63** (6.14-7.16)	**7.72** (7.04-8.43)	**8.49** (7.66-9.41)	**9.23** (8.21-10.4)	**9.94** (8.66-11.4)	**10.8** (9.21-12.8)	**11.4** (9.59-13.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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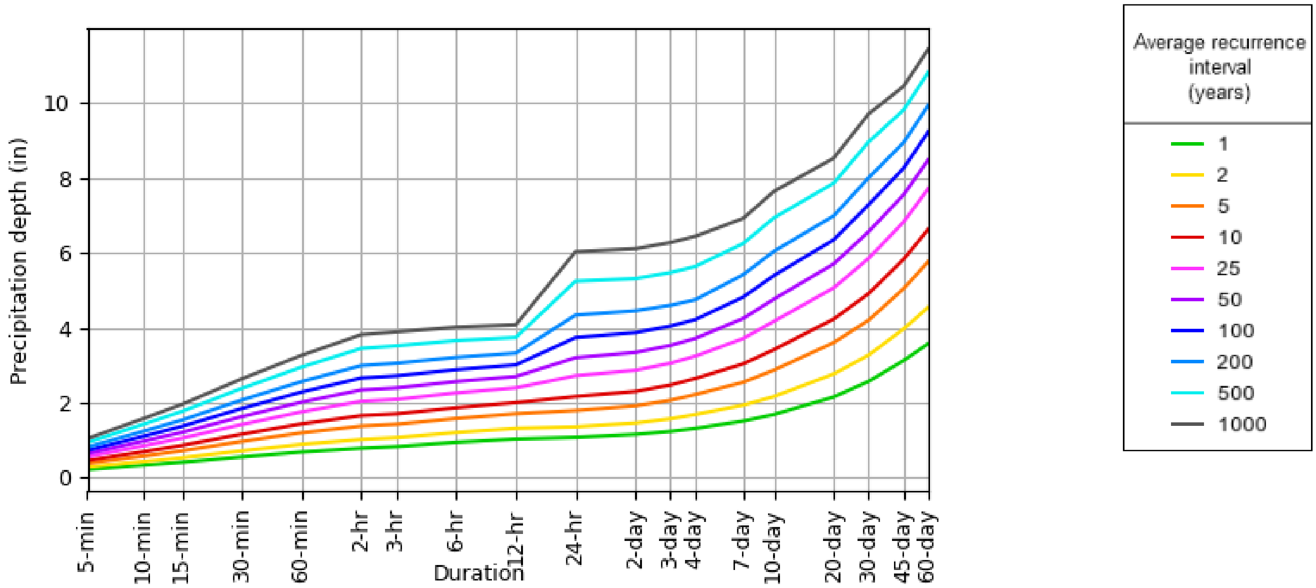
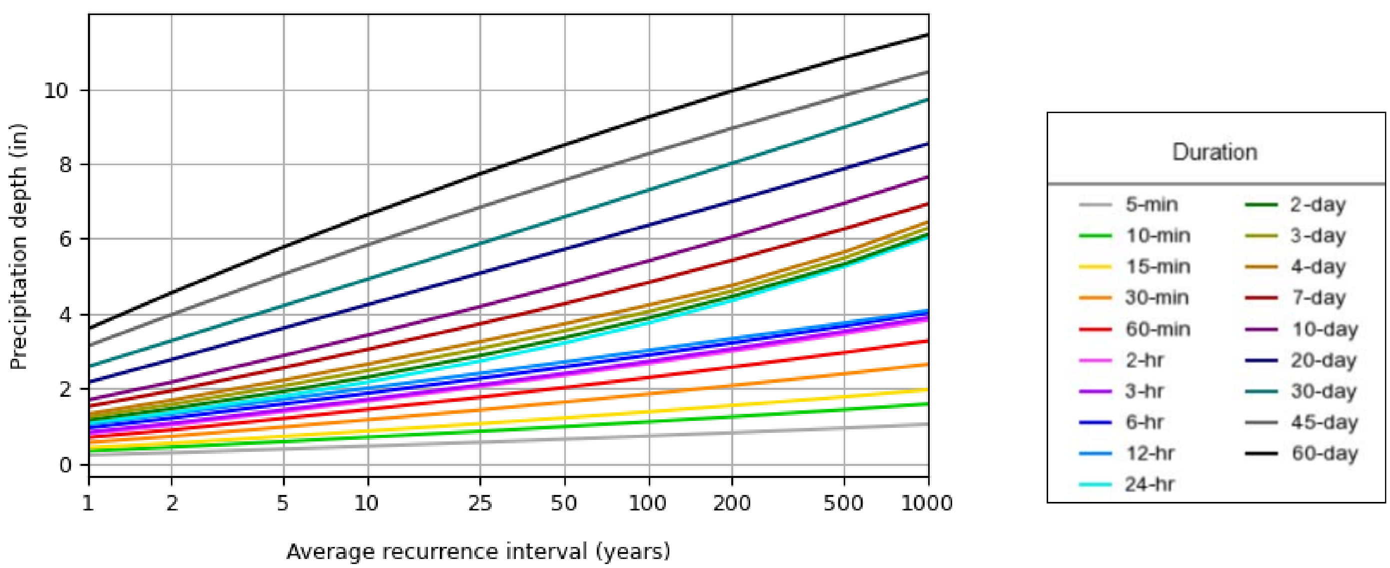
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 32.2790°, Longitude: -106.7470°





NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Aug 31 23:08:20 2023

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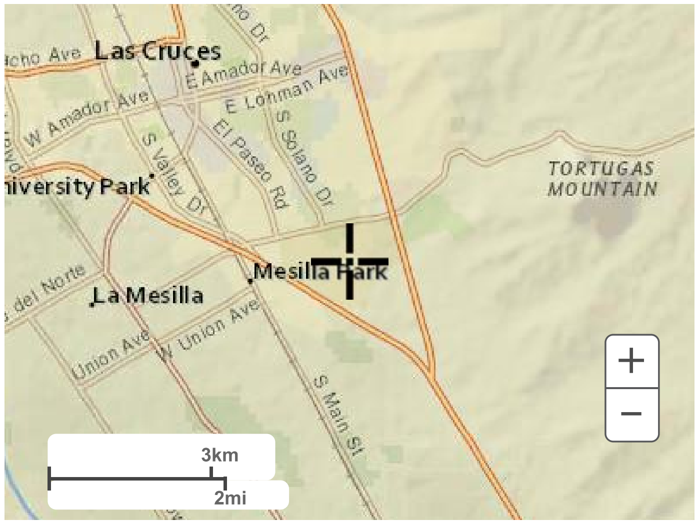
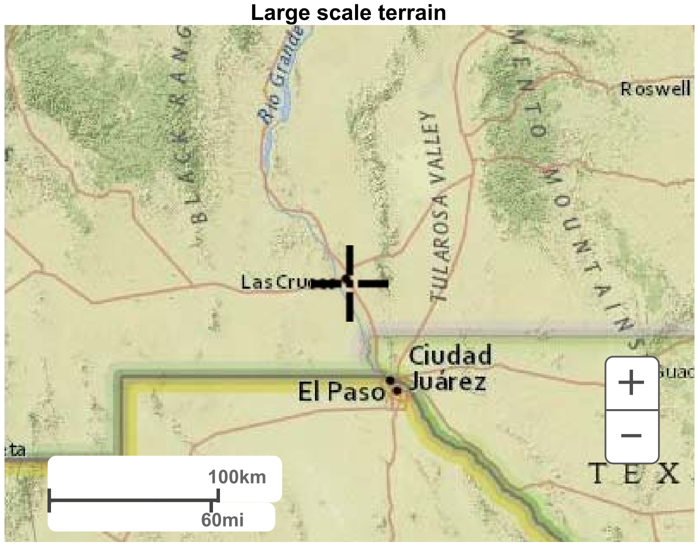
Maps & aerials

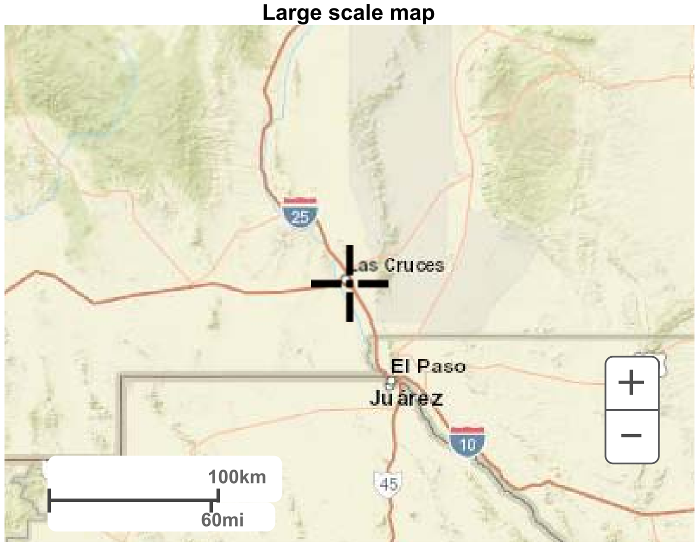
Small scale terrain



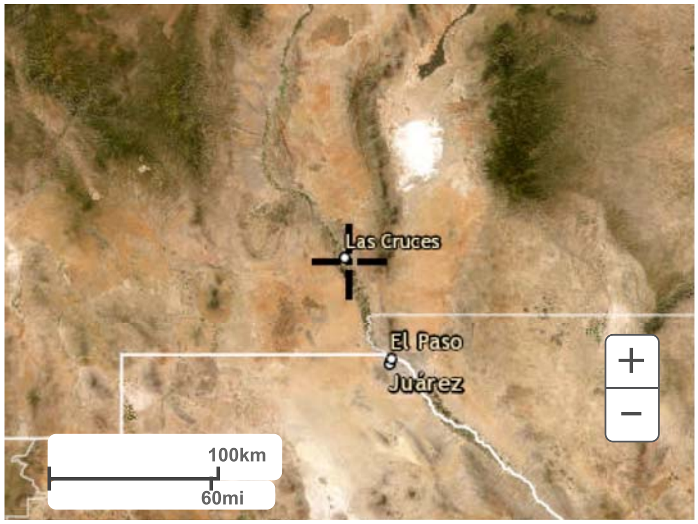
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NM STATE UNIVERSITY

Appendix D

Time of Concentration Calculations

Time of Concentration Calculations
Tc=(L1/V1+L2/V2…)/60)
Upland velocity values found using Figure 402-15 and Table 402-8
Hydraulic Velocity Values found using Section 402.9.5

Kirpich Formula .0078*L^.77*S^.385
Upland Formula (grassed waterways) L/(3600*V)

