Salem Area Drainage Master Plan
Prepared for County of Doña Ana

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Prepared by:

SMITH ENGINEERING COMPANY
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(a) Digital models are included on DVD

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(a) Digital models are included on DVD

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EXECUTIVE SUMMARY

Description and Purpose of Project

This Drainage Report was prepared by Smith Engineering Company (Smith) to develop drainage improvement options, recommendations, and conceptual level engineer's opinions of probable costs (EOPC) for the community of Salem and the adjacent surrounding areas.

Summary of Existing Problem Areas and Proposed Options

A number of problematic areas within Salem were identified through various field observations, meetings with Doña Ana County Flood Commission (DACFC), and discussions with area residents. The majority of issues are a direct result of non-engineered conveyance systems in densely developed areas (on privately owned properties) and a lack of maintenance of said facilities. These areas are identified on Figures 3, 4 and 5 included in the Map Pocket.

The approximate contributing drainage area for Salem was provided by the DACFC. Smith analyzed and delineated a number of sub-basins within the aforementioned area. These basins were lumped into five respective scenarios: sub-basins outfalling into the Velarde Dam, the North Salem Dam, the South Salem Dam, the Reed-Thurmand Dam, and those basins that do not flow to a detention structure (Uncontrolled Basins). Existing condition HEC-HMS hydrologic models were developed for the design storms: 5-year, 10-year, and 100-year return periods of 24-hour duration. The modeling results can be found later within this report.

Smith held meetings with the DACFC and residents of Salem to present a number of possible improvements to lessen the effects of the 5-year and 10-year design storm events. From these meetings, a total of nine (9) different options were developed to help mitigate stormwater runoff within the community of Salem. Options 1 through 7 and 9 directly affect the developed area of Salem; while Option 8 affects the uncontrolled basin just west of Salem. Various Option schematics and resulting hydrologic benefits of each Option can be found within Section 3 of this report.

Conclusions and Recommendations

Based on input from the DACFC and area residents, the various options were narrowed down to the most efficient, cost effective, and constructible. The selected options are Options 4, 5, 6, and 7. A Composite Option and corresponding HEC-HMS hydrologic model was built to model the affects of the selected improvements. The results and schematic of the Composite Option can be found in Section 4 of this report.

Smith recommends the Composite Option for consideration of the Doña Ana County Flood Commission based on the existing conditions within the community of Salem; in conjunction with maintenance of existing storm drainage systems.

If improvements are not implemented within the next five (5) or so years, or if significant change(s) occur within Salem or adjacent areas, the modeling, subsequent results, and proposed improvements should be re-visited and evaluated in detail.
SECTION 1. GENERAL PROJECT INFORMATION

1.1 Description and Purpose of Project

The Doña Ana County Flood Commission (DACFC) authorized Smith to prepare this Drainage Master Plan. The purpose is to develop drainage improvement options, recommendations, and conceptual level engineer’s opinions of probable costs (EOPC) for the community of Salem and the adjacent surrounding areas. Figure 1 presents the Salem Vicinity Map.

Figure 1: Salem Project Vicinity Map

1.2 Field Observation

Smith conducted three field observations in August, September, and November 2015. Appendix 1 contains annotated photographs of the various locations in the Salem community and some existing drainage infrastructure.
SECTION 2. EXISTING HYDROLOGIC AND HYDRAULIC ANALYSES

2.1 Existing Flood Control Structures

The Salem Basin contains four small dams or “floodwater retarding structures” designed and built by the USDA Soil Conservation Service in cooperation with the Caballo Soil Conservation District. The Construction Plans for each dam are included in Appendix 2. The dam names and basic data are presented in the following table.

<table>
<thead>
<tr>
<th>Name – Year Built</th>
<th>Drainage Area</th>
<th>Pond Depth to Top of Dam (Nov. 2015 *)</th>
<th>Maximum Storage Volume to Top of Dam (Nov. 2015 *)</th>
<th>Principal Spillway Pipe Diameter</th>
<th>Emergency Spillway Length*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velarde Arroyo Floodwater Retarding Structure 1957</td>
<td>2.95</td>
<td>30</td>
<td>471</td>
<td>18 inches</td>
<td>200 feet</td>
</tr>
<tr>
<td>North Salem Arroyo Floodwater Retarding Structure 1956</td>
<td>3.78</td>
<td>20</td>
<td>280</td>
<td>18 inches</td>
<td>200 feet</td>
</tr>
<tr>
<td>South Salem Arroyo Floodwater Retarding Structure 1959</td>
<td>0.91</td>
<td>14</td>
<td>95</td>
<td>18 inches</td>
<td>120 feet</td>
</tr>
<tr>
<td>Reed-Thurmand Arroyo Floodwater Retarding Structure 1958</td>
<td>3.69</td>
<td>14</td>
<td>362</td>
<td>24 inches</td>
<td>200 feet</td>
</tr>
</tbody>
</table>

*Computed by Smith based on DAC Lidar 2 foot contours

The other significant structure is a reinforced concrete grade control or “drop structure” located immediately east of Grande Avenue and 200 feet south of Salem Street. Appendix 1 contains annotated photographs of this structure.

2.2 Drainage Basin Description and Basin Delineation

A. Drainage Basin Description

Most of the basin is undeveloped range land with mild to steep topography. The community of Salem is the developed urban area, and the remaining land use is agricultural land in the valley areas below the four dams and below the steep hills as can be seen on Figures 3, 4 and 5 (map pocket).
Interstate 25 (I-25) passes through the basin and has many culverts that provide stormwater conveyance under I-25. NM 187 is the other main highway that is located at the southern end of the drainage basin, and it has a few culvert locations that convey stormwater south of the highway.

B. FEMA Floodplains

FEMA has developed Flood Insurance Rate Maps (FIRMs) for the Salem area and these are dated September 27, 1991 (a copy of these are included in Appendix 2). Note that only Approximate A Floodzones have been delineated and the maps are at a very small scale.

C. Drainage Basin Delineation

Figures 3, 4 and 5 (map pocket) presents the drainage basin and sub-basin delineations. The orthophotography date is 2010 and date of the Lidar two foot contours development is 2010.

The sub-basin numbering scheme was assigned as listed here:

- **Sub-basins numbered 1 through 29**
  These are uncontrolled meaning they do not outfall into any of the four dams.

- **Sub-basins numbered in the 100 series**
  Outfall into the Velarde Dam

- **Sub-basins numbered in the 200 series**
  Outfall into the North Salem Dam

- **Sub-basins numbered in the 300 series**
  Outfall into the South Salem Dam

- **Sub-basins numbered in the 400 series**
  Outfall into the Reed-Thurmand Dam

Analysis points were determined based on the following:

1. Outfall locations based on topography
2. Culvert and drainage channel locations
3. Existing features (dams, principal and emergency spillway outfall locations)
4. East side of the most dense Salem development
5. Drainage paths (soil or streets) within Salem
6. Street locations

The total area of all sub-basins is 14.5 square miles.
2.3 Drainage Analysis Criteria and Program

A. Design Storm

The DACFC requested that the design storms shall be the 5-year and 10-year 24-hour storms. The proposed options will not include design for the 100-year 24-hour storm, although the results will be included.

B. Hydrologic Computer Program

The US Army Corps of Engineers “HEC-HMS - Hydrologic Modeling System” program or commonly called “HEC-HMS” (Version 4.0) was selected for simulation of basin storm rainfall – runoff for existing basin and also for the proposed options.

C. Existing Dams

The DACFC stated that none of the four dams were designed as flood control dams with respect to present dam design standards. Therefore, none of these dams will meet criteria and regulations as specified by the NM State Engineers Dam Safety Bureau (NMOSE DSB).

In the existing and proposed options HEC-HMS models, all four dams will be assumed to remain in place the 100-year, 10-year and 5-year, 24-hour durations storms.

2.4 Rainfall Data

A. Rainfall Distribution

The study basin is located within the USDA Natural Resources Conservation Service (NRCS) (previously the Soil Conservation Service (SCS)) Type II rainfall distribution area as defined by the NRCS. Please refer to Appendix 4 for Figure B-2 that illustrates the Type II boundaries.

However, the DACFC dictated that the 25% Frequency Storm Distribution be adopted. That distribution is available in the HEC-HMS program and it places most of the rainfall in a short period at 25% of the storm duration, or at 6 hours for a 24-hour storm. Appendix 3 contains Figures R1-Cumulative and Figure R2-Incremental rainfall distribution.

B. Areal Reduction Factors

Areal reduction factors were considered from Figure 14 – NOAA Atlas 2, Vol. IV, Appendix 4 contains a copy. NOAA 14 has not yet developed areal reduction factors. The total basin area = 14.5 square miles, however the sub-basin drainage areas to the four dams and outfall locations are small and range from about 1 square mile to about 3.7 square miles. Therefore a rainfall areal reduction factor is not applicable and was not applied.
C. Point Rainfall Data

Point rainfall data for the 5-year, 10-year, and 100-year return period storms for various durations were obtained from NOAA Atlas 14 website for the lower basin (west of I-25) and also for the upper basin (east of I-25).

Appendix 4 contains the printouts from the NOAA Atlas 14 point rainfall data results. The point rainfall depths are basically identical between the lower and upper basins, therefore the upper basin point depths were assumed applicable to the entire basin model. Table 1 (Appendix 3) contains the point rainfall depth data.

2.5 Soils Data and Runoff Curve Numbers (CNs)

Soils data used to determine Runoff Curve Numbers (CNs) were obtained from the Natural Resources Conservation Service (NRCS) internet site Web Soil Surveys as follows:


Appendix 4 contains the Web Soil Survey information. The Figures in Appendix 4 illustrate the soil map unit locations and tables that summarize the hydrologic soil groups and cover types for the various soil map units.

Table 3 (Appendix 3) contains a summary of the CNs for each sub-basin and the areal weighted CN data and results for all sub-basins. The data and assumptions applied to develop Table 3 are based on the following:

A. Antecedent Runoff Condition II (ARC II) is defined as the soil average runoff condition (moisture condition) by the NRCS. Antecedent Runoff Condition III (ARC III) is defined as the wetter soil condition. For all sub-basins denoted as “Arid and Semiarid Rangelands” with “Desert Shrub Cover Type” a composite (average) CN value between ARC II CN and ARC III CN was adopted.

B. Hydrologic Soil Group (A, B, C, or D) – Determined by the NRCS per soil map unit (Appendix 4 contains the Web Soil Survey Data).

