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TECHNICAL MEMORANDUM

CITY OF AMARILLO
MARTIN ROAD LAKE
Storm Water Master Plan Project
Phase I Project Memorandum

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INTRODUCTION

Martin Road Lake is a collection of two playa lakes, divided by Martin Road, located northeast of downtown Amarillo. Martin Road Lake also serves as the focal point of Martin Road Park; a City of Amarillo operated park facility that includes 12 picnic areas, baseball fields, a tennis/basketball court, and a skate park. The drainage area of Martin Road Lake is approximately 1,750 acres, and includes13 outfalls, over 100 inlets, 7 channels, and more than 3 miles of storm sewer. Previous modeling and limited historical data has indicated there is potential for flooding in the park and the areas surrounding the park. In addition, there has not been a comprehensive condition assessment conducted to date and the hydrologic analysis has not been updated in over 20 years. The purpose of this memorandum is to document the results of the first phase of the Martin Road Lake Master Plan. Phase 1 determines the extent of existing, localized flooding and evaluates the condition of the storm sewer conveyance structures within the drainage basin. This memorandum also determines planning level costs to address these items so that the City of Amarillo may include modifications to the system in the 2014 Capital Improvements Program. Phase 2 will provide more detail on the selected flood mitigation alternative and on overall project phasing.

PLEASE NOTE, THE FINAL RESULTS AND METHODOLOGY CONTAINED IN THE PHASE 2 ANALYSIS SUPERCEDE THE PHASE 1 RESULTS PRESENTED IN THIS DOCUMENT.

HYDROLOGIC ANALYSIS

Phase 1 of the Martin Road Lake Master Plan includes an update of the effective floodplain model to determine the extent of playa lake flooding. Phase 1 also compares the updated model to a different, standard hydrologic method to verify applicability to the drainage basin. A discussion of the results of this task is included in the following section. Unless otherwise specified all vertical elevations are presented in NAVD 1988.

ASAPP Evaluation

The Amarillo Simulation Analysis of Playa Performance (ASAPP) model was developed by HDR in 1993 to assess the performance of playas and playa pumping systems. The ASAPP model considers daily inflow, direct precipitation, infiltration, evaporation, lake drainage area, runoff conditions, lake geometry, and pumping rates in its calculations.

The first ASAPP model input is the historical precipitation and evaporation data for the City of Amarillo. The original ASAPP model, provided to APAI by the City, contained historical evaporation and precipitation through the year 1991. In order to update the ASAPP model for 1992 – 2012, two data sources were utilized. The historical precipitation data was obtained from the National Climatic Data Center website for the Amarillo Airport (near data location).[1] The historical evaporation data was obtained from the Texas Water Development Board (TWDB) website for the 206 quadrangle (containing the majority of Potter County).[2]

In addition to the climate modifications, the existing ASAPP model was updated based on revised drainage area size, curve number (see HEC-HMS section), and the lake geometry information. The drainage area and lake geometry information was determined using the 2-foot topography survey associated with this project (see Electronic Deliverable 1).

The ASAPP model does not allow an individual model to perform a simulation of more than 100 years. In order to incorporate data from the full period of record, the model was broken into two individual sub-models (1897 – 1991, 1992 – 2012). The ending water surface elevation from the 1897 – 1991 model was utilized as the starting water surface elevation for the 1992 – 2012 model. The updated model for 1897 – 1991 calculated a 100-year water surface elevation of 3630.6 feet and the updated model for 1992-2012 calculated a 100-year water surface elevation of 3631 feet (1988 projection). It should be

[1] http://www7.ncdc.noaa.gov/CDO/cdoselect.cmd?datasetabbv=GSOD&countryabbv=&georegionabbv

[2] http://www.twdb.texas.gov/surfacewater/conditions/evaporation/index.asp

noted that the results for the 1992 – 2012 model indicate that caution should be used – statistics were computed for a period significantly less than the period of record.

As the 1992-2012 model uses historical information for a period significantly less than 100 years, the final data processing had to be conducted outside of the ASAPP model. The daily level output from the 1992 – 2012 model was appended to the updated output from 1897 through 1991. An exceedance probability calculation was performed in Microsoft Excel on all days with a precipitation exceeding the initial abstraction value. Initial abstraction is defined as the maximum rainfall absorbed without producing runoff. The initial abstraction exceedance probability calculation yielded a 100-year water surface elevation of 3630.03. The output from the initial abstraction calculations using the ASAPP level results is included in Table 1.