Basin	Tc	Method	L	E1	E2	dH	S	V	Lag
	min		Length of flow path, ft	Elevation at begin of flow path, ft	Elevation at end of flow path, ft	Change in elevatiom through flow path, ft	Slope, ft/ft	ft/s	min
Basin 1	10								6.00
Basin 2	10								6.00
Basin 3	10								6.00
Basin 4	10								6.00
Basin 5	22.0	Kirpich	3687	3937	3882	55.00	0.015		13.17
Basin 6	10								6.00
Basin 7	10								6.00
Basin 8	10								6.00
Basin 9	10								6.00
Basin 10	26.6	Kirpich	5405	3988	3883	105.00	0.019		15.98
Basin 11	10								6.00
Basin 12	35.2	Kirpich	6183	3959	3883	76.00	0.012		21.13
Basin 13	10								6.00
Basin 14	10								6.00
Basin 15	10								6.00
Basin 16	26.9	Kirpich	5636	3999	3883	116.00	0.021		16.14
Basin 17	5.5	Kirpich	1382	3999	3891	108.00	0.078		3.27
Basin 18	16.4	Kirpich	3054	3959	3892	67.00	0.022		9.82
Basin 19	23.5	Kirpich	4000	3970	3911	59.00	0.015		14.09
Basin 20	13.7	Kirpich	2392	3970	3919	51.00	0.021		8.23
Basin 21	10								6.00
Basin 22	11.7	Kirpich	2045	3990	3942	48.00	0.023		7.03
Basin 23	9.63	Upland	1361	3990	3961	29.00	0.021	2.36	5.78
Basin 24	10								6.00
Basin 25	10								6.00
Basin 26	10								6.00

Basin 27	10								6.00
Basin 28	10								6.00
Basin 29	10								6.00
Basin 30	10								6.00
Basin 31	10								6.00
Basin 32	36.98	Upland	911	3993	3991	2.00	0.002	0.41	22.19
Basin 33	10								6.00
Basin 34	10								6.00
Basin 35	12.60	Upland	603	3887	3882	5.00	0.008	0.80	7.56
Basin 36	10								6