C. Land Use Type is either – arid rangeland (most sub-basins), urban (within the community of Salem) or cultivated agricultural land. The orthophotography as presented on the Drainage Basin Maps (map pocket) was used to make the land use type determinations. The CN tables are obtained from “Urban Hydrology for Small Watersheds, US Dept of Agricultural Soil Conservation Service, Technical Release 55 (TR-55), June 1986. *

D. The TR-55 CN tables are listed here:

Table 2-2a Runoff Curve Numbers for Urban Areas. *
Table 2-2b Runoff Curve Numbers for Cultivated Agricultural Land. *
Table 2-2c Runoff Curve Numbers for Other Agricultural Lands. *
Table 2-2d Runoff Curve Numbers for Arid and Semiarid Rangelands. *
E. Cover Type, Hydrologic Condition and Percent Imperviousness

Arid Rangeland - assumed Cover Type and Hydrologic Condition – Desert Shrub, etc., poor hydrologic condition (Table 2-2d applies)

Urban - assumed Cover Type and Average Impervious Area – 1/8 acre., 65% impervious (Table 2-2a applies)

Cultivated Agricultural Land - assumed Cover Type and Hydrologic Condition – Row Crops – Straight Row. 65%, poor hydrologic condition (Table 2-2b applies)

F. CN selections were based on the previous data, assumptions and NRCS soils data / and Tables.

G. Areal weighted CNs were computed by areal weighting the CN per soil map unit by the acreage of that map unit relative to the total sub-basin acreage.

2.6 Split hydrographs for Sub-basins

A. Purpose

When sub-basins are mostly homogeneous in terms of land use type and runoff curve numbers are similar, an areal weighted CN approach may be acceptable. When non-homogeneous land use types occur and a greater range of CNs occur between those land used types, the sub-basin runoff is more accurately simulated with split hydrographs as described in Subsection 2.6.B.

Sub-basins sb.14, sb.19 and sb.20 are located below the North and South Salem Dams and have both undeveloped and developed area (refer to Figures 5 and 6 – map pocket). For these three sub-basins, the most appropriate way to simulate the runoff is simulate the pervious sub-basin area with one hydrograph and the impervious sub-basin area with another hydrograph. The total basin hydrograph is the combination of both hydrographs (“split hydrographs”).

Hydrograph 1 of 2 hydrographs will simulate the pervious or undeveloped sub-basin area and will have a sub-basin name such as sb.14P (“P” for pervious). Hydrograph 2 of 2 hydrographs will simulate the impervious or developed sub-basin area and will have a sub-basin name such as sb.14I (“I” for impervious). The pervious area CN values are computed in Table 3 (Appendix 3). The impervious area CN values are computed in Table 3.1 (Appendix 3) as described here.

B. Impervious Area Assumptions and Computations for Sub-basins sb14, sb.19, & sb.20

1. Measure the developed and graded approximate limits, and compute that total area in square feet, acres and square miles.

2. Measure a typical roof in the developed area, and count the number of roofs in the developed area, multiply number of roofs by typical area, to compute the total impervious roof area in square feet and acres.
3. From TR-55 Table 2-2a (end of Table 3), the CN for a roof for any Hydrologic Soil Group CN = 98.

4. Assume the remainder of the developed area is compacted gravel and dirt roads. The gravel - road area equals the total developed area minus the roof area. From TR-55 Table 2-2a, assume "Gravel (including right-of-way)" and Hydrologic Soil Group B, therefore the CN = 85.

5. Compute an areal weighted CN value for the developed area based on the roof area and CN = 98, and the remaining gravel area CN = 85.

### 2.7 Travel Time (Tt), Time of Concentration (Tc) and Unit Hydrograph Lag Time (TL) Computations and Unit Hydrograph

A water course may have up to three sub-reaches that comprise the longest flow path. The upper overland flow reach, then a shallow concentrated flow reach followed by a channel reach. The NRCS TR-55 Tt and Tc method was applied to each water course. The time of concentration (Tc) for the watercourse equals the summation of travel times (Tt) from each sub-reach. Appendix 4 contains the TR-55 description and procedures.

The NRCS Unit Hydrograph Lag Time Method (TL) was applied to the Tc to compute the unit hydrograph Time to Peak (Tp). Note that Lag Time = 0.6 Tc. Appendix 4 contains the reference pages from Part 630 Hydrology, National Engineering Handbook, May 2015, Chapter 15 that describes the lag time concept and method.

Manning’s Roughness Coefficients “n” assumptions were obtained from TR-55, by experience and by review of “n” value tables by Chow, 1959 (copies include in Appendix 4).

Channel slopes were computed from elevations and length measurements from the drainage basin maps using the DACFC supplied imagery and LIDAR data (map pocket). Typical channel widths were also measured from the drainage basin maps.

Tables 4.1 through 4.5 (Appendix 3) summarizes the travel time, time of concentration and lag time data and results. Table 2 (Appendix 3) also presents the lag time results.

### 2.8 Channel Routing

The Muskingum-Cunge channel routing method was applied to route hydrographs. Figures 3, 4, and 5 (map pocket) illustrates the routing reaches. Manning’s “n” values were assumed based on experience and the Manning’s “n” values from Chow, 1959 and locations of routing reaches as observed on the drainage basin maps. Bottom width assumptions were determined as the typical channel width from the drainage basin maps. Table 5 (Appendix 3) presents the Muskingum-Cunge channel routing input data summary.

Note that runoff losses to channel bed infiltration and percolation were assumed to be small and were therefore not simulated.
2.9 **Sediment Bulking**

The HEC-HMS models simulate clear water hydrographs unless a “Flow Ratio” is applied to simulate sediment volume within hydrographs that is also called sediment bulking. Note that a sediment bulking value of about 17% is considered the limit before mud flow would occur. Due to lack of site specific data, a sediment bulking factor of 10% or a factor of 1.10 was assumed for all sub-basin hydrographs. That assumption is based on review of information presented in Sediment and Erosion Design Guide, Nov. 2008, Mussetter Engineering Inc. Appendix 4 contains a copy of relevant pages from that document.

2.10 **Computation Time Increment for HEC-HMS Models**

The computation increment assumed within a HEC-HMS model may make a large difference in model peak discharge results particularly for large drainage basins. Guidance on computation intervals was found in a Digital Engineering Library (McGraw-Hill, a copy included in Appendix 4) and summarized here.

Compute / select the computation time increment based on Time of Concentration (Tc) and the following equation:

\[
\frac{Tc}{5} \leq \text{computation time increment} \leq \frac{Tc}{3}
\]

Table 6 (Appendix 3) contains a summary of all sub-basin Tcs and the average Tc. The results of the rule above produce a computation interval of 10 minutes. However, at the direction of Doña Ana County, a 1 minute computation interval was selected for all sub-basins.

2.11 **Reservoir Routing Data**

Elevation – Area – Storage – Discharge data, assumptions and computations for each dam are summarized in Tables within Appendix 3 as follows:

- Table 7 V Dam: Velarde Dam Elevation-Storage-Discharge Data
- Table 8 NS Dam: North Salem Dam Elevation- Storage-Discharge Data
- Table 9 SS Dam: South Salem Dam Elevation- Storage-Discharge Data
- Table 10 RT Dam: Reed-Thurmand Dam Elevation- Storage-Discharge Data

Elevation – area data were computed by Smith based on the DAC Lidar 2 foot contour data. The principal spillway diameters were obtained from the Construction Plans (Appendix 2) and the emergency spillway widths were measured on the drainage basin maps using the DACFC supplied aerial imagery and LIDAR data (map pocket).

2.12 **Inflow-Diversion Functions**

Inflow-Diversion Functions were applied to each of the dam outflow hydrographs or “reservoir routed hydrographs”. The purpose of simulating the routed hydrographs with this method is that this “function” allows separation of the outflow hydrograph into two hydrographs as described.
Here. The first hydrograph or “diversion” hydrograph represents the principal spillway flow and the second hydrograph or “main” hydrograph represents the emergency spillway flow (if any).

The inflow-diversion rating curves that apply to the reservoir outflow hydrograph for each dam are summarized in Tables within Appendix 3 as follows:

- Table 7.1 V Dam: Velarde Dam Inflow-Diversion Data
- Table 8.1 NS Dam: North Salem Dam Inflow-Diversion Data
- Table 9.1 SS Dam: South Salem Dam Inflow-Diversion Data
- Table 10.1 RT Dam: Reed-Thurmand Dam Inflow Diversion Data

### 2.13 HEC-HMS Hydrologic Models

Figures EX1 through EX10 (included in Appendix 5) presents the HEC-HMS model schematics along with a generic legend.

The following output summary tables are included in Appendix 5.

- Table 18 5-year 24-hour Storm Existing Conditions Hydrologic Summary
- Table 19 10-year 24-hour Storm Existing Conditions Hydrologic Summary
- Table 20 100-year 24-hour Storm Existing Conditions Hydrologic Summary
- Table 21 Reservoir Routing Summary

**Table 21** is also presented on the following page. The table results indicate that the 5-year 24-hour duration storms remain below the emergency spillways for all four dams.

The 10-year 24-hour storms are contained below the emergency spillways in the Velarde, South Salem, and Reed-Thurmand Dams, however, that storm will spill through the emergency spillway in the North Salem Dam.

The 100-year 24-hour storm will spill through the emergency spillways in all four of the dams.