Table 1. Initial Abstraction Results – ASAPP Model

Event	%Chance	Elevation (feet)
2-year	50%	3615.21
5-year	20%	3623.57
10-year	10%	3626.66
25-year	4%	3628.40
50-year	2%	3629.39
100-year	1%	3630.03

The ASAPP model simulation predicts that July 9, 2010 would have the highest water surface elevation of the entire simulation (3630 feet). The Amarillo/Potter/Randall Office of Emergency Management indicated that the flash flood event that occurred at the Rick Husband International Airport (4-5 miles east of Martin Road Lake) on July 7-8 was “very close or may have exceeded the 100 year event).[3]

Impact of Island

Martin Road Lake also includes an island that hosts utility infrastructure. In April 2013, the City of Amarillo was notified by Excel Energy that the island had been targeted for removal by the end of 2013. The lake geometry inputs were modified to determine the impact of the island’s removal (down to 3596 feet). The difference in the 100-year surface water surface water elevation with the island removed is negligible. The output from the initial abstraction calculations using the ASAPP level results (with the island removed) is included in Table 2. The updated model (with and without the island) is included as Electronic Deliverable 2.

[3] http://oem.amarillo.gov/wp-content/uploads/2012/02/FloodingReport_FINAL.pdf

Table 2. Initial Abstraction Results – ASAPP Model without Island

Event	%Chance	Elevation (feet)
2-year	50%	3615.08
5-year	20%	3623.46
10-year	10%	3626.66
25-year	4%	3628.36
50-year	2%	3629.36
100-year	1%	3630.02

HEC-HMS Evaluation

The United States Army Corps of Engineers (USACE) hydrologic modeling program HEC-HMS was used to verify the runoff and flood storage elevation calculations proposed by the updated ASAPP model. While the ASAPP model uses historical precipitation and evaporation data, the HEC-HMS model determines runoff and lake storage based upon mathematical models of the various hydrologic processes in the watershed.

The first HEC-HMS model input is the contributing drainage area of Martin Road Lake, which was divided into eight sub-basins each draining directly into the lake. Sub-basins drainage boundaries were delineated using the City's 2-foot topographic maps and took into consideration the existing storm drain systems that outfall into the lake. Flow routing from each sub-basin was not used in this model because the playa lake acts as a retention pond and has no outlet. HEC-HMS also requires a meteorological (precipitation) input to model runoff. The City's Storm Water Management Criteria Manual lists precipitation depth-duration-frequency data specific to Amarillo. The 24-hour rainfall depths for each storm event (2, 5, 10, 25, 50, and 100-year) were used in the model. The SCS Unit Hydrograph method was applied to generate the response of each sub-basin to the precipitation. The SCS Curve Number loss method was used to model the portion of the precipitation that infiltrates into the ground. A Curve Number for each sub-basin was calculated based upon the areas of various ultimate land uses and soil types measured per sub-basin. The final input for each sub-basin is the lag time, which is an empirical equation requiring the time of concentration (T_c) as the input. T_c is the time it takes for a drop of water falling at the hydraulically most remote point in the sub-basin to reach the outlet or lake. T_c is based upon the slope and length of that flow path.

The stage-storage-discharge curve determined from the updated survey of Martin Road Lake was used in HEC-HMS to equate the runoff modeled for each storm event to a level in the lake. The output from the HEC-HMS model is summarized in Table 3. This table shows that the lake levels for each storm event predicted by HEC-HMS are near those predicted by the ASAPP model, although HEC-HMS consistently

predicts a slightly lower water surface elevation in all but the 2 year storm (1.9 feet less for the 100-year event). The updated model (with and without the island) is included as Electronic Deliverable 3.

Table 3. HEC-HMS Results – ASAPP Model without Island

Event	%Chance	Elevation (feet)
2-year	50%	3615.08
5-year	20%	3621.59
10-year	10%	3624.15
25-year	4%	3625.88
50-year	2%	3627.33
100-year	1%	3628.13

Review of Field Gage Data

More than 1,300 days of field measured water surface elevations (from 1984 through 2012) were collected and compared to the updated ASAPP model output as a form of calibration (daily level information not available from HEC-HMS). In general, the ASAPP model does appear to duplicate the occurrence of actual peak recorded levels. However, the ASAPP model does appear to over predict the amount of water leaving Martin Road Lake in dry periods (either through evaporation or pumping operations) (see Figure 1 and

Figure 2). There are several possible explanations for the inconsistencies in dry weather periods:

- Data frequency: On average, ASAPP field data is collected once every 7.5 days – the City of Amarillo endeavors to collect data on a regular basis, in particular directly after storm events (see
- Table 4). However, lack of field data on ASAPP predicted dry weather days appear to indicate that these non-storm days were not consistently recorded. The addition of a continuous data recorder may aid in refining the data collection effort. Another option is to collect field data on days without recorded precipitation for the previous 14 days.
- Operational protocols: The City of Amarillo staff has indicated that they aim to maintain Martin Road Lake levels at or around 3610 feet. The shutoff elevation for the Martin Road Lake pump station is currently set to 3610 in the ASAPP model, but the model predicts water surface elevations significantly below this elevation. Therefore, the model calculation assumptions may need to be refined to more accurately represent operational protocols or dry weather conditions at Martin Road Lake. The City of Amarillo should consider refining the ASAPP model calculations or developing a new model to incorporate more sophisticated operational controls. Additionally, at the time ASAPP was originally developed, less than 10 years of field data was available for the playa lakes for the calibration effort. Currently, almost 30 years of historical field data is available.

Refinements to the ASAPP model calculations or the development of a new model should be considered to increase the accuracy of the ASAPP predictions.

Table 4. Data Collection Summary

Description	Days with Field Data	Total Days	Percentage
All Days (11/19/1984 – 12/31/2012)	1371	10270	13%
Days with recorded precipitation	390	2080	19%
Days with recorded precipitation >1”	45	109	41%
Days with recorded precipitation >2”	10	22	45%
Days with no precipitation	981	8190	12%
Days with precipitation not recorded for 7 prior consecutive days	348	3384	10%
Days with precipitation not recorded for 14 prior consecutive days	151	1510	10%

Figure 1. ASAPP Daily Water Surface Elevation Results versus Field Data (intermittent intervals) – Sorted by Elevation

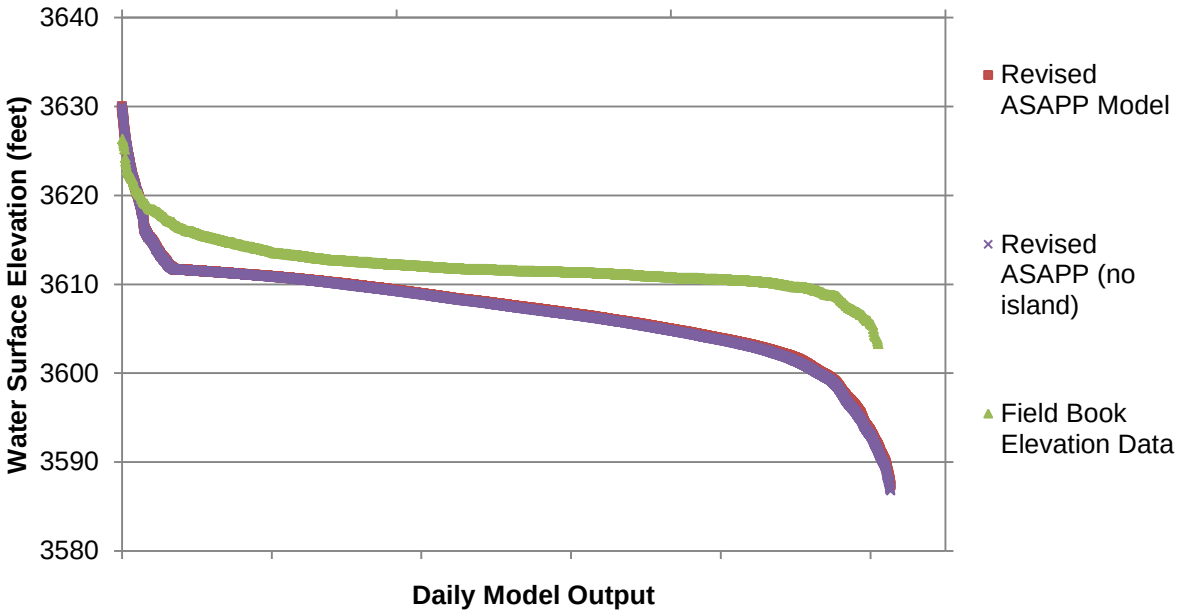
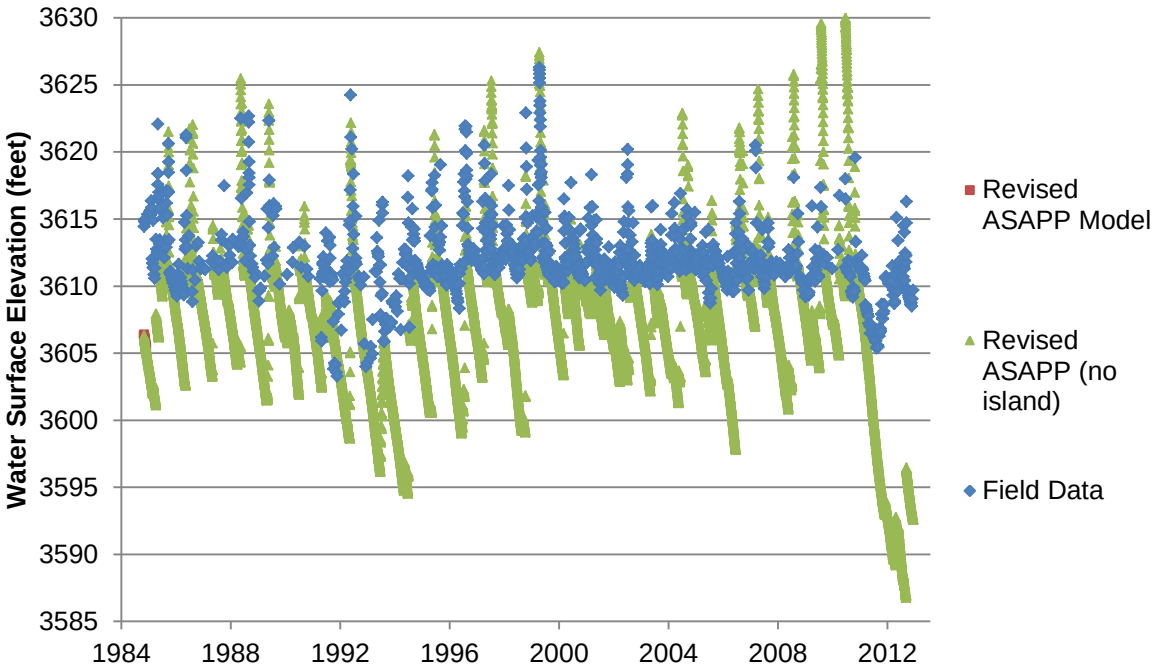