Appendix E

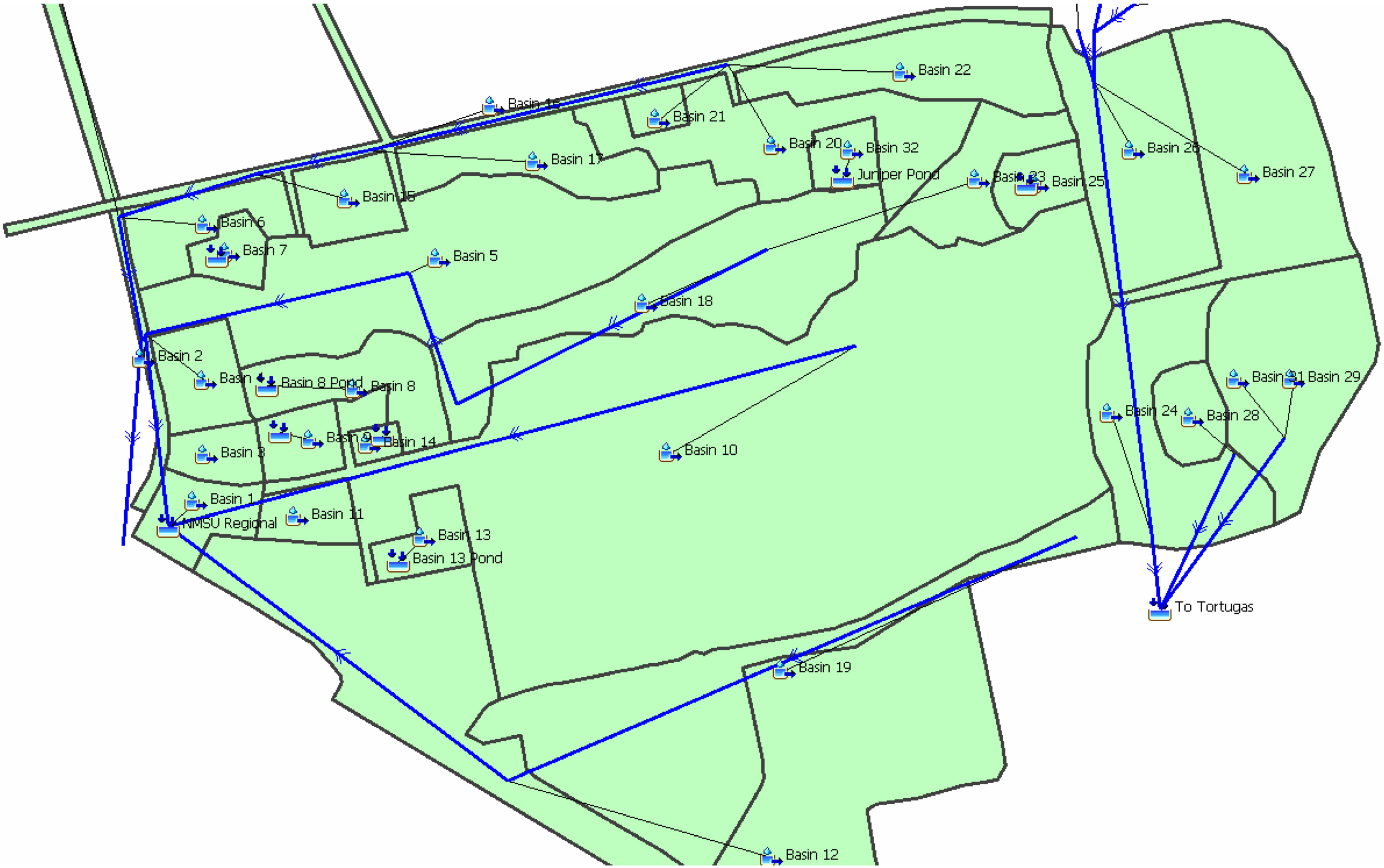
Curve Number Calculations

Curve Number Calculations

Basin	Area (ac)	Description	CN1	%	CN2	%	CN3	%	%Impervious	Total CN
Basin 1	6.17	Pond with SG C and D	74	40%	80	50%			10%	79.4
Basin 2	2.84	Road	98						100%	98
Basin 3	3.89	Field with SG C&D	74	40%	80	60%			0%	77.6
Basin 4	6.63	Field with SG C&D	80		80	100%			0%	80
Basin 5	46.21	College Dr, Horseshoe area, SG A&D	80	15%	39	40%			45%	71.7
Basin 6	7.7	Field and Parking, SG C&D	74	40%	40	5%			55%	85.5
Basin 7	3.33	Pond and Parking, SG D	80	35%					65%	91.7
Basin 8	10.29	Buildings, parking, pond, SG C&D	80	20%					80%	94.4
Basin 9	4.43	Ag facilities, onsite ponding, SG B&C&D	89	20%	79	30%	86	10%	40%	89.3
Basin 10	172.13	Stewart Basin, Buildings, Grass, SGA	39	40%					60%	74.4
Basin 11	4.2	Ag facilities, onsite ponding, SG B&C&D	89	20%	79	30%	86	5%	45%	89.9
Basin 12	92.52	Sam Steel Wy Basin, Open Areas, SGA	72	35%	68	5%			60%	87.4
Basin 13	4.68	Ag bldg, onsite pond, SG A	68	15%					85%	93.5
Basin 14	1.35	Ag bldg, onsite pond, SG A	68	15%					85%	93.5
Basin 15	6.17	Parking, Green Space, SGD	80	20%					80%	94.4
Basin 16	13.08	University Ave, Impervious	98						100%	98
Basin 17	10.94	Performing arts basin, SGA	39	30%					70%	80.3
Basin 18	29.44	Frenger Basin, SGA	39	20%					80%	86.2
Basin 19	38.71	Wells St Basin, SGA	39	15%					85%	89.15
Basin 20	20.5	Garcia to Art Bldg, SGA	39	30%					70%	80.3
Basin 21	1.9	Pond, SGA	39	100%					0%	39
Basin 22	16.04	Pinon to Jordan Rd, SGA	39	15%					85%	89.15
Basin 23	9.33	Pinon to Corbet, SGA	39	75%					25%	53.75
Basin 24	21.78	West of Stadium, SGA	39	40%					60%	74.4
Basin 25	4.53	Duck Pond	39	40%					60%	74.4
Basin 26	22.96	Pan Am & Parking, SGA	39	5%					95%	95.05
Basin 27	25.78	Arrowhead to Stewart, SGA	39	3%					97%	96.23
Basin 28	4.88	Inside Stadium,	39	80%					20%	50.8
Basin 29	23.41	Arrowhead to Tortugas, SGA	39	80%					20%	50.8
Basin 30	6.89	El Paseo to University	98						100%	98
Basin 31	9.67	Convention Center, onsite ponding	79	10%					90%	96.1
Basin 32	21.24	Mostly fields, SGC and D	86	20%	89	70%			10%	89.3
Basin 33	2.9	SGC, buildings, parking	86	40%					60%	93.2
Basin 34	12.52	Ag field, SGC	86	100%					0%	86
Basin 35	4.7	Buildings, parking, SGC and D	86	5%	89	5%			90%	96.95
Basin 36	3.33	Juniper Hall Basin	39	40%					60%	74

Appendix F

Hydrologic Results



Basin 22
Basin 16
Basin 21
Basin 20
Basin 32
Basin 17
Jumper Pond
Basin 23
Basin 25
Basin 26
Basin 27
Basin 15
Basin 6
Basin 7
Basin 5
Basin 18
Basin 2
Basin
Basin 8 Pond
Basin 8
Basin 9
Basin 14
Basin 3
Basin 10
Basin 21
Basin 29
Basin 24
Basin 28
Basin 1
NMSU Regional
Basin 11
Basin 13
Basin 13 Pond
To Tortugas
Basin 19
Basin 12

Hydrological Analysis Data

	Peak Discharge (cfs)			Volume (ac-ft)		
Hydrologic Elements	10-Year	50-Year	100-Year	10-Year	50-Year	100-Year
Alunmi Pond	2.4	5.6	7.4	0.2	0.4	0.5
Arrowhead North of Wells	0	1.1	2.7	0	0.3	0.7
Basin 1	5.3	10.6	13.3	0.3	0.7	0.9
Basin 10	64.7	147.7	191.3	6.4	15.1	20.4
Basin 11	7.8	12.6	14.8	0.4	0.8	0.9
Basin 12	87.8	149.8	179.6	8	14.7	18.3
Basin 13	10.6	16.1	18.6	0.6	1	1.2
Basin 13 Pond	10.6	16.1	18.6	0.6	1	1.2
Basin 14	3	4.6	5.4	0.2	0.3	0.3
Basin 14 Pond	3	4.6	5.4	0.2	0.3	0.3
Basin 15	14.6	21.8	25.2	0.8	1.3	1.6
Basin 16	24.8	35.3	40.2	2.2	3.4	4
Basin 17	10.2	20	24.9	0.6	1.3	1.7
Basin 18	37.1	64.4	77.6	2.4	4.5	5.7
Basin 19	45.1	72.9	86	3.8	6.7	8.3
Basin 2	6.3	8.9	10.2	0.4	0.6	0.7
Basin 20	20.6	41	51.2	1.3	2.8	3.6
Basin 21	0	0	0	0	0	0
Basin 22	28.3	46.3	54.8	1.6	2.8	3.5
Basin 23	0	0.8	1.5	0	0.2	0.3
Basin 24	11.3	27	35.3	0.8	1.9	2.6
Basin 25	2.4	5.6	7.4	0.2	0.4	0.5
Basin 26	56.2	83.4	95.9	3.2	5.1	6.1
Basin 27	66.6	97	111	3.8	5.9	7.1
Basin 28	0	0.2	0.5	0	0.1	0.1
Basin 29	0	1	2.3	0	0.3	0.5
Basin 3	2.8	6	7.7	0.2	0.4	0.5
Basin 30	19	27.1	30.8	1.1	1.7	2
Basin 31	24.7	36.1	41.3	1.4	2.2	2.6
Basin 32	22.4	37	43.9	2.1	3.7	4.5
Basin 33	6.3	9.7	11.3	0.4	0.6	0.7
Basin 34	73	126.5	152.3	4.2	7.8	9.8
Basin 35	12.4	17.9	20.4	0.7	1.1	1.3
Basin 36	1.6	4	5.3	0.1	0.3	0.4
Basin 4	17	24.9	28.5	1	1.5	1.8
Basin 5	54.2	90.3	107.6	4.5	8	9.9
Basin 6	16.9	25.9	30.1	0.9	1.6	1.9
Basin 7	4.8	8.3	10	0.3	0.5	0.6
Basin 7 Pond	4.8	8.3	10	0.3	0.5	0.6
Basin 8	27.4	39.5	45.1	1.6	2.4	2.9
Basin 8 Pond	27.4	39.5	45.1	1.6	2.4	2.9
Basin 9	4	7.9	9.9	0.2	0.5	0.7
Basin 9 Pond	4	7.9	9.9	0.2	0.5	0.7
College Arroyo	116.7	176.3	202.8	12	21	26
College Arroyo Inlet	123.4	191.2	221.9	12.8	22.9	28.6
College Dr	79.6	133.6	159.7	6.9	12.6	15.8
Don Roser Pond 1	33.7	55.6	64.8	3.8	8.1	10.6
El Paseo 1	106	171.5	203.1	8.6	14.8	18.2
El Paseo 2	95.1	154.2	182.7	8.6	14.8	18.2
Espina	28.9	51.2	62.5	2.4	4.7	5.9
Frenger	34.9	61.3	74.7	2.4	4.7	6