**Appendix 5** also contains the HEC-HMS “reservoir routing” output and the “inflow-diversion” function output for each dam.
<table>
<thead>
<tr>
<th>Reservoir - Detention Pond Name</th>
<th>Principal Spillway Pipe Diameter</th>
<th>Return Period / year</th>
<th>Peak Inflow</th>
<th>Peak Outflow</th>
<th>Inflow Runoff Volume</th>
<th>Outflow Runoff Volume</th>
<th>Maximum Design Storage Volume (top of embankment)</th>
<th>100Yr - 24 Hr Peak Storage Volume</th>
<th>Peak Water Surface Elevation</th>
<th>Emergency Spillway Elevation</th>
<th>Pond Invert Elevation</th>
<th>Max Pond Depth</th>
<th>Peak Water Depth</th>
<th>Top of Pond Embankment Elevation</th>
<th>Freeboard to Emergency Spillway Elevation</th>
<th>Freeboard to top of Pond Embankment</th>
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<td>Velarde Dam 18 100 / 24</td>
<td></td>
<td>3,263</td>
<td>268</td>
<td>318.2</td>
<td>318.2</td>
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<td>238.9</td>
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<td>168.3</td>
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<td>4144.50</td>
<td>4122.00</td>
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<td>4152.00</td>
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<td>14</td>
<td>7.1</td>
<td>4106.00</td>
<td>2.4</td>
<td>6.9</td>
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</tbody>
</table>

a - Appendix 2 contains the As-built plans see Drainage Basin Maps (located in map pocket) for locations
b - From plans located in Appendix 2
c - From HEC-HMS model output included in Appendix 5
d - See Elevation-Storage-Discharge data tables included in Appendix 3. Elevation - Area data were developed from the DAC Lidar 2-foot contours, storage volume computed from that data.
e - Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights
f - Negative number indicates the flow depth exceeds referenced elevation - no freeboard available therefore cell highlights (Spills through emergency spillway or top of dam by this depth)
2.14 Existing Drainage Infrastructure Hydraulic Capacities

A. Existing Drainage Infrastructure

The existing drainage infrastructure (excluding the four dams) in the vicinity of Salem are limited. These structures are labeled on Figures 3, 4 and 5 and include the following facilities:

1. Small soil channel located on the north side of Salem that drains east to west from near the northeast corner of Salem. This soil channel will be called Channel ECH1 and it has several culvert / road crossings. Channel ECH1 then drains south basically through the soil yards of residents and outfalls just south of Salem St. This soil channel will be called Channel ECH2. Channel ECH2 outfalls to a larger soil channel located just east of Grande Avenue that will be called Channel ECH3.

2. Channel ECH3 contains a grade control or “drop structure” located in the soil channel located just east of Grande Avenue and about 200 feet south of Salem Street.

3. Channel ECH3 outfalls to a channel that drains south, parallel to Grande Avenue and that channel will be called Channel ECH4.

4. Channel ECH4 diminishes at the northeast corner of NM 187 and Grande Avenue at the entrance to the Franzoy Produce Warehouse. Beyond this driveway, heading southeast, Channel ECH5 begins and daylights across NM 187 at culvert EC1.

5. Channel ECH6 is located northeast of the intersection of NM 187 and Saratoga Street. It conveys the outflow (both principal and emergency spillways) from the Velarde Dam across the agricultural fields leaving the Salem area through existing culvert EC4.

6. Four drainage culvert crossings are located along NM 187 and these are labeled as culverts EC1, EC2, EC3, and EC4. Please refer to Figures 4 and 5 (map pocket for their locations).

7. The existing dirt road (ER1-Ford Street) on the east side of the community of Salem acts as a conveyance system. It runs from the start of ECH1 south to its intersection with Salem Street.

B. Open Channel Hydraulic Capacities

Rough hydraulic capacities of Channels ECH1, ECH2, ECH3, ECH4, ECH5, ECH6, and ER1 were computed with the FlowMaster Program (output included in Appendix 7).
Smith engineers estimated the typical channel size based on photographs and field observation. The hydraulic summary of those channels as compared to the 5-year, 10-year and 100-year storm peak discharges are presented in Table 60 in Appendix 7.

C. Culvert Hydraulic Capacities

Rough culvert capacities were computed with the Bentley CulvertMaster program (output is included in Appendix 7). During the basin field observation, Smith engineers measured the following culvert related dimensions:

1. number of culverts,
2. material and culvert diameter or dimensions
3. open culvert area to soffit
4. maximum available headwater depth to edge of road

The culvert hydraulic summary as compared to the 5-year, 10-year and 100-year storm peak discharges are presented in Table 61 in Appendix 7.
SECTION 3. OPTIONS HYDROLOGIC & HYDRAULIC ANALYSES

3.1 Proposed Options Hydrologic Data

Many of the assumptions (hydrologic) made in the existing model were replicated in the HEC-HMS Proposed Option Models. Brief synopses of the assumptions carried over are presented below:

A. Model computation time increment – 1 minute
B. No additional Sub-Basins were created in the proposed options models
C. Soils data and runoff curve numbers values for each Sub-Basin remain unchanged
D. The storm events models in the existing conditions model are the same events used to create the proposed options models

Additional reservoirs and conveyance channels are proposed in a number of the Options models. The reservoir routing summary results are included in Table 46 (Appendix 6). The channel routing summary and capacity results for the proposed improvements are included in Table 62 (Appendix 7).

3.2 Conceptual Design Options

The following design options were considered for conceptual level design:

A. Open Channels
B. Roadway Improvements
C. Detention Ponds: Multiple Use/Storm Water Quality Improvements

Conceptual level Engineer’s Opinion of Probable Costs (EOPC) were prepared for each viable option selected by the DACFC. The total cost includes for contingency, engineering, and 2016 New Mexico Gross Receipts Tax (NMGRT). Construction Phase Services have not been included. The conceptual level EOPC estimates are presented later in this plan.

3.3 Most Significant Drainage Problem Areas

The developed areas of Salem are the most adversely affected by storm events. This is due to the lack of engineered facilities within the development to handle stormwater runoff. There are a number of conveyance facilities not designed to handle any certain storm event, but only to help alleviate the affects to adjacent properties. The primary focus of the Proposed Options will be to intercept stormwater runoff upstream of the developed areas and utilize controlled release through Salem without adverse affects to the residents.
3.4 Analyses and Options Summary

Proposed Options 1 through 7 and Option 9 directly affect the community of Salem; while proposed Option 8 affects the uncontrolled basin just west of Salem. Each proposed option was simulated as a standalone hydrologic model; except as denoted later some of the proposed improvements are combined in various options.

A. OPTION 1 (Refer to Figure OPT 1)

1. Option 1 Purpose

Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem area from Sub-Basin 14 (sb.14) during any rainfall event. The purpose of Option 1 is to detain the runoff generated within sb.14 and utilize controlled release of stormwater into Salem.

2. Option 1 Description

Simulate a single detention pond complete with both a principal outlet and an emergency spillway. Sub-Basin 14 (sb.14) Pond (on vacant privately owned land at the south end of the basin).

a. Assume all of sb.14 outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.

b. The sb.14 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 2.1 ac-ft).

c. Pond principal outlet (12” CMP) will release a controlled volume of detained water to continue downstream along its natural course.

d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded. Should the pond ever become silted in, the spillway would still be capable of passing the 100-year design storm.

e. Assume the North and Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

Figure OPT 1 – See following page

4. Option 1 Result:

sb.14 Detention Pond

a. will detain all 5-year peak inflow volume of 0.7 ac-ft.

b. will detain all 10-year peak inflow volume of 1.0 ac-ft.

c. will detain all 100-year peak inflow volume of 2.1 ac-ft.

d. See Figure OPT 1 (next page) for reservoir routing data and freeboard summary.

5. Option 1 Conclusion:

The pond is very effective for the 5-, 10-, and 100-year storm events.
Table 3: OPTION 1

<table>
<thead>
<tr>
<th>Sub-Basin</th>
<th>Proposed Detention Pond</th>
<th>Elevation</th>
<th>Storage Volume</th>
<th>Volume Runoff</th>
<th>Volume Inflow</th>
<th>Period / Runoff</th>
<th>Inflow Rate</th>
<th>Outflow Rate</th>
<th>Invert Elevation</th>
<th>Design Storage</th>
<th>Outflow Elevation</th>
<th>Design Inflow Rate</th>
<th>Freeboard to Top</th>
<th>Freeboard to Pond</th>
<th>Top of Pond</th>
<th>Principal Pipe Outlet from Dam</th>
<th>Proposed Pipe Outlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>ab.14P</td>
<td>8.20 AC</td>
<td>42.70 EF</td>
<td>3.00 AC</td>
<td>3.00 AC</td>
<td>3.00 AC</td>
<td>5.00 AC</td>
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<td>8.20 AC</td>
<td>42.70 EF</td>
<td>8.20 AC</td>
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<tr>
<td>ab.19P</td>
<td>8.20 AC</td>
<td>42.70 EF</td>
<td>3.00 AC</td>
<td>3.00 AC</td>
<td>3.00 AC</td>
<td>5.00 AC</td>
<td>8.20 AC</td>
<td>42.70 EF</td>
<td></td>
<td></td>
<td>8.20 AC</td>
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<td></td>
<td>8.20 AC</td>
<td>42.70 EF</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. The values in the elevation and storage volume columns are calculated based on the conceptual design.
2. Freeboard to Top of Pond is calculated based on the flow depth exceeds referenced elevation - no freeboard available therefore no highlighting of cells through emergency spillway or toe of dam by this depth.
3. The following values are not calculated or are included in subsequent calculations:
   a. Freeboard to Top of Pond
   b. Flow depth

Legend:
- MAJOR BOUNDARY
- SUB-BASELINE
- PRINCIPAL PIPE OUTLET FROM DAM
- EXISTING PROPERTY LINE
- PROPOSED IMPROVEMENTS

Note: Digital orthophotography and linear components completed in 2018 by DOAG. GAGE: FOR PLANNING PURPOSES ONLY. FOR CONSTRUCTION, BIDDING, OR PERMITTING PURPOSES, USE THE CONSTRUCTION PLAN FOR SUBMISSION.
B. OPTION 2 (Refer to Figure OPT 2)

1. Option 2 Purpose

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from Sub-Basin 19 (sb.19) during any rainfall event. The purpose of Option 2 is to detain the runoff generated within sb.19 as well as the stormwater released from the North Salem Dam, via the principal outlet, prior to its continuing downstream into Salem.

2. Option 2 Description

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   Sub-Basin 19 (sb.19) Pond (on vacant privately owned land at the south end of the basin).

   a. Assume all of sb.19 outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.
   b. The sb.19 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 3.5 ac-ft).
   c. Pond principal outlet (12" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
   e. Assume the North Salem Dam is in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 2 – See following page

4. Option 2 Result:

   sb.19 Detention Pond

   a. will detain a minimal amount of the 5-year peak inflow volume of 181.5 ac-ft.
   b. will detain a minimal amount of the 10-year peak inflow volume of 229.9 ac-ft.
   c. will detain a minimal amount of the 100-year peak inflow volume of 239.4 ac-ft.
   d. See Figure OPT 2 (next page) for reservoir routing data and freeboard summary.

5. Option 2 Conclusion:

   The pond is not effective for any of the design storms. The release (through the principal spillway) from the North Salem Dam inundates the proposed detention pond in Option 2.
C. **OPTION 3 (Refer to Figure OPT 3)**

1. **Option 3 Purpose**

   Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from the undeveloped portions of Sub-Basin 20 (sb.20P) during any rainfall event. The purpose of Option 3 is to detain the runoff generated within sb.20P and utilize controlled release of stormwater into Salem.