Figure 2. ASAPP Daily Water Surface Elevation Results versus Field Data (intermittent intervals) –, Chronological Order



Methodology Discussion

Three methods to determine the 100-year water surface elevation of Martin Road Lake were compared. One method was predictive based on 116 years of climatic data (ASAPP), one was based on 29 years of actual field measurements, and one was based on estimating runoff volumes. Table 5 summarizes all available historical and current water surface elevation results for each method for the available return periods.

HEC-HMS Discussion

The HEC-HMS model is highly dependent on the storm duration and assumed impervious cover and is not directly related to historical data. However, the hydrologic variables of the Martin Road Lake watershed have not changed appreciably in recent decades.

ASAPP Discussion

The ASAPP model calculates the various return interval water surface elevations based on an inherent statistical method. There are several different probability distributions that are used in hydrologic evaluations, but almost all assume at least independence of events (one storm event does not affect the next). As it may take some time to lower the water surface elevation of Martin Road Lake by pumping following a storm event it cannot be stated that all storm events are independent. In addition, it is likely that the lake pumps are not always immediately operated following every storm event. At a minimum the accuracy of the statistical method would improve if a sensitivity method were included to help address dates where successive rainfall occurs. The inability to access this method and the lack of flexibility to input additional climatic data decreases the accuracy of the results. However, the ASAPP model does predict water surface elevations on a daily basis for the period of record that can be verified by field data.

The 2013 ASAPP model appears to provide a more conservative prediction of the storm event water surface elevations than HEC-HMS (a two foot higher water surface elevation for the 100-year event). In addition, the ASAPP model is a FEMA accepted model that has historically been utilized for all playa lakes within the City of Amarillo. In order to maintain a conservative and consistent approach for flood elevation predictions surrounding playa lakes in Amarillo, it is recommended that the City of Amarillo continue to use the ASAPP model, but consider revising the ASAPP calculations or constructing a new playa lake modeling software that utilizes additional historical data for calibration purposes, includes more sophisticated operational controls, and provides the capability to separate storm events.

Table 5. Comparison of Historical and Current 100-Year Water Surface Elevations of Martin Road Lake

Source	Time Reference	100 – Year Elevation (feet)*	Method
1993 Master Plan	1993 known conditions	3631.4	ASAPP
2010 LOMR		3632.3	ASAPP
2013 ASAPP	Current conditions	3630.03	ASAPP
2013 ASAPP (without island)	Future Conditions	3630.02	ASAPP
2013 HEC-HMS (without island)		3628.13	Runoff
Highest recorded level (1984-2012)	Historical	3626.3**	Recorded levels

* For comparison purposes, some vertical projections were adjusted to NAVD 1988.
** Included for comparison purposes, not verified as a 100-year event.