I-Mall	52.5	85.6	102	4.5	8	9.9
Juniper Pond	1.6	4	5.3	0.1	0.3	0.4
NMSU Regional Pond	273.3	493	602.4	26.4	51.1	65.3
Reach-Triviz1	7.3	10.9	12.6	0.5	0.8	1
Reach-Univ1	0.9	1.3	1.5	0.1	0.1	0.1
Reach-Univ2	39	61.3	71.3	5	10	12.8
Sam Steel Way	129.8	218.2	260.4	11.8	21.4	26.6
Stewart Street	55.5	129.7	169.4	6.4	15.1	20.3
To Tortugas	123.4	192.3	224.6	12.8	23.3	29.2
Union Storm Drain	88.1	145.1	172.7	8.3	14.7	18.3
University 1	46.1	82.3	100.1	2.9	5.6	7.1
University 2	43.4	77.7	94.6	2.9	5.6	7.1
University 3	72.4	123.7	148.9	5.7	10.2	12.7
University 4	82.3	137.9	165	6.5	11.5	14.3
Wells Street	44.9	72.8	85.9	3.8	6.7	8.3

Appendix G

Hydraulic Results

Hydraulic Analysis Results

	Description	Estimate Capacity*	10 -Yr	100-Yr
Drainage Structure Name		cfs	cfs	cfs
College Arroyo Inlet Across Wells St	Drop Inlet	3 cfs	117 cfs	203 cfs
Espina Street	Street Flow	74 cfs	31 cfs	65 cfs
Frenger	Street Flow	85 cfs	35 cfs	75 cfs
Stewart Street	Street Flow	66 cfs	56 cfs	169 cfs
Wells Street	Street Flow	154 cfs	45 cfs	86 cfs
College Dr	12” Culvert	7 cfs	80 cfs	158 cfs
NMSU Police Sta Pond	Pond	4 ac-ft	0.27 ac-ft	0.64 ac-ft
Frenger St Pond	Pond	4 ac-ft	1.6 ac-ft	2.9 ac-ft
NMSU Regional Pond	Pond	18 ac-ft	26 ac-ft	65 ac-ft

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Tuesday, September 19, 2023

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Sam Steel Channel

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Channel Width 6.00 ft

Longitudinal Slope: 0.0067 ft/ft

Manning's n: 0.0250

Depth 2.0000 ft

Result Parameters

Flow 118.1725 cfs

Area of Flow 20.0000 ft^2

Wetted Perimeter 14.9443 ft

Hydraulic Radius 1.3383 ft

Average Velocity 5.9086 ft/s

Top Width 14.0000 ft

Froude Number: 0.8712

Critical Depth 1.8530 ft

Critical Velocity 6.5705 ft/s

Critical Slope: 0.0090 ft/ft

Critical Top Width 13.41 ft

Calculated Max Shear Stress 0.8362 lb/ft^2

Calculated Avg Shear Stress 0.5595 lb/ft^2

Channel Analysis: Wells

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width 30.00 ft

Longitudinal Slope: 0.0180 ft/ft

Manning's n: 0.0120

Depth 0.5000 ft

Result Parameters

Flow 153.5977 cfs

Area of Flow 15.0000 ft^2

Wetted Perimeter 31.0000 ft

Hydraulic Radius 0.4839 ft

Average Velocity 10.2398 ft/s

Top Width 30.0000 ft

Froude Number: 2.5520

Critical Depth 0.9337 ft

Critical Velocity 5.4833 ft/s

Critical Slope: 0.0023 ft/ft

Critical Top Width 30.00 ft

Calculated Max Shear Stress 0.5616 lb/ft^2

Calculated Avg Shear Stress 0.5435 lb/ft^2

Channel Analysis: College

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width 30.00 ft

Longitudinal Slope: 0.0005 ft/ft

Manning's n: 0.0160

Depth 0.5000 ft

Result Parameters

Flow 19.1997 cfs

Area of Flow 15.0000 ft^2

Wetted Perimeter 31.0000 ft

Hydraulic Radius 0.4839 ft

Average Velocity 1.2800 ft/s

Top Width 30.0000 ft

Froude Number: 0.3190

Critical Depth 0.2334 ft

Critical Velocity 2.7416 ft/s

Critical Slope: 0.0062 ft/ft

Critical Top Width 30.00 ft

Calculated Max Shear Stress 0.0156 lb/ft^2

Calculated Avg Shear Stress 0.0151 lb/ft^2

Channel Analysis: Frenger

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width 20.00 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0150