2. **Option 3 Description**

   Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

   Sub-Basin 20P (sb.20P) Pond (on vacant land owned and administered by the Bureau of Land Management [BLM]).

   a. Assume all of sb.20P outfalls into the pond. This is not completely accurate, but for the modeling purposes will provide a slight excess in storage capacity.
   b. The sb.20P pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 3.8 ac-ft).
   c. Pond principal outlet (12” CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   d. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded. Should the pond ever become silted in, the spillway would still be capable of passing the 100-year design storm.
   e. Assume the North and South Salem Dams are in place.

3. **Conceptual Pond Grading Plan(s) are as follows:**

   **Figure OPT 3** – See following page

4. **Option 3 Result:**

   sb.20P Detention Pond

   a. will detain all of the 5-year peak inflow volume of 0.5 ac-ft.
   b. will detain all of the 10-year peak inflow volume of 0.9 ac-ft.
   c. will detain approximately half of the 100-year peak inflow volume of 7.7 ac-ft.
   d. See **Figure OPT 3** (next page) for reservoir routing data and freeboard summary.

5. **Option 3 Conclusion:**

   The pond is very effective for the 5- and 10-year design storms. Approximately half of the 100-year design storm would be detained in this detention pond.
D. OPTION 4 (Refer to Figure OPT 4)

1. Option 4 Purpose

Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff enters the Salem Area from Sub-Basin 23 (sb.23) during any rainfall event. The purpose of Option 4 is to re-route the runoff generated within sb.23 as well as the stormwater released from the South Salem Dam, via the principal outlet, into Sub-Basin 22 (sb.22). The stormwater runoff will continue south along Ford Street bypassing most of the developed areas of Salem under Option 4A. Option 4B presents an alternate alignment to Option 4A; namely an earthen channel adjacent (east side) to Ford Street to convey stormwater runoff south towards Salem Street. At Salem Street the stormwater would be conveyed beneath the roadway in a concrete box culvert (CBC).

2. Option 4 Description

Simulate a channel capable of conveying the intercepted stormwater runoff into Ford Street or the earthen channel adjacent to Ford Street.

a. sb.23 Channel (on vacant land owned and administered by the Bureau of Land Management [BLM])
   i. Assume approximately 97-percent of the stormwater runoff generated in sb.23 and all of the stormwater released from the South Salem Dam principal outlet will be re-routed into sb.22.
   ii. The sb.23 channel is sized to convey the 100-year/24-hour stormwater runoff.

b. Roadway/Grading Improvement to Ford Street (Option 4A):
   i. Grade improvements will be required along the north end Ford Street; adjacent to the Cemetery and private residences, to create positive slope from sb.23.
   ii. Assume concrete curb and gutter will be placed along Ford Street, as well as a paved inverted crown street for erosion protection and conveyance of stormwater.

c. Channel (adjacent to Ford Street – Option 4B):
   i. Grade improvements will be required along the northern end east of Ford Street to create positive slope.
   ii. A low flow channel crossing will be installed across the private roadway, along the southern end of the cemetery.
   iii. The channel (PCH 4.B) is sized to convey the 100-year/24-hour stormwater runoff.

d. Assume that the North and South Salem Dams are in place.
3. Conceptual Grading Plan(s) are as follows:

**Figure OPT 4** – See following page

4. Option 4A Result:

   a. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 5-year peak discharge of 23 cfs.
   b. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 10-year peak discharge of 30 cfs.
   c. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 100-year peak discharge of 57 cfs.
   d. See **Figure OPT 4** for flow depths in the proposed channel and Ford Street.

5. Option 4B Result:

   a. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 5-year peak discharge of 23 cfs.
   b. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 10-year peak discharge of 30 cfs.
   c. The proposed channels (PCH4 and PCH 4.B) and the proposed CBC will convey the 100-year peak discharge of 57 cfs.
   d. See **Figure OPT 4** for flow depths in the proposed channels.

6. Option 4 A/B Conclusion:

   The proposed channel(s) and/or improvements to Ford Street can redirect the intercepted flow from the subject areas for each of the design storm events.
E. OPTION 5 (Refer to Figure OPT 5)

1. Option 5 Purpose

This option should be used in conjunction with Option 4. The purpose of Option 5 is to re-route the stormwater runoff from the undeveloped portion of Sub-Basin 20 (sb.20P) and any stormwater runoff leaving the South Salem Dam, via the emergency spillway, into the channel and improvements to Ford Street proposed in Option 4 (PCH4 and PR1). The stormwater runoff will continue south along Ford Street bypassing most of the developed areas of Salem under Option 4A. Option 4B presents an alternate alignment to Option 4A; namely an earthen channel adjacent (east side) to Ford Street to convey stormwater runoff south towards Salem Street. At Salem Street the stormwater would be conveyed beneath the roadway in a concrete box culvert (CBC).

2. Option 5 Description

Simulate a channel capable of conveying the intercepted stormwater runoff into the channel (PCH4) and the Ford Street Improvements (PR4) proposed in Option 4A or into channel (PCH4) and then south along the channel parallel to Ford Street (Option 4B).

   a. sb.20 Channel (on vacant land owned and administered by the Bureau of Land Management [BLM])

      i. Assume the stormwater runoff generated by the pervious portion of Sub-Basin 20 (sb.20P) will be re-routed into the sb.23 channel (Option 4)
      ii. The sb.20 channel is sized to convey the 100-year/24-hour stormwater runoff.

3. Conceptual Grading Plan(s) are as follows:

   Figure OPT 5 – See following page

4. Option 5 Results with Option 4A:

   a. The proposed channel (PCH5) will convey the 5-year peak discharge of 3 cfs.
   b. The proposed channel (PCH5) will convey the 10-year peak discharge of 6 cfs.
   c. The proposed channel (PCH5) will convey the 100-year peak discharge of 66 cfs.
   d. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 5-year peak discharge of 26 cfs.
   e. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 10-year peak discharge of 36 cfs.
   f. The proposed channel (PCH4) and the proposed improvements to Ford Street (PR4) will convey the 100-year peak discharge of 100 cfs.
   g. See Figure OPT 5 for flow depths in the proposed channel (PCH4) and Ford Street.
   h. See Figure OPT 5 for flow depths in the proposed channel PCH5.
5. Option 5 Results with Option 4B:

a. The proposed channel (PCH5) will convey the 5-year peak discharge of 3 cfs.
b. The proposed channel (PCH5) will convey the 10-year peak discharge of 6 cfs.
c. The proposed channel (PCH5) will convey the 100-year peak discharge of 66 cfs.
d. The proposed channels (PCH4 and PCH 4.B) will convey the 5-year peak discharge of 26 cfs.
e. The proposed channels (PCH4 and PCH 4.B) will convey the 10-year peak discharge of 36 cfs.
f. The proposed channels (PCH4 and PCH 4.B) will convey the 100-year peak discharge of 100 cfs.
g. See Figure OPT 5 for flow depths in the proposed channels (PCH4 and PCH 4.B)
h. See Figure OPT 5 for flow depths in the proposed channel PCH5.

6. Option 5 Conclusion:

The proposed channel(s) and/or improvements to Ford Street can redirect the intercepted flow from the subject areas for each of the design storm events.
F. OPTION 6 (Refer to Figure OPT 6)

1. Option 6 Purpose

Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from upstream Sub-Basins 17 and 22 (sb.17 and sb.22) could be intercepted before inundating downstream agricultural lands.

2. Option 6 Description

Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

a. Sub-Basin 16 (sb.16) Pond (on Doña Ana County Owned park at the north end of the basin).
   i. Assume all of Sub-Basins 17 and 22 (sb.17 and sb.22) outfalls into the pond.
   ii. Assume that the proposed improvements in Options 4 and 5 will not be constructed.
   iii. The sb.16 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 5.1 ac-ft).
   iv. Channelization to capture flows from each of the aforementioned sub-basins will be required.
   v. Pond principal outlet (12” CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   vi. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
   vii. Assume that both the North and South Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 6 – See following page

4. Option 6 Result:

   sb.16 Detention Pond
   a. will detain all 5-year peak inflow volume of 2.1 ac-ft.
   b. will detain all 10-year peak inflow volume of 3.2 ac-ft.
   c. will detain approximately half of the 100-year peak inflow volume of 7.4 ac-ft.
   d. See Figure OPT 6 (next page) for reservoir routing data and freeboard summary.

5. Option 6 Conclusion:

   The pond is very effective for the 5- and 10-year storm events; and is capable of detaining approximately half of the stormwater runoff during the 100-year storm event.
## Table 4 - Option 6

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<thead>
<tr>
<th>Sub-Basin</th>
<th>MAX Depth</th>
<th>WATER Depth</th>
<th>Surface Elevation</th>
<th>Embankment Volume (top of embankment)</th>
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<tr>
<td>sb.22</td>
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</table>

**PROPOSED OPTION 6 POND**

**PROPOSED OPTION 6 CHANNEL (EAST SIDE OF POND)**

**LEGEND**

- **MAJOR BASIN BOUNDARY**
- **SUB-BASIN NUMBER**
- **PRINCIPAL PIPE OUTLET FROM DAM**
- **EXISTING PROPERTY LINE**
- **PROPOSED IMPROVEMENTS**

**NOTE:** Digital Orthophotography and Land Use inventory completed in 2018 by Dona Ana County. The contour interval for OK is 1 foot.
G. OPTION 7 (Refer to Figure OPT 7)

1. Option 7 Purpose

This option should be adopted in conjunction with Options 4A or 4B and Option 5. Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from upstream Sub-Basins 17 and 22 (sb.17 and sb.22) could be intercepted before inundating downstream agricultural lands.

2. Option 7 Description

Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

a. Sub-Basin 16 (sb.16) Pond (on Doña Ana County Owned park at the north end of the basin).
   i. Assume Sub-Basins 17, 20P, 22 and 23 (sb.17, sb.20P, sb.22, and sb.23) outfall into the pond.
   ii. Assume that the proposed improvements in Options 4 and 5 will be constructed.
   iii. Channelization to capture flows from each of the aforementioned sub-basins will be required.
   iv. The sb.16 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume of 16.2 ac-ft).
   v. Pond principal outlet (24" CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   vi. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.
   vii. Assume that both the North and South Salem Dams are in place.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 7 – See following page

4. Option 7 Result:

   sb.16 Detention Pond

   a. will detain approximately half of the 5-year peak inflow volume of 32.9 ac-ft.
   b. will detain about one-third of the 10-year peak inflow volume of 48.4 ac-ft.
   c. will detain about one-tenth of the 100-year peak inflow volume of 99.4 ac-ft.
   d. See Figure OPT 7 (next page) for reservoir routing data and freeboard summary.