CONDITION ASSESSMENT

Phase 1 of the Martin Road Lake Master Plan includes a risk-based assessment of the drainage structures located throughout the Martin Road Lake Drainage Area. A risk-based approach to asset management provides not only the condition information required to make project recommendations but also a ranking of each asset. The asset ranking is intended to be used to group assets by improvement needs and to aid in developing phased solutions to drainage problems. This section includes a summary of the results of the condition assessment (see Appendix A and Electronic Deliverable 4 for more information). The recommendations developed as part of the condition assessment are included in the Rehabilitation List and Preliminary Cost section of this memorandum.

Outfalls, Inlets, and Channels

For outfalls, inlets, and channels, condition and criticality scoring was used to rank assets and provide recommendations for improvements. The overall condition score was multiplied by the overall criticality score to obtain a risk score, which identified the locations with the highest potential need for repair. As with any assessment, this scoring system is subjective and is comparative in nature: as more structures are reviewed the range of physical results (and thus the range of responses) will change, potentially changing the scoring of the earlier sites. A spreadsheet documenting the results of the condition assessment for outlets, inlets, and channels is included in Appendix A. This spreadsheet allows the user to sort and filter according to specific parameters such as risk score, erosion failure, structure, and location. The spreadsheet also includes webpage links to Google Maps showing the structure locations on an aerial photo and a webpage link to the photos taken at each location.

Pump Stations

The pump station at Martin Road Lake consists of one pump and a SCADA system to maintain water levels in the lake. The Amarillo maintenance staff operates the pump station such that the water surface elevation of Martin Road Lake is at approximately 3610.00 (under normal conditions). The current conditions of the pump station are fair; the pump station is in working order and Amarillo staff does not anticipate any impending mechanical failures. There is minor erosion at the base of the fence on the north side of the pump station that should be addressed.

Storm Sewer System

The CCTV inspection determined that the Martin Road Lake storm sewer system is generally in good condition. There were some sections of line that were inaccessible due either to trash in the line or inlet configuration that did not allow access. The predominant CCTV comment was that trash accumulated in certain sections of the lines that were evaluated. No major structural concerns were found in the report. A copy of the full inspection report was provided to the City. A hydraulic evaluation will be conducted in Phase 2 of this project to determine capacity related improvements.

Martin Road Lake

The lake (and immediate surrounding area) was reviewed for stability and condition and found to be operating well. There are isolated areas of rill and overland erosion near the water surface of the western lake. These areas do not appear to require immediate attention but should be monitored to ensure that they are stable. Other physical facilities of the lake area are covered under separate assessments.

Rehabilitation List and Preliminary Costs

The projects identified in the condition assessment were divided into three phases based on the asset scores: Phase 1 projects, which consist of the top 10% of the asset scores, are considered short term priority (1 year time period) and indicate immediate improvements are required. Phase 2 projects, which consist of the top 50% of the asset scores, are considered medium term priority (1-5 year time period). Phase 3 projects, which consist of the remaining assets where improvements may be needed in the future, should be considered in the 5+ year time period.

Table 6. Asset Costs Ranked by Risk Categories

Category	Phase			Total	Notes
	1	2	3		
Inlet	$21,000	$40,000	-	**$61,000**	See detailed listing of inlets for condition and notes in Appendix A.
Outfall	$24,000	$41,000	$26,000	**$91,000**	
Channel	$180,000	$77,000	$116,000	**$373,000**	
Pump Station	$8,000	-	$1,000	**$9,000**	Visual inspection showed no obvious signs of hydraulic degradation or condition failures. Costs are for more detailed evaluation of pump performance and detailed condition/inspection.
Playa Condition	-	-	$6,000	**$6,000**	No uncategorized issues detected: costs are for future, ongoing inspections.
Playa Flood Control	$4,215,000	$4,117,000	-	**$8,332,000**	Assuming Alternative 2b.
Storm Sewer Condition	$10,000	$5,000	-	**$15,000**	No major issues detected with CCTV - costs are placeholders for small/spot repairs.
Storm Sewer Capacity	-	-	-	**-**	Hydraulic evaluation not completed (Phase 2 of Master Plan) - placeholder.
Total	**$4,458,000**	**4,280,000**	**$149,000**	**$8,887,000**	

Phase 1 Short Term Priority - 1 year time period. Top 10% of assets or immediate improvements required
Phase 2 Medium Term Priority - 1-5 year time period. Top 50% of assets or improvements required.
Phase 3 Long Term Priority - 5+ year time period. Improvements may be needed.

STORAGE DEFICIENCY SOLUTIONS

This section describes several options for the lowering of the floodplain surrounding Martin Road Lake. The lake has two distinct sections, separated by Martin Road. The east portion of the lake is shallower than the western portion. The two sections are connected by a several box culverts beneath Martin Road. The 2013 ASAPP model indicates that 145 structure area in the floodplain in the Martin Road Lake area.