Depth 0.5000 ft

Result Parameters

Flow 85.4338 cfs

Area of Flow 10.0000 ft^2

Wetted Perimeter 21.0000 ft

Hydraulic Radius 0.4762 ft

Average Velocity 8.5434 ft/s

Top Width 20.0000 ft

Froude Number: 2.1292

Critical Depth 0.8275 ft

Critical Velocity 5.1620 ft/s

Critical Slope: 0.0039 ft/ft

Critical Top Width 20.00 ft

Calculated Max Shear Stress 0.6240 lb/ft^2

Calculated Avg Shear Stress 0.5943 lb/ft^2

Channel Analysis: Espina

Notes:

Input Parameters

Channel Type: Rectangular

Channel Width 48.00 ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.0150

Depth 0.5000 ft

Result Parameters

Flow 123.6036 cfs

Area of Flow 24.0000 ft^2

Wetted Perimeter 49.0000 ft

Hydraulic Radius 0.4898 ft

Average Velocity 5.1502 ft/s

Top Width 48.0000 ft

Froude Number: 1.2835

Critical Depth 0.5905 ft

Critical Velocity 4.3606 ft/s

Critical Slope: 0.0040 ft/ft

Critical Top Width 48.00 ft

Calculated Max Shear Stress 0.2184 lb/ft^2

Calculated Avg Shear Stress 0.2139 lb/ft^2

Curb and Gutter Analysis: Stewart (at EC)

Notes:

Gutter Input Parameters

Longitudinal Slope of Road: 0.0000 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0120

Gutter Width: 1.0000 ft

Gutter Result Parameters

Width of Spread: 17.0000 ft

Gutter Result Parameters

Design Flow: 18.5824 cfs

Gutter Depression: 0.0000 in

Area of Flow: 2.8900 ft^2

Eo (Gutter Flow to Total Flow): 0.1494

Gutter Depth at Curb: 4.0800 in

Inlet Input Parameters

Inlet Location: Inlet on Grade

Inlet Type: Grate

Grate Type: P - 1-7/8

Grate Width: 0.0000 ft

Grate Length: 0.0000 ft

Local Depression: 0.0000 in

Inlet Result Parameters

Intercepted Flow: 1.7245 cfs

Bypass Flow: 16.8579 cfs

Approach Velocity: 6.4299 ft/s

Splash-over Velocity: 2.2186 ft/s

Efficiency: 0.0928

Curb and Gutter Analysis: Espina

Notes:

Gutter Input Parameters

Longitudinal Slope of Road: 0.0000 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0120

Gutter Width: 1.0000 ft

Gutter Result Parameters

Width of Spread: 25.0000 ft

Gutter Result Parameters

Design Flow: 36.7477 cfs

Gutter Depression: 0.0000 in

Area of Flow: 6.2500 ft^2

Eo (Gutter Flow to Total Flow): 0.1033

Gutter Depth at Curb: 6.0000 in

Inlet Input Parameters

Inlet Location: Inlet on Grade

Inlet Type: Grate

Grate Type: P - 1-7/8

Grate Width: 0.0000 ft

Grate Length: 0.0000 ft

Local Depression: 0.0000 in

Inlet Result Parameters

Intercepted Flow: 2.5444 cfs

Bypass Flow: 34.2033 cfs

Approach Velocity: 5.8796 ft/s

Splash-over Velocity: 2.2186 ft/s

Efficiency: 0.0692

Curb and Gutter Analysis: Sam Steel 1/2 Roadway

Notes:

Gutter Input Parameters

Longitudinal Slope of Road: 0.0000 ft/ft

Cross-Slope of Pavement: 0.0200 ft/ft

Uniform Gutter Geometry

Manning's n: 0.0150

Gutter Width: 2.0000 ft

Gutter Result Parameters

Width of Spread: 16.0000 ft

Gutter Result Parameters

Design Flow: 8.9427 cfs

Gutter Depression: 0.0000 in

Area of Flow: 2.5600 ft^2

Eo (Gutter Flow to Total Flow): 0.2999

Gutter Depth at Curb: 3.8400 in

Inlet Input Parameters

Inlet Location: Inlet on Grade

Inlet Type: Grate

Grate Type: P - 1-7/8

Grate Width: 0.0000 ft

Grate Length: 0.0000 ft

Local Depression: 0.0000 in

Inlet Result Parameters

Intercepted Flow: 2.3742 cfs

Bypass Flow: 6.5684 cfs

Approach Velocity: 3.4932 ft/s

Splash-over Velocity: 2.2186 ft/s

Efficiency: 0.2655

Appendix I

Cost Estimates

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Storage Alt 1: Restore NMSU Regional Pond

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$27,000.00	$27,000.00
2	Unclassified Excavation, include disposal	CY	18000	$30.00	$540,000.00
3	Demobilization, close out documents	LS	1	$13,500.00	$13,500.00
	Construction Sub Total				*$580,500.00*
4	Contingencies		25%		$145,125.00
5	NM Gross Receipts Tax		6.500%		$37,732.50
	Total Construction Project Cost				**$763,357.50**

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Storage Alt 2: NMSU Regional Pond Automatic Outfall