5. Option 7 Conclusion:

The pond will detain a portion of runoff from the 5- and 10-year design storms, but won’t provide much benefit during the 100-year storm event.
H. OPTION 8 (Refer to Figure OPT 8)

1. Option 8 Purpose

Through examination of existing topography (DACFC LIDAR) and the results of the HEC-HMS hydrologic analysis reveal that substantial stormwater runoff from Sub-Basin 8 (sb.8) could be intercepted before inundating downstream agricultural lands.

2. Option 8 Description

Simulate a single detention pond complete with both a principal outlet and an emergency spillway.

a. Sub-Basin 8 (sb.8) Pond (on vacant privately owned land at the south end of the basin).

   i. Assume all of Sub-Basin 8 (sb.8) outfalls into the pond, except for any stormwater runoff that exits the North Salem Dam via the emergency spillway.
   ii. The sb.8 pond will be a detention pond sized to detain the 10-year/24-hour storm event (maximum design storage volume is 25.5 ac-ft).
   iii. Pond principal outlet (24” CMP) will release a controlled volume of detained water to continue downstream along its natural course.
   iv. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.

3. Conceptual Pond Grading Plan(s) are as follows:

   Figure OPT 8 – See following page

4. Option 8 Result:

   sb.8 Detention Pond

   i. will detain all 5-year peak inflow volume of 13.9 ac-ft.
   ii. will detain all 10-year peak inflow volume of 22.2 ac-ft.
   iii. will detain approximately half of the 100-year peak inflow volume of 51.7 ac-ft.
   iv. See Figure OPT 8 (next page) for reservoir routing data and freeboard summary.

5. Option 8 Conclusion:

   The pond is very effective for the 5- and 10-year design storms, and will detain approximately half of the 100-year design storm.
TABLE 4 - OPTION 8

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<th>Proposed Reservoirs</th>
<th>Detention Pond Routing Summary</th>
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<td>Emergency Spillway Elevation</td>
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<td>Pond Invert Elevation</td>
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<td>Max Pond Depth</td>
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<td>Top of Pond Embankment Elevation</td>
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<td>Freeboard to Emergency Spillway</td>
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<td>Freeboard to top of Pond Embankment</td>
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</table>

**Legend:***
- **MAJOR BASIN BOUNDARY**
- **SUB-BASIN BOUNDARY**
- **PRINCIPAL PIPE OUTLET FROM DAM**
- **EXISTING PROPERTY LINE**
- **PROPOSED IMPROVEMENT**

- **UNCONTROLLED BASIN (BASINS sb.1 THRU sb.29)**
- **VELARDE DAM BASIN (BASINS sb.100 THRU sb.107)**
- **NORTH SALEM DAM BASIN (BASINS sb.200 THRU sb.205)**
- **SOUTH SALEM DAM BASIN (BASINS sb.300 THRU sb.301)**
- **REED-THURMAND DAM BASIN (BASINS sb.400 THRU sb.409)**

- **OPT8.Pond**
- **Emergency Spillway**
- **Pond Invert**
- **Max Pond Depth**
- **Top of Pond Embankment Elevation**
- **Freeboard to Emergency Spillway Elevation**
- **Freeboard to top of Pond Embankment**
I. OPTION 9 (Refer to Figure OPT 9)

1. Option 9 Purpose and Description

This option was presented by concerned citizens and interested individuals during the second (2nd) public meeting. It utilizes the same proposed infrastructure in Options 4 and 5, but proposes additional channelization south of the Ford Street and Salem Street intersection. The proposed channel continues south toward the agricultural fields along NM 187. The channel would cut across the existing fields and cross NM 187 at existing culvert EC1. After crossing NM 187, via existing culvert EC1, the flow would be directed into a proposed detention pond (see Figure OPT 9).

2. Option 9 Result and Conclusion:

This proposed Option 9 was discussed with the lease/landowner of the agricultural fields, to be disrupted by the improvement, and the proposal was determined to be unfeasible and therefore abandoned. Therefore, no thorough evaluation of Option 9 was conducted. See Figure OPT 9 (next page) for a conceptual layout.
IS 2-FOOT.

OPTION 9 - DETENTION POND & CHANNEL

THEREFORE NO THOROUGH EVALUATION OF THE OPTION WAS COMPLETED. AS A RESULT, OPTION #9 WAS ABANDONED AND THE IDEA WAS STRONGLY DISCOURAGED. AS A RESULT, OPTION #9 WAS ABANDONED AND THEREFORE NO THOROUGH EVALUATION OF THE OPTION WAS COMPLETED.
J. MAINTENANCE OF EXISTING FACILITIES

Doña Ana County, in conjunction with the Caballo Soil and Water Conservation District (SCWCD), should evaluate and clean/maintain all facilities on both public (State of New Mexico and Bureau of Land Management Lands) as well as any facilities administered by the County or SCWCD. Many of the conveyance facilities (channel parallel to Grande Avenue from Salem Street north and the channel parallel to Fr Ramon Estiville Avenue) are located within private properties and may not be accessed by County Personnel. In this case private owners should be advised of the possible hazards associated without routine maintenance of their facilities. The Doña Ana County Community and Constituent Services Office have procedures and resources available to assist area residents with maintenance of facilities. See Figure Maintenance on the following page for areas requiring maintenance.

3.5 HEC-HMS Hydrologic Models

Figures OP1 through OP8 (included in Appendix 6) presents the HEC-HMS model schematics along with a generic legend.

The following output summary tables are included in Appendix 6.

Table 22: 5-year 24-hour Storm Option 1 Proposed Conditions Hydrologic Summary
Table 23: 10-year 24-hour Storm Option 1 Proposed Conditions Hydrologic Summary
Table 24: 100-year 24-hour Storm Option 1 Proposed Conditions Hydrologic Summary
Table 25: 5-year 24-hour Storm Option 2 Proposed Conditions Hydrologic Summary
Table 26: 10-year 24-hour Storm Option 2 Proposed Conditions Hydrologic Summary
Table 27: 100-year 24-hour Storm Option 2 Proposed Conditions Hydrologic Summary
Table 28: 5-year 24-hour Storm Option 3 Proposed Conditions Hydrologic Summary
Table 29: 10-year 24-hour Storm Option 3 Proposed Conditions Hydrologic Summary
Table 30: 100-year 24-hour Storm Option 3 Proposed Conditions Hydrologic Summary
Table 31: 5-year 24-hour Storm Option 4 Proposed Conditions Hydrologic Summary
Table 32: 10-year 24-hour Storm Option 4 Proposed Conditions Hydrologic Summary
Table 33: 100-year 24-hour Storm Option 4 Proposed Conditions Hydrologic Summary
Table 34: 5-year 24-hour Storm Option 5 Proposed Conditions Hydrologic Summary
Table 35: 10-year 24-hour Storm Option 5 Proposed Conditions Hydrologic Summary
Table 36: 100-year 24-hour Storm Option 5 Proposed Conditions Hydrologic Summary
Table 37: 5-year 24-hour Storm Option 6 Proposed Conditions Hydrologic Summary
Table 38: 10-year 24-hour Storm Option 6 Proposed Conditions Hydrologic Summary
Table 39: 100-year 24-hour Storm Option 6 Proposed Conditions Hydrologic Summary
Table 40: 5-year 24-hour Storm Option 7 Proposed Conditions Hydrologic Summary
Table 41: 10-year 24-hour Storm Option 7 Proposed Conditions Hydrologic Summary
Table 42: 100-year 24-hour Storm Option 7 Proposed Conditions Hydrologic Summary
Table 43: 5-year 24-hour Storm Option 8 Proposed Conditions Hydrologic Summary
Table 44: 10-year 24-hour Storm Option 8 Proposed Conditions Hydrologic Summary
Table 45: 100-year 24-hour Storm Option 8 Proposed Conditions Hydrologic Summary
Table 46: Reservoir Routing Summary
3.6 Summary of Options Hydrologic Benefits

Table 46.1 on the following page presents the hydrologic benefits of the proposed options at various key areas within and around the community of Salem. A composite hydrologic model was developed based on the County’s selected options; the results of the composite model are presented within Section 4 of this report.
TABLE 46.1
OPTION PEAK DISCHARGE SUMMARY AT CRITICAL ANALYSIS POINTS
(Comparison of Existing Peak Discharges to Option Peak Discharges)
Salem Area Drainage Master Plan

<table>
<thead>
<tr>
<th>Location Description</th>
<th>Existing or Option No.</th>
<th>HEC-HMS Analysis Point Model Name</th>
<th>5-year 24-hour Peak Discharge</th>
<th>10-year 24-hour Peak Discharge</th>
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<td>b</td>
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</tbody>
</table>

OPTIONS 1 - 7 RELATE TO THE TOWN OF SALEM

| Grande Avenue at Salem Street                                   | Existing               | j.sb13&rtc.16                      | 12                            | 19                            | 42                               | Pond     |
| Option 1                                                        |                        |                                   | 2                             | 3                             | 7                                |          |

North End of Ford Street Private Property East Boundary

| Existing                                                      | j.sb23 & rtc.10        | 23                                | 30                            | 57                            |                                   |          |
| Option 1                                                       |                        |                                   | 2                             | 3                             | 7                                |          |
| Option 2                                                       |                        |                                   | 23                            | 30                            | 57                               |          |
| Option 3                                                       |                        |                                   | 23                            | 30                            | 57                               |          |
| Option 4                                                       |                        |                                   | -                             | -                             | -                                |          |
| Option 5                                                       |                        |                                   | -                             | -                             | -                                |          |
| Option 7                                                       |                        |                                   | -                             | -                             | -                                |          |

North End of Channel Parallel to Grande Avenue (East Side)

| Existing                                                      | j.sb19-sb20&sb.23      | 56                                | 70                            | 141                           |                                   |          |
| Option 2                                                       |                        |                                   | 54                            | 60                            | 142                              |          |
| Option 3                                                       |                        |                                   | 54                            | 65                            | 111                              |          |
| Option 4                                                       |                        |                                   | 33                            | 40                            | 105                              |          |
| Option 5                                                       |                        |                                   | 32                            | 36                            | 80                               |          |
| Option 7                                                       |                        |                                   | 32                            | 36                            | 80                               |          |