Table 7. Existing Structures in Floodplain by Elevation

Elevation (Feet)	Structures* Remaining in Floodplain
3,630	145
3,629	91
3,628	51
3,627.5	33
3,627	14
3,626	5

*Not all structures are inhabited/inhabitable

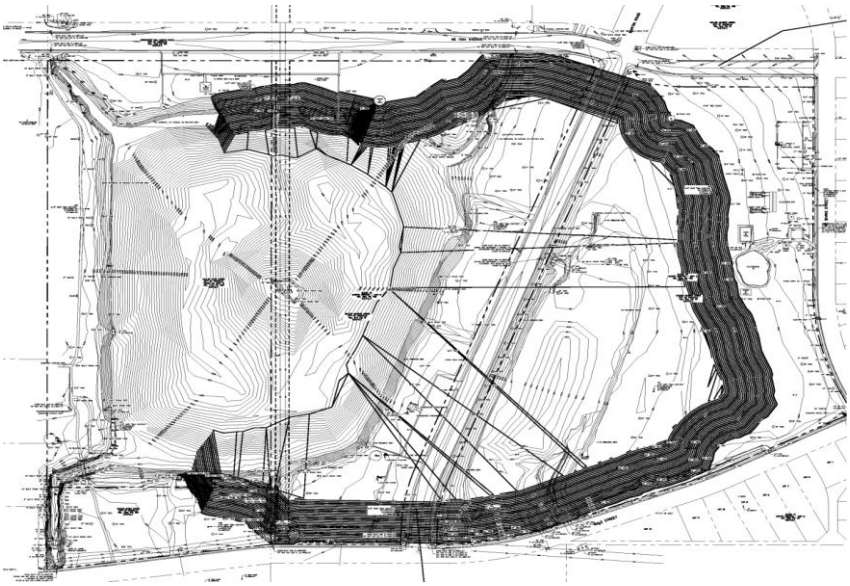
Options for Lowering Floodplain

Two options were evaluated to lower the floodplain in the area surrounding Martin Road Lake: the first assumes that Martin Road itself can be removed and that traffic could be permanently routed to other area roads. The second option assumes that the removal of Martin Road is not viable.

- **Option 1**: Although Martin Road provides vital access to several schools in the area, it is neither the only route nor the sole option available to local residents. The north, south, and east banks of the lake would be changed in this option, beginning at elevation 3,625 and extending to elevation 3,597. The slope would be adjusted to a 4H:1V. Areas on the each side of the lake would not be significantly impacted by the improvements. The conceptual total design and construction cost of lowering the floodplain by four feet is approximately $10,100,000 for Option 1.

  The Potter-Randall Appraisal District lists the average value of the properties below elevation 3,630 as $140,000. The total value of the all the properties below 3,630 is $18,200,000. This total does not include any cost of publicly owned infrastructure. If the floodplain is to be lowered so that most of the structures (145 parcels) are out of the floodplain, the cost per structure would be approximately $69,700. For an additional approximate amount of $430,686, the City could buy out the additional three developed parcels that are below 3,626 feet. Due to the low elevation of these structures, they could be susceptible to repeated flooding damages and could have recurring damage due to flooding. Although the excavation of this option does not extensively encroach on the recreational areas above elevation 3,625, the 4H:1V lake side slopes would reduce the recreational nature of the area. Figure 3 provides a description of the earthwork involved in Option 1.

Figure 3. Option 1 Graphical Description



- Option 2a: This option includes leaving Martin Road intact and excavating portions of the eastern and western lake as shown in Figure 4. Beginning at elevation 3,625 and proceeding to elevation 3,597 the slopes of the lake would be changed to a 4H:1V. This option would allow for an excavation volume of approximately 228,500 cubic yards. The added storage volume would lower the floodplain to elevation 3,929, which will remove 54 structures from the floodplain. Assuming that the replacement cost of each structure is approximately $120,400, the total replacement cost of the 54 structures is $6,501,600. This cost does not include any damages to publicly owned infrastructure. The conceptual construction cost for this option is $4,215,000, or approximately $76,390 per structure. Since Option 2a does not remove all of the structures from of the floodplain, it is possible to have a buyout program for the purpose of purchasing properties that could be severely damaged when inundated with flood water.
- Option 2b: Option 2b includes all excavation from Option 2a with additional, off-site excavation to the southeast of Martin Road Lake. The off-site parcels are listed in Figure 5. To be able to excavate 228,500 cubic yards from parcels A, B, and C (11.7 acres), the excavation depth would need to be approximately 12.5 feet deep. Table 8 lists the appraised values of the parcels from Figure 5. This option is attractive in that it provides significant additional storage without removing Martin Road Lake. The off-site parcels would be hydraulically connected to the east segment of Martin Road Lake either with an overflow/bypass pipe or by a continuous connection (by gravity with a potential siphon). This option should be reviewed to determine the feasibility of acquiring the necessary off-site parcels to provide additional storage volume. Since Option 2b does not remove all of the structures from of the floodplain, it is possible to have a buyout program for the purpose of purchasing properties that could be damaged when flooded.