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, permits, submittals	LS	1	$4,550.00	$4,550.00
2	Traffic Control	LS	1	$20,000.00	$20,000.00
3	Unclassified Excavation, include disposal	CY	50	$30.00	$1,500.00
4	24" Diameter Corrugated Culvert Pipe, complete in place	LF	180	$250.00	$45,000.00
5	Concrete Outfall Structure	LS	1	$20,000.00	$20,000.00
6	Asphalt and Concrete Repair	SY	44	$100.00	$4,444.44
7	Demobilization, close out documents	LS	1	$2,280.00	$2,280.00
	Construction Sub Total				*$97,774.44*
8	Contingencies		25%		$24,443.61
9	NM Gross Receipts Tax		6.500%		$6,355.34
	Total Construction Project Cost				**$128,573.39**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Storage Alt 3: Cole Village Pond

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$30,680.00	$30,680.00
2	Traffic Control	LS	1	$20,000.00	$20,000.00
3	Unclassified Excavation, include disposal	CY	13000	$30.00	$390,000.00
4	Riprap Slope Stabilization	SY	1189	$100.00	$118,888.89
5	Trench Drain Inlet	EA	2	$30,000.00	$60,000.00
6	36" Diameter Corrugated Culvert Pipe, complete in place	LF	75	$275.00	$20,625.00
7	Asphalt and Concrete Repare	SY	39	$100.00	$3,888.89
8	Demobilization, close out documents	LS	1	$15,340.00	$15,340.00
	Construction Sub Total				*$659,422.78*
9	Contingencies		25%		$164,855.69
10	NM Gross Receipts Tax		6.500%		$42,862.48
	Total Construction Project Cost				**$867,140.95**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Storage Alt 4: Central Heating Plant Underground Storage*

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$6,780.00	$6,780.00
2	Traffic Control	LS	1	$30,000.00	$30,000.00
3	Unclassified Excavation, include disposal	CY	50	$30.00	$1,500.00
4	6-ft Diameter Diversion Manhole	EA	2	$25,000.00	$50,000.00
5	48" Diameter Corrugated Culvert Pipe, complete in place	LF	130	$300.00	$39,000.00
6	Asphalt and Concrete Repare	SY	150	$100.00	$15,000.00
7	1000 gpm Pump, access hatch, discharge piping and valves, including power and controls	LS	1	$500,000.00	$500,000.00
8	Demobilization, close out documents	LS	1	$3,390.00	$3,390.00
	Construction Sub Total				*$645,670.00*
10	Contingencies		25%		$161,417.50
11	NM Gross Receipts Tax		6.500%		$41,968.55
	Total Construction Project Cost				**$849,056.05**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Storage Alt 5: Dispersed Green Stormwater Infrastructure

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	College near Zuhl	CY	3871	$35.00	$135,492.00
2	College Dr and Knox St	CY	419	$35.00	$14,678.30
3	Wells St Median	CY	484	$35.00	$16,936.50
5	Horseshoe Perimeter	CY	645	$35.00	$22,582.00
6	Intermural Fields Sidewalk Culverts	EA	2	$5,000.00	$10,000.00
7	Preciado Park Sidewalk Culverts	EA	3	$5,000.00	$15,000.00
8	Hardman Residence Sidewalk Culvert	EA	1	$5,000.00	$5,000.00
9	Bioswale near Universty and Jordan	LF	300	$30.00	$9,000.00
10	Bioswales in pine tyree grove west of duck pond	LF	300	$30.00	$9,000.00
	Construction Sub Total				*$237,688.80*

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Conveyance Alt 1: Stewart St Storm Drain

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$84,140.00	$84,140.00
2	Traffic Control	LS	1	$50,000.00	$50,000.00
3	5-ft Diameter Manhole	EA	5	$10,000.00	$50,000.00
4	6-ft Diameter Manhole	EA	6	$15,000.00	$90,000.00
5	24" Diameter Corrugated Culvert Pipe, complete in place	LF	689	$225.00	$155,025.00
6	36" Diameter Corrugated Culvert Pipe, complete in place	LF	729	$250.00	$182,250.00
7	48" Diameter Corrugated Culvert Pipe, complete in place	LF	2200	$300.00	$660,000.00
8	Curb Drop Inlet	EA	13	$15,000.00	$195,000.00
9	Asphalt and Concrete Repare	SY	3004	$100.00	$300,377.78
10	Demobilization, close out documents	LS	1	$42,070.00	$42,070.00
	Construction Sub Total				*$1,808,862.78*
11	Contingencies		25%		$452,215.69
12	NM Gross Receipts Tax		6.500%		$117,576.08
	Total Construction Project Cost				**$2,378,654.55**

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Conveyance Alt 2: Water Harvesting and Pedestrian Corridor (Locust to Espina)

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$144,560.00	$144,560.00
2	Traffic Control	LS	1	$75,000.00	$75,000.00
3	Unclassified Excavation, include disposal	CY	10200	$30.00	$306,000.00
4	Channel Improvements (Riprap or other)	SY	7344	$50.00	$367,200.00
5	Concrete Path 4" Thick	SY	9180	$80.00	$734,400.00
6	Pedestrian Channel Crossings	EA	6	$75,000.00	$450,000.00
7	48" Diameter Culvert Pipe, complete in place	LF	1411	$300.00	$423,300.00
8	6-ft Diameter Manhole	EA	1	$15,000.00	$15,000.00
9	Landscaping, including irrigation	SY	10404	$50.00	$520,200.00
10	Demobilization, close out documents	LS	1	$72,280.00	$72,280.00
	Construction Sub Total				*$3,107,940.00*
11	Contingencies		25%		$776,985.00
12	NM Gross Receipts Tax		6.500%		$202,016.10
	Total Construction Project Cost				**$4,086,941.10**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Conveyance Alt 3: College Dr Storm Drain