Existing Channel East of Grande Avenue Where it Crosses Salem Street

| Existing                                                      | j.sb18 & rtc.7         | 57                                | 73                            | 145                           |                                   |          |
| Option 2                                                       |                        |                                   | 54                            | 61                            | 143                              |          |
| Option 3                                                       |                        |                                   | 55                            | 67                            | 144                              |          |
| Option 4                                                       |                        |                                   | 35                            | 61                            | 140                              |          |
| Option 5                                                       |                        |                                   | 37                            | 60                            | 139                              |          |
| Option 7                                                       |                        |                                   | 37                            | 60                            | 139                              |          |

Existing Culvert Crossing Under NM 187 that Releases the Stormwater Runoff Above

| Existing                                                      | out.sb15               | 58                                | 75                            | 148                           |                                   |          |
| Option 2                                                       |                        |                                   | 54                            | 61                            | 144                              |          |
| Option 3                                                       |                        |                                   | 56                            | 69                            | 146                              |          |
| Option 4                                                       |                        |                                   | 37                            | 61                            | 141                              |          |
| Option 5                                                       |                        |                                   | 37                            | 61                            | 140                              |          |
| Option 7                                                       |                        |                                   | 37                            | 61                            | 140                              |          |

Proposed Ponding on County Property South of Salem Street

| Existing                                                      | rtc.11                 | 8                                 | 14                            | 36                            |                                   |          |
| Option 6                                                       |                        |                                   | 2                             | 4                             | 29                               |          |
| Option 7                                                       |                        |                                   | 19                            | 22                            | 60                               |          |

OPTIONS 8 RELATES TO UNCONTROLLED BASIN JUST WEST OF TOWN OF SALEM

| Proposed Detention Pond on the South End of Sub-Basin sb.8 | Existing               | sb.8 + rtc.22                      | 98                            | 174                           | 460                              | Pond     |
| Option 8                                                     |                        | OPT8.Pond                         | 13                            | 18                            | 216                              |          |

a - See Drainage Basin Maps in map pocket for location and Report Text for Channel and Culvert Locations
b - See Appendix 5 for Existing and Appendix 6 for Proposed HEC-HMS Modeling Schematics for Analysis Point Locations
c - See Appendix 5 for Existing and Appendix 6 for Proposed HEC-HMS Model Summary Tables
d - See Appendix 6 for Proposed HEC-HMS Hydrologic Summary Results
SECTION 4. PRIORITIZATION OF OPTIONS

The Doña Ana County Flood Commission reviewed each Option Model and their respective results; in conjunction with Smith, the following Options were determined to be viable and shall be cost evaluated.

A. Option 4
B. Option 5
C. Option 6
D. Option 7

After comparisons of the selected Option(s) Model output, as well as thorough discussions with the Doña Ana County Flood Commission, the most effective Options were compiled into a Composite Option as explained below.

4.1 Proposed Composite Option Description

The proposed detention ponds (Ponds 1 and 2) are located on the Doña Ana County owned property just south of Salem Street; see Figure Composite – Map Pocket. Each of the channel and/or roadway improvements are located along the eastern stretch of the community of Salem.

Composite Option Description

The Composite Options include a Pond 1 (Phase 1) and a Pond 2 (Phase 2). Each of these will also include a conveyance Option A and/or B.

**Phase 1 Pond**

Phase 1 includes the construction of detention pond, Pond 1, to detain stormwater runoff from sub-basin sb.17; as well as channelization improvements (PCH C.3 and PCH C.4) to route stormwater runoff into the proposed pond.

**Phase 2 Pond**

Phase 2 includes an expansion of Pond 1 into Pond 2. It enlarges the Pond 2 footprint to include Pond 1 footprint and it deepens the entire pond to increase capacity. Therefore, excavation quantities for the Phase 2-Pond 2 portion of the pond are only those outside or below the Phase 1-Pond 1 area.

Phase 2 also includes the roadway improvements (Ford Street Option A) or channel improvements adjacent to Ford Street (Composite Option B) as well as channelization improvements to intercept upstream stormwater runoff.

Initially Composite Option Pond 1 would be constructed to detain some of the stormwater runoff from the developed portions of Salem. As funding becomes available, the remaining improvements in the Composite Option can be phased into place. The last portion of the Composite Option Pond 2 (detention pond) would increase the storage capacity of the Composite Option Pond 1.
Composite Option Assumptions

Detention Pond 1, as well as detention Pond 2, are located on the Doña Ana County owned park at the north end of the sub-basin sb.16.

a. Assume Sub-Basins 17, 20P, 22 and 23 (sb.17, sb.20P, sb.22, and sb.23) outfall into the Pond 2 once it’s completed. Initially, only Sub-Basin sb.17 will outfall into Pond 1.

b. Will require channelization to capture flows from each of the aforementioned sub-basins.

c. The Composite Option Pond 2 will be a detention pond sized to detain approximately one-third of the 10-year/24-hour storm event (maximum design storage volume of 16.2 ac-ft).

d. Pond principal outlet (24” CMP) will release a controlled volume of detained water to continue downstream along its natural course.

e. Pond emergency spillway is sized to allow the 100-year/24-hour stormwater runoff to continue its natural course unimpeded.

f. Assume that both the North and South Salem Dams are in place.

Conveyance Options A or B

The Composite Option also contains  channel (PCH C.1, PCH C.2, PCH C.3, PCH C.4, and PCH C.B-Option B) or roadway improvements (Ford Street PR C-Option A) to intercept upstream incoming stormwater runoff and direct it into the Composite Option Pond 2.

The conveyance Options are as follows:
A: Improvements to Ford Street (PR.C) as a conveyance system, or
B: An earthen channel adjacent (east side) to Ford Street (PCH C.B) as the conveyance system.

Refer to Figure COMPOSITE – Included in Map Pocket for Pond Option locations and conveyance options.

4.2 HEC-HMS Hydrologic Composite Option Model

The assumptions (hydrologic) made in the Options models were replicated in the HEC-HMS Proposed Composite Option Model. Brief synopses of the assumptions carried over are presented below:
A. Model computation time increment – 1 minute
B. No additional Sub-Basins were created in the Proposed Composite Option Model
C. Soils data and Runoff Curve Numbers values for each Sub-Basin remain unchanged
D. The storm events models in the existing conditions model are the same events used to create the Proposed Composite Option Model
E. Simulate a detention pond complete with both a principal outlet and an emergency spillway.

The Composite Option reservoir routing summary results (Pond 2) are included in **Table 57 (Appendix 6)**. The channel routing and capacity summary results for the proposed composite improvements are included in **Table 63 (Appendix 7)**.

**Figure Composite Option** (included in Appendix 6) presents the HEC-HMS model schematic(s) along with a generic legend.

The following output summary tables are included in **Appendix 6**.

- Table 54 5-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary
- Table 55 10-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary
- Table 56 100-year 24-hour Storm Composite Option Proposed Conditions Hydrologic Summary
- Table 57 Composite Option Reservoir Routing Summary

4.3 **Composite Option Results**

1. Composite Option Detention Pond 2 (including deeper Pond 1)
   a. will detain approximately half of the 5-year peak inflow volume of 32.9 ac-ft.
   b. will detain about one-third of the 10-year peak inflow volume of 48.4 ac-ft.
   c. will detain about one-tenth of the 100-year peak inflow volume of 99.4 ac-ft.

   See **Figure Composite (map pocket)** that also presents the reservoir routing data and freeboard summary.

**Composite Option Conclusion:**

The Composite Option Pond 2 will detain a fair portion of the 5- and 10-year storm events, but will not provide much benefit against the 100-year storm event. However, each of the Composite Option Channels (PCH C.1, PCH C.2, PCH C.3, PCH C.4, and PCH C.B-Option B)
or the roadway improvements to Ford Street (PR C-Option A) can adequately convey the 100-year storm event runoff volumes.

Maintenance, as mentioned previously, is an integral part of the proposed improvements and shall be continued throughout.

4.4 Composite Option – Conceptual EOPC

The conceptual level EOPC for the Composite Option (Tables 58 and 59-Appendix 6) are presented on the following pages. As mentioned previously, the EOPC accounts for contingency, engineering services, and 2016 New Mexico Gross Receipts Taxes. Construction phase services (administration and observation) are not included within the EOPC.
TABLE 58 - COMPOSITE OPTION A
Includes - detention pond, channel improvements, and roadway improvement to Ford Street
ENGINEER'S OPINION OF PROBABLE COST (EOPC) FOR CONCEPTUAL DESIGN

**PHASE 1 - COMPOSITE OPTION A**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM DESCRIPTION</th>
<th>UNIT</th>
<th>ESTIMATED QUANTITY</th>
<th>UNIT COST</th>
<th>ITEM COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLEARING AND GRUBBING, COMPLETE IN PLACE</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>2</td>
<td>SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE</td>
<td>CY</td>
<td>8,300</td>
<td>$15.00</td>
<td>$124,500.00</td>
</tr>
<tr>
<td>3</td>
<td>RELOCATION OF EXISTING PARK AMENITIES</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>4</td>
<td>UNCLASSIFIED EXCAVATION</td>
<td>CY</td>
<td>560</td>
<td>$10.00</td>
<td>$5,600.00</td>
</tr>
<tr>
<td>5</td>
<td>LINEAR GRADING</td>
<td>LIN. FEET</td>
<td>580</td>
<td>$15.00</td>
<td>$8,700.00</td>
</tr>
<tr>
<td>6</td>
<td>12&quot; SUBGRADE PREPARATION, COMPLETE IN PLACE</td>
<td>SY</td>
<td>10,100</td>
<td>$5.00</td>
<td>$50,500.00</td>
</tr>
<tr>
<td>7</td>
<td>FINAL GRADING, COMPLETE IN PLACE</td>
<td>SY</td>
<td>8,900</td>
<td>$5.00</td>
<td>$44,500.00</td>
</tr>
<tr>
<td>8</td>
<td>24&quot; DIAMETER OUTLET PIPE</td>
<td>LIN. FEET</td>
<td>40</td>
<td>$50.00</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>9</td>
<td>RIP-RAP CLASS A, COMPLETE IN PLACE</td>
<td>CY</td>
<td>435</td>
<td>$25.00</td>
<td>$10,875.00</td>
</tr>
<tr>
<td>10</td>
<td>CHAIN LINK FENCE (6' HIGH), COMPLETE IN PLACE</td>
<td>LIN. FEET</td>
<td>1,264</td>
<td>$25.00</td>
<td>$31,600.00</td>
</tr>
<tr>
<td>11</td>
<td>16' DOUBLE CHAIN LINK GATE w/ LOCKING MECHANISM, COMPLETE IN PLACE</td>
<td>EA</td>
<td>1</td>
<td>$4,000.00</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>12</td>
<td>SECURITY SIGNING (ATTACHED TO FENCING &amp; GATE)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$500.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>13</td>
<td>CONSTRUCTION TRAFFIC CONTROL</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>14</td>
<td>MOBILIZATION/DEMOBILIZATION</td>
<td>LUMP SUM</td>
<td>1</td>
<td>8.00%</td>
<td>$28,000.00</td>
</tr>
<tr>
<td>15</td>
<td>CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>2.00%</td>
<td>$7,000.00</td>
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<tr>
<td>16</td>
<td>MATERIALS TESTING</td>
<td>ALLOW</td>
<td>1</td>
<td>2.00%</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>17</td>
<td>NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$15,000.00</td>
<td>$15,000.00</td>
</tr>
</tbody>
</table>