Figure 4. Option 2a Graphical Description

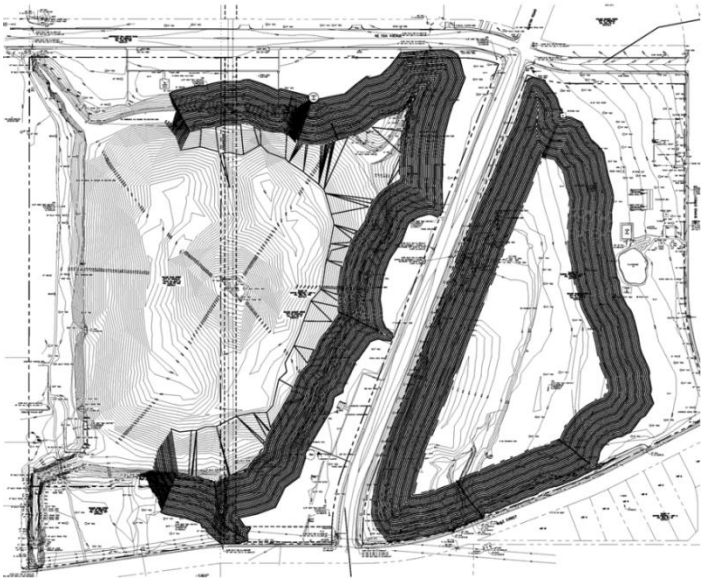


Figure 5. Option 2b Offsite Parcels

Table 8. Parcel Costs Associated with Option 2b

Parcel	Owner	Appraised Price (as of April 9, 2013)	Area (Acres)
A	TALON/LPE LTD	$13,200	6.0
B	TALON/LPE LTD	$5,775	2.7
C	PRESCOTT BROTHERS LTD	$5,447	3.0
D	AISD	$308,348	3.7
E	AISD	$10,890	4.7

Highest Appraised Properties Below 3,630 Feet

The Potter-Randall Appraisal District shows that the Will Rogers Elementary School is the most expensive property below elevation 3,630 in the Lake Martin Road drainage basin. Table 9 presents the top 10 valued properties below elevation 3,630. Note that not all properties had finished floors surveyed: some are estimated based on available topography. Finished floor elevations should be verified by City of Amarillo survey staff.

Table 9. Top Ten Appraised Properties Below 3,630 Feet

Number	Type/Owner	Subdivision	Appraised Value	Minimum Estimated Finished Floor Elevation (ft.)
1	Public School	Will Rogers Elementary School	$2,830,820	3628
2	Lakeview Apartments, LLC	Martin	$2,215,354	3628
3	Lakeview Apartments, LLC	Martin	$2,118,696	3625
4	City of Amarillo	950/1020 Forest Hill	$1,494,616	3627
5	Greyland Properties, Inc.	850 Forest Hill	$1,338,177	3629
6	Greyland Properties, Inc.	Forest Hill	$783,521	3627
7	Children's Learning Center	Martin	$645,840	3626
8	Christian Mission Holyground Church	Wright	$563,892	3626
9	City of Amarillo	Martin Lake	$455,376	3620
10	Talon Drilling, LLC	Forest Hill	$304,865	3629

Other Options Considered

Off system storage and modifications to drainage basin patterns were both considered when developing storage deficiency solutions. An obvious location for off system storage (beyond the distance and scope of Option 2b) in the Martin Road Lake watershed was not feasible. Modifications to the drainage basin patterns were initially considered, but did not appear to be justified based on cost considerations.