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$17,330.00	$17,330.00
2	Traffic Control	LS	1	$20,000.00	$20,000.00
3	Unclassified Excavation, include disposal	CY	100	$20.00	$2,000.00
4	42" Diameter Corrugated Culvert Pipe, complete in place	LF	753	$300.00	$225,900.00
5	Curb Drop Inlet	EA	2	$15,000.00	$30,000.00
6	Pond Inlet	EA	1	$10,000.00	$10,000.00
7	Asphalt and Concrete Repare	SY	586	$100.00	$58,566.67
8	Demobilization, close out documents	LS	1	$8,670.00	$8,670.00
	Construction Sub Total				*$372,466.67*
9	Contingencies		25%		$93,116.67
10	NM Gross Receipts Tax		6.500%		$24,210.33
	Total Construction Project Cost				**$489,793.67**

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Conveyance Alt 4: College Arroyo at Wells St

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$8,740.00	$8,740.00
2	Traffic Control	LS	1	$20,000.00	$20,000.00
3	Unclassified Excavation, include disposal	CY	75	$20.00	$1,500.00
4	36" Diameter Corrugated Culvert Pipe, complete in place	LF	420	$250.00	$105,000.00
5	36" Diameter End Section	EA	6	$1,800.00	$10,800.00
6	Concrete Roadway Cap	SY	311	$120.00	$37,333.33
7	Demobilization, close out documents	LS	1	$4,370.00	$4,370.00
	Construction Sub Total				*$187,743.33*
8	Contingencies		25%		$46,935.83
9	NM Gross Receipts Tax		6.500%		$12,203.32
	Total Construction Project Cost				**$246,882.48**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Conveyance Alt 5: Arrowhead Dr C&G From Wells to Stewart

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$45,320.00	$45,320.00
2	Traffic Control	LS	1	$20,000.00	$20,000.00
3	Unclassified Excavation, including removals & disposal	CY	2315	$20.00	$46,296.30
4	Cold Milling	SY	6944	$5.00	$34,722.22
5	Subgrade Prep, Base Course, Tack Coat complete in place	SY	6944	$15.00	$104,166.67
6	3" Asphaltic Concrete Surface Course, complete in place	SY	6944	$50.00	$347,222.22
7	Concrete Curb & Gutter, complete in place	LF	2788	$50.00	$139,400.00
8	Concrete Sidewalk, 4" thick, complete in place	SY	1204	$125.00	$150,541.67
9	Pavement Markings 4", yellow, complete in place	LF	1400	$1.25	$1,750.00
10	Landscaping, complete in place	SY	1244	$50.00	$62,222.22
11	Demobilization, close out documents	LS	1	$22,660.00	$22,660.00
	Construction Sub Total				*$974,301.30*
12	Contingencies		25%		$243,575.32
13	NM Gross Receipts Tax		6.500%		$63,329.58
	Total Construction Project Cost				**$1,281,206.20**

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Conveyance Alt 6: Arrowhead at Wells

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$2,550.00	$2,550.00
2	Traffic Control	LS	1	$10,000.00	$10,000.00
3	Unclassified Excavation, include disposal	CY	84	$20.00	$1,685.19
4	24" Diameter Corrugated Culvert Pipe, complete in place	LF	63	$225.00	$14,175.00
5	Median Drop Inlet	EA	1	$20,000.00	$20,000.00
7	Asphalt and Concrete Repair	SY	51	$100.00	$5,055.56
8	Demobilization, close out documents	LS	1	$1,280.00	$1,280.00
	Construction Sub Total				*$54,745.74*
9	Contingencies		25%		$13,686.44
10	NM Gross Receipts Tax		6.500%		$3,558.47
	Total Construction Project Cost				**$71,990.65**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Conveyance Alt 7: Wells St at Sam Steel Way

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$22,960.00	$22,960.00
2	Traffic Control	LS	1	$10,000.00	$10,000.00
3	Unclassified Excavation, include disposal	CY	1426	$20.00	$28,518.52
4	36" Diameter Corrugated Culvert Pipe, complete in place	LF	1100	$250.00	$275,000.00
5	Curb Drop Inlet	EA	4	$15,000.00	$60,000.00
7	Asphalt and Concrete Repair	SY	856	$100.00	$85,555.56
8	Demobilization, close out documents	LS	1	$11,480.00	$11,480.00
	Construction Sub Total				*$493,514.07*
9	Contingencies		25%		$123,378.52
10	NM Gross Receipts Tax		6.500%		$32,078.41
	Total Construction Project Cost				**$648,971.01**

ESTIMATED SUMMARY
OF COSTS AND QUANTITIES

Conveyance Alt 8: Sam Steel Channel Improvements

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$3,370.00	$3,370.00
2	Unclassified Excavation, include disposal	CY	100	$20.00	$2,000.00
3	36" Diameter Corrugated Culvert Pipe, complete in place	LF	100	$250.00	$25,000.00
4	12" thick concrete or rock cladding	SY	134	$300.00	$40,333.33
5	Demobilization, close out documents	LS	1	$1,690.00	$1,690.00
	Construction Sub Total				*$72,393.33*
6	Contingencies		25%		$18,098.33
7	NM Gross Receipts Tax		6.500%		$4,705.57
	Total Construction Project Cost				**$95,197.23**

ESTIMATED SUMMARY OF COSTS AND QUANTITIES

Water Quality Recommendations

ITEM NO.	ITEM DESCRIPTION	UNIT	ESTIMATED QUANTITY	UNIT COST	ESTIMATED COST
	Base Bid				
1	Mobilization, bonds, insurance, submittals	LS	1	$1,630.00	$1,630.00
2	Unclassified Excavation, include disposal	CY	344	$20.00	$6,874.07
3	Earth and Gravel Berm	LF	1278	$20.00	$25,560.00
4	Demobilization, close out documents	LS	1	$820.00	$820.00
	Construction Sub Total				*$34,884.07*
5	Contingencies		25%		$8,721.02
6	NM Gross Receipts Tax		6.500%		$2,267.46
	Total Construction Project Cost				**$45,872.56**