A) SUBTOTAL OF COMPOSITE OPTION A PHASE 1 EOPC:  
$347,000.00

B) CONTINGENCY @ 25%:  
$86,750.00

C) SUBTOTAL COMPOSITE OPTION A PHASE 1 EOPC AND CONTINGENCY:  
$433,750.00

D) PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of C)  
$86,750.00

E) SUBTOTAL COMPOSITE OPTION A EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (C + D)  
$520,500.00

F) ALLOWANCES  
UTILITY RELOCATION (IF APPLICABLE)  
$5,000.00

G) SUBTOTAL COMPOSITE OPTION A PHASE 1 EOPC: (E + F)  
$525,500.00

H) NEW MEXICO GROSS RECEIPTS TAX (NMGRRT - JANUARY 2016) - 6.7500%  
$35,471.25

I) TOTAL COMPOSITE OPTION A PHASE 1 EOPC w/ TAX (NMGRRT 2016): (G + H)  
$560,971.25

**PHASE 2 - COMPOSITE OPTION A**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM DESCRIPTION</th>
<th>UNIT</th>
<th>ESTIMATED QUANTITY</th>
<th>UNIT COST</th>
<th>ITEM COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CLEARING AND GRUBBING, COMPLETE IN PLACE</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>2</td>
<td>SOIL BULK EXCAVATION FOR PONDS (incl. EXCAVATION AND DISPOSAL), COMPLETE IN PLACE</td>
<td>CY</td>
<td>17,900</td>
<td>$15.00</td>
<td>$268,500.00</td>
</tr>
<tr>
<td>3</td>
<td>RELOCATION OF EXISTING PARK AMENITIES</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>4</td>
<td>UNCLASSIFIED EXCAVATION</td>
<td>CY</td>
<td>1,080</td>
<td>$10.00</td>
<td>$10,800.00</td>
</tr>
<tr>
<td>5</td>
<td>LINEAR GRADING</td>
<td>LIN. FEET</td>
<td>2,210</td>
<td>$15.00</td>
<td>$33,150.00</td>
</tr>
<tr>
<td>6</td>
<td>12&quot; SUBGRADE PREPARATION, COMPLETE IN PLACE</td>
<td>SY</td>
<td>13,600</td>
<td>$5.00</td>
<td>$68,000.00</td>
</tr>
<tr>
<td>7</td>
<td>FINAL GRADING, COMPLETE IN PLACE</td>
<td>SY</td>
<td>8,350</td>
<td>$5.00</td>
<td>$41,750.00</td>
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<tr>
<td>8</td>
<td>2&quot; HMA SP III COMPLETE</td>
<td>SY</td>
<td>3,050</td>
<td>$15.00</td>
<td>$45,750.00</td>
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</tbody>
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### Table: Composite Option Costs

<table>
<thead>
<tr>
<th>Item Description</th>
<th>SY</th>
<th>Price</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Base Course 8&quot;</td>
<td>3,050</td>
<td>$8.00</td>
<td>$24,400.00</td>
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<tr>
<td>Chain Link Fence (6' High), Complete in Place</td>
<td>700</td>
<td>$25.00</td>
<td>$17,500.00</td>
</tr>
<tr>
<td>24&quot; Standard Curb &amp; Gutter</td>
<td>2,500</td>
<td>$20.00</td>
<td>$50,000.00</td>
</tr>
<tr>
<td>Security Signing (Attached to Fencing &amp; Gate)</td>
<td>1</td>
<td>$500.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>Construction Traffic Control</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>Mobilization/Demobilization</td>
<td>1</td>
<td>8.00%</td>
<td>$54,000.00</td>
</tr>
<tr>
<td>Construction Staking (incl. Layout, Quantity Verification, As-Built Information, Complete)</td>
<td>1</td>
<td>2.00%</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>Materials Testing</td>
<td>1</td>
<td>2.00%</td>
<td>$14,000.00</td>
</tr>
<tr>
<td>NPDES Permitting and SWPPP Preparation and Implementation</td>
<td>1</td>
<td>$15,000.00</td>
<td>$15,000.00</td>
</tr>
</tbody>
</table>

### J) Subtotal of Composite Option A EOPC: $664,000.00

### K) Contingency @ 25%: $166,000.00

### L) Subtotal Composite Option A EOPC and Contingency: $830,000.00

### M) Pre-Construction Costs: (Design, Survey, Geotechnical, & SUE = 20% of L) $166,000.00

### N) Subtotal Composite Option A EOPC, Contingency, and Pre-Construction Costs: (L + M) $996,000.00

### O) Allowances
- Utility Relocation (if applicable) $5,000.00
- Land Acquisition (assumed value of $2,000/AC) $4,000.00

### P) New Mexico Gross Receipts Tax (NMGRT - January 2016) - 6.750% $1,005,000.00

### Q) Total Composite Option A EOPC: (P + Q) $67,837.50

### R) Total Composite Option A Phase 2 EOPC w/ Tax (NMGRT 2016): (P + Q) $1,072,837.50

### S) Total Composite Option A EOPC w/ Tax (NMGRT 2016): (I + R) $1,633,808.75

### Assumptions for Composite A Option EOPC

1. Phase 1 of the composite option will construct the initial pond to detain the runoff generated in sub-basin sb.17 as well as the channel improvements to route stormwater runoff into the pond.
2. Phase 2 of the composite option will increase the capacity of the detention pond to detain runoff from the intercepted upstream sub-basins (sb.17, sb.20P, sb.22, & sb.23). Additional roadway (Ford Street) and channel improvements will also be constructed.
3. Assume that the Dona Ana County owned park in sb.16 can be utilized for construction of the proposed detention pond.
4. Assume the utility relocation required for these improvements is minimum (assumed $5,000).
5. Retention pond is sized to detain approximately one-third (1/3) of the stormwater runoff generated by the 10-year/24-hour storm w/ a minimum of one-foot (1') freeboard. Phase 2
6. Conceptual pond volume takes into account the runoff generated by sub-basins: sb.17, sb.20P, sb.22, and sb.23. Phase 2
7. Assume proposed channel (PCH C.4) will be rip-rap lined; as well as a 40' wide by 20' long by 2' deep pad at the emergency spillway and a 10' wide by 10' long by 2' deep pad at the principal outlet pipe.
8. Unclassified excavation is assumed to be the total volume of the proposed channel improvements.
9. Soil bulk excavation for ponds is assumed to be the total volume of the proposed detention pond.
# Table 59 - Composite Option B

Includes - detention pond and channel improvements

## Engineer's Opinion of Probable Cost (EOPC) for Conceptual Design

### Phase 1 - Composite Option B

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Estimated Quantity</th>
<th>Unit Cost</th>
<th>Item Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clearing and grubbing, complete in place</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>2</td>
<td>Soil bulk excavation for ponds (incl. excavation and disposal), complete in place</td>
<td>CY</td>
<td>8,300</td>
<td>$15.00</td>
<td>$124,500.00</td>
</tr>
<tr>
<td>3</td>
<td>Relocation of existing park amenities</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>4</td>
<td>Unclassified excavation</td>
<td>CY</td>
<td>560</td>
<td>$10.00</td>
<td>$5,600.00</td>
</tr>
<tr>
<td>5</td>
<td>Linear grading</td>
<td>LIN. FEET</td>
<td>580</td>
<td>$15.00</td>
<td>$8,700.00</td>
</tr>
<tr>
<td>6</td>
<td>12&quot; subgrade preparation, complete in place</td>
<td>SY</td>
<td>10,100</td>
<td>$5.00</td>
<td>$50,500.00</td>
</tr>
<tr>
<td>7</td>
<td>Final grading, complete in place</td>
<td>SY</td>
<td>8,900</td>
<td>$5.00</td>
<td>$44,500.00</td>
</tr>
<tr>
<td>8</td>
<td>24&quot; diameter outlet pipe</td>
<td>LIN. FEET</td>
<td>40</td>
<td>$50.00</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>9</td>
<td>Rip-Rap Class A, complete in place</td>
<td>CY</td>
<td>435</td>
<td>$25.00</td>
<td>$10,875.00</td>
</tr>
<tr>
<td>10</td>
<td>Chain link fence (6' high), complete in place</td>
<td>LIN. FEET</td>
<td>1,264</td>
<td>$25.00</td>
<td>$31,600.00</td>
</tr>
<tr>
<td>11</td>
<td>16&quot; double chain link gate w/ locking mechanism, complete in place</td>
<td>EA</td>
<td>1</td>
<td>$4,000.00</td>
<td>$4,000.00</td>
</tr>
<tr>
<td>12</td>
<td>Security signing (attached to fencing &amp; gate)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$500.00</td>
<td>$500.00</td>
</tr>
<tr>
<td>13</td>
<td>Construction traffic control</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>14</td>
<td>Mobilization/demobilization</td>
<td>LUMP SUM</td>
<td>1</td>
<td>8.00%</td>
<td>$28,000.00</td>
</tr>
<tr>
<td>15</td>
<td>Construction staking (incl. layout, quantity verification, as-built information, complete)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>2.00%</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>16</td>
<td>Materials testing</td>
<td>ALLOW</td>
<td>1</td>
<td>2.00%</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>17</td>
<td>NPDES permitting and SWPPP preparation and implementation</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$15,000.00</td>
<td>$15,000.00</td>
</tr>
<tr>
<td></td>
<td><strong>A) Subtotal of Composite Option B Phase 1 EOPC:</strong></td>
<td></td>
<td></td>
<td></td>
<td>$347,000.00</td>
</tr>
<tr>
<td></td>
<td><strong>B) Contingency @ 25%:</strong></td>
<td></td>
<td></td>
<td></td>
<td>$86,750.00</td>
</tr>
<tr>
<td></td>
<td><strong>C) Subtotal Composite Option B Phase 1 EOPC and Contingency:</strong></td>
<td></td>
<td></td>
<td></td>
<td>$433,750.00</td>
</tr>
<tr>
<td></td>
<td><strong>D) Pre-Construction Costs: (Design, Survey, Geotechnical, &amp; SUE = 20% of C)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$86,750.00</td>
</tr>
<tr>
<td></td>
<td><strong>E) Subtotal Composite Option B EOPC, Contingency, and Pre-Construction Costs: (C + D)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$520,500.00</td>
</tr>
<tr>
<td></td>
<td><strong>F) Allowances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Utility relocation (if applicable)</td>
<td></td>
<td></td>
<td></td>
<td>$5,000.00</td>
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<tr>
<td></td>
<td>Land acquisition (assumed value of $2,000/ac)</td>
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<td></td>
<td></td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td><strong>G) Subtotal Composite Option B Phase 1 EOPC: (E + F)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$525,500.00</td>
</tr>
<tr>
<td></td>
<td><strong>H) New Mexico Gross Receipts Tax (NMGRT - January 2016) - 6.75%</strong></td>
<td></td>
<td></td>
<td></td>
<td>$35,471.25</td>
</tr>
<tr>
<td></td>
<td><strong>I) Total Composite Option B Phase 1 EOPC w/ Tax (NMGRT 2016): (G + H)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$560,971.25</td>
</tr>
</tbody>
</table>