Recommendations and Preliminary Costs

If the City is seeking to make immediate and significant protection available to area residents, and if funds are available, it is recommended that Option 1 be used to provide most of the properties adjacent to the lake with protection from the 100-year flood event. If the City desires to take several steps to provide a particular level of protection, it is recommended that Option 2b be executed and a buyout program be initiated to purchase developed parcels that have high replacement costs when damaged by flooding. It is recommended that the City of Amarillo allocate an initial budget between $6 and $11 million for this project. This budget cost includes the conceptual construction cost, engineering cost, and a contingency. The cost of excavation is the largest unit cost of the overall construction cost for this project. If the local contractors can use the excavated material for other projects in the area, at no cost to the City, it would reduce the construction cost and possibly allow the City to provide a better level of protection than what is provided in Option 2b. It is also recommended that the City not permit any additional development to occur on undeveloped parcels below elevation 3,630 unless certain building requirements are implemented to reduce the structural damage caused by flooding. Once the option is selected, the design phase would refine the excavation volume and design to maximize the use of the park area and minimize unnecessary impacts to existing features.

Table 10. Summary of Preliminary Cost Information

Option	Impact to Floodplain	$$ for Excavation Only	$$ for Buyout Program *	Total Cost**
No.1	-4 feet	$10,043,000	$430,686	$10,474,000
No.2a	-1 foot	$4,215,000	$430,686	$4,646,000
No.2b	-2.5 feet	$8,332,000	$774,344	$9,106,000

*For Option 1 and 2a, the buyout program is only for three properties that are the lowest-developed in the floodplain and does not include City Park facilities. For Option 2b, the buyout program also includes the properties listed in Table 8.
** The cost shown does not include labor costs or legal costs to purchase the parcels, abandonment cost, or empty parcel maintenance costs. This cost does not include purchasing of any parcels south of the existing lake for additional capacity and flood mitigation.

PHASE 1 CONCLUSIONS

This memorandum summarizes the results of the Phase 1 portion of the Martin Road Lake Master Plan. Phase 2 of the Master Plan, which collects more information and provides additional analyses of the preferred solutions, will be conducted in the section half of 2013 and is contingent on several strategic decisions from the City of Amarillo.

PLEASE NOTE, THE FINAL RESULTS AND METHODOLOGY CONTAINED IN THE PHASE 2 ANALYSIS SUPERCEDE THE PHASE 1 RESULTS PRESENTED IN THIS DOCUMENT.

- **Decision on preferred model (HEC-HMS or ASAPP) for development of flooding solutions:** The 2013 ASAPP model appears to provide a more conservative prediction of the storm event water surface elevations than HEC-HMS (a two foot higher water surface elevation for the 100-year event). In addition, the ASAPP model is a FEMA accepted model that has historically been utilized for all playa lakes within the City of Amarillo. In order to maintain a conservative and consistent approach for flood elevation predictions surrounding playa lakes in Amarillo, it is recommended that the City of Amarillo continue to use the ASAPP model, but consider revising the ASAPP calculations or constructing a new playa lake modeling software that utilizes additional historical data for calibration purposes, includes more sophisticated operational controls, and provides the capability to separate storm events.
- **Selection of a preferred option for lowering the floodplain (identified as Option 1, Option 2a, or Option 2b):** If the City is seeking to make immediate and significant protection available to area residents, and if funds are available, it is recommended that Option 1 be used to provide most of the properties adjacent to the lake with protection from the 100-year flood event ($10,474,000 preliminary cost estimate to reduce the floodplain by 4 feet). If the City desires to take several steps to provide a particular level of protection, it is recommended that Option 2b be executed and a buyout program be initiated to purchase developed parcels that have high replacement costs when damaged by flooding ($9,106,000 preliminary cost estimate to reduce the floodplain by 2.5 feet).

Once these decisions are finalized, the Phase 2 effort can commence. Phase 2 of the Martin Road Lake Master Plan includes:

- A storm sewer hydraulic assessment, intended to develop improvements based on hydraulic deficiencies.
- A geotechnical evaluation of subsurface conditions, which also includes the development of slope stabilization solutions.
- The refinement of a rehabilitation plan for the top 4 locations identified in Phase 1. The top 4 locations as identified in Phase 1 are:
    - Outfall 6 – Outfall pipe exposed, fractured concrete, severe erosion level, slight vegetation.
    - Outfall 10 – Minor erosion, but structure in poor condition.
    - Outfall 11 – Severe erosion, exposed (irrigation?) piping, dirt in outfall pipe.
    - Channel 3 –Heavy erosion is present.
    - There are several inlets (Inlet 2021 and Inlet 2588) that should be inspected/maintained by City Staff immediately – the volume of trash is preventing proper function.

Appendices

Appendix A – Data Collection Criteria Manual (See Tab 2)

Electronic Deliverables (See attached CD.)

Electronic Deliverable 1 - Survey Information

Electronic Deliverable 2 - Updated ASAPP Model

Electronic Deliverable 3 - HEC-HMS Model

Electronic Deliverable 4 - Condition Assessment Information – Outfalls, Inlets, Channels, Storm Sewer CCTV Data, and Pump Station