### Phase 2 - Composite Option B

<table>
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<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Estimated Quantity</th>
<th>Unit Cost</th>
<th>Item Cost</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Clearing and grubbing, complete in place</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>2</td>
<td>Soil bulk excavation for ponds (incl. excavation and disposal), complete in place</td>
<td>CY</td>
<td>17,900</td>
<td>$15.00</td>
<td>$268,500.00</td>
</tr>
<tr>
<td>3</td>
<td>Relocation of existing park amenities</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$1,500.00</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>4</td>
<td>Unclassified excavation</td>
<td>CY</td>
<td>2,700</td>
<td>$10.00</td>
<td>$27,000.00</td>
</tr>
<tr>
<td>5</td>
<td>Linear grading</td>
<td>LIN. FEET</td>
<td>2,260</td>
<td>$15.00</td>
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<tr>
<td>6</td>
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<td>$5.00</td>
<td>$65,750.00</td>
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<tr>
<td>7</td>
<td>Final grading, complete in place</td>
<td>SY</td>
<td>8,350</td>
<td>$5.00</td>
<td>$41,750.00</td>
</tr>
<tr>
<td>8</td>
<td>Chain link fence (6' high), complete in place</td>
<td>LIN. FEET</td>
<td>700</td>
<td>$25.00</td>
<td>$17,500.00</td>
</tr>
</tbody>
</table>
SALEM AREA DRAINAGE MASTER PLAN (DMP) - COMPOSITE OPTION

<table>
<thead>
<tr>
<th></th>
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<th>LIN. FEET</th>
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</thead>
<tbody>
<tr>
<td>9</td>
<td>5’ SPAN BY 3’ RISE CONCRETE BOX CULVERT w/ HEADWALLS AND CONCRETE APRON</td>
<td></td>
<td>50</td>
<td>$500.00</td>
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<tr>
<td>10</td>
<td>SECURITY SIGNING (ATTACHED TO FENCING &amp; GATE)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$500.00</td>
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<td>11</td>
<td>CONSTRUCTION TRAFFIC CONTROL</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$2,500.00</td>
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<tr>
<td>12</td>
<td>MOBILIZATION/DEMOBILIZATION</td>
<td>LUMP SUM</td>
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<td>8.00%</td>
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<td>13</td>
<td>CONSTRUCTION STAKING (incl. LAYOUT, QUANTITY VERIFICATION, AS-BUILT INFORMATION, COMPLETE)</td>
<td>LUMP SUM</td>
<td>1</td>
<td>2.00%</td>
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<tr>
<td>14</td>
<td>MATERIALS TESTING</td>
<td>ALLOW</td>
<td>1</td>
<td>2.00%</td>
</tr>
<tr>
<td>15</td>
<td>NPDES PERMITTING AND SWPPP PREPARATION AND IMPLEMENTATION</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$15,000.00</td>
</tr>
</tbody>
</table>

J) SUBTOTAL OF COMPOSITE OPTION B EOPC: $572,000.00
K) CONTINGENCY @ 25%: $143,000.00
L) SUBTOTAL COMPOSITE OPTION B EOPC AND CONTINGENCY: $715,000.00
M) PRE-CONSTRUCTION COSTS: (DESIGN, SURVEY, GEOTECHNICAL, & SUE = 20% of L) $143,000.00
N) SUBTOTAL COMPOSITE OPTION B EOPC, CONTINGENCY, AND PRE-CONSTRUCTION COSTS: (L + M) $858,000.00
O) ALLOWANCES
   - UTILITY RELOCATION (IF APPLICABLE) $5,000.00
   - LAND ACQUISITION (ASSUMED VALUE OF $2,000/AC) $4,000.00
P) SUBTOTAL COMPOSITE OPTION B EOPC: (N + O) $867,000.00
Q) NEW MEXICO GROSS RECEIPTS TAX (NMGRT - JANUARY 2016) - 6.7500% $58,522.50
R) TOTAL COMPOSITE OPTION B PHASE 2 EOPC w/ TAX (NMGRT 2016): (P + Q) $925,522.50
S) TOTAL COMPOSITE OPTION B EOPC w/ TAX (NMGRT 2016): (I + R) $1,486,493.75

ASSUMPTIONS FOR COMPOSITE B OPTION EOPC

1. PHASE 1 OF THE COMPOSITE OPTION WILL CONSTRUCT THE INITIAL POND TO DETAIN THE RUNOFF GENERATED IN SUB-BASIN sb.17 AS WELL AS THE CHANNEL IMPROVEMENTS TO ROUTE STORMWATER RUNOFF INTO THE POND.
2. PHASE 2 OF THE COMPOSITE OPTION WILL INCREASE THE CAPACITY OF THE DETENTION POND TO DETAIN RUNOFF FROM THE INTERCEPTED UPSTREAM SUB-BASINS (sb.17, sb.20P, sb.22, & sb.23). ADDITIONAL CHANNEL IMPROVEMENTS WILL ALSO BE CONSTRUCTED.
3. ASSUME THAT THE DONA ANA COUNTY OWNED PARK IN sb.16 CAN BE UTILIZED FOR CONSTRUCTION OF THE PROPOSED DETENTION POND.
4. ASSUME THE UTILITY RELOCATION REQUIRED FOR THESE IMPROVEMENTS IS MINIMUM (ASSUMED $5,000).
5. RETENTION POND IS SIZED TO DETAIN APPROXIMATELY ONE-THIRD (1/3) OF THE STORMWATER RUNOFF GENERATED BY THE 10-YEAR/24-HOUR STORM w/ A MINIMUM OF ONE-FOOT (’1”) FREEBOARD. PHASE 2 CONCEPTUAL POND VOLUME TAKES INTO ACCOUNT THE RUNOFF GENERATED BY SUB-BASINS: sb.17, sb.20P, sb.22, AND sb.23. PHASE 2
6. ASSUME PROPOSED CHANNEL (PCH C.4) WILL BE RIP-RAP LINED, AS WELL AS A 40’ WIDE BY 20’ LONG BY 2’ DEEP PAD AT THE EMERGENCY SPILLWAY AND A 10’ WIDE BY 10’ LONG BY 2’ DEEP PAD AT THE PRINCIPAL OUTLET PIPE.
7. UNCLASSIFIED EXCAVATION IS ASSUMED TO BE THE TOTAL VOLUME OF THE PROPOSED CHANNEL IMPROVEMENTS.
8. SOIL BULK EXCAVATION FOR PONDS IS ASSUMED TO BE THE TOTAL VOLUME OF THE PROPOSED DETENTION POND.
4.5 Conclusions and Recommendations

Smith, in conjunction with the Doña Ana County Flood Commission and the residents of Salem, has determined that the Composite Option is the most practical, efficient, and cost effective approach to managing stormwater runoff within the community of Salem. This option is capable of intercepting and detaining a large portion of stormwater runoff; thereby minimizing the localized flooding issues with the developed areas of Salem.

The results and recommendations within this Drainage Master Plan should be reviewed at least every five years or as existing or developed conditions change. The presence of the four SCS Dams upstream of Salem benefit the area greatly, but they’re subject to erosion, lost capacity due to sedimentation, and possible failure due to storm events beyond their engineered capacities. Should any of these events occur, or if new development within the community occurs, the findings and recommendations within this Plan should be revisited.

In addition to the recommendation of the Composite Option, the County and residents of Salem should take a proactive approach to maintaining the existing drainage conveyances and systems within the area.
SECTION 5. REFERENCES

Figure 14, Depth-Area Curves (Source: NOAA Atlas 2 Vol. IV, 1973).


NOAA Atlas 14 Point Precipitation Frequency Estimates (printed from NOAA Atlas 14 internet site)

Soils Data obtained from the Internet – US Dept. of Agriculture - Natural Resource Conservation Service – Web Soil Survey as follows:


A. Figure B-2, Approximate Geographic Boundaries for SCS Rainfall Distributions
B. Table 2-2a. Runoff Curve Numbers for Urban Areas.
C. Table 2-2b. Runoff Curve Numbers for Cultivated Agricultural Lands.
D. Table 2-2c. Runoff Curve Numbers for Other Agricultural Lands.
E. Table 2-2d. Runoff Curve Numbers for Arid and Semiarid Rangelands.
F. Chapter 3 – Time of Concentration and Travel Time Procedure
G. Appendix F – Equations for Figures and Exhibits


Manning’s “n” Values from – Open Channel Hydraulics, Ven T. Chow, 1959.

Sediment Bulking Factors were assumed based on select pages – Figure 3.8 within – Sediment and Erosion Design Guide, November 2008. Prepared by Mussetter Engineering Inc. Prepared for the Southern Sandoval County Flood Control Authority.

Time Increment Computation based on select pages from Chapter 4 – Hydrology for Drain System Design and Analysis, Digital Engineering Library @ McGraw Hill.