Master Drainage Study

Prepared for

CITY OF LIVE OAK

March 2011

Lateral 1 North of Paseo Avenue during the December 31, 2005 Storm.

Lateral 1 South of Paseo Avenue during the December 31, 2005 Storm.

Pennington Ranch Storm Drain Outlet

Lateral 6 Box Culvert Under Highway 99

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EXECUTIVE SUMMARY

This Executive Summary (ES) provides an overview of the Master Drainage Study (MDS) prepared in support of the City of Live Oak 2030 General Plan. The critical elements of each chapter of the MDS are summarized in a section of this ES. However, prior to the chapter summaries, a brief description of the City and Regional Drainage is presented.

CITY AND REGIONAL DRAINAGE SUMMARY

The City owns and maintains storm drain pipe systems, detention basins, and pump stations to provide drainage and prevent flooding within the City and convey runoff to the Reclamation District 777 (RD 777) open channel drainage system. The existing drainage facilities are shown in Figure ES-1. The existing City and most of the City at buildout of the 2030 General Plan are within the RD 777 service area. RD 777's facilities consist of a series of drainage channels along with culverts and some piping, and these facilities are shown on Figure ES-2. RD 777's system conveys flows to the south and west to the East Interceptor Canal and then to the Wadsworth Canal. The Wadsworth Canal flows to the Sutter Bypass, which in turn flows to the Sacramento River. The regional drainage is shown in Figure ES-3.

At buildout of the City of Live Oak 2030 General Plan, the northwest corner of the City will be within RD 2056 service area. This area drains to the west into Morrison Slough. Morrison Slough also drains to the south and west into the East Interceptor Canal and then to Wadsworth Canal, the Sutter Bypass, and ultimately to the Sacramento River.

PURPOSES OF THIS MDS (CHAPTER 1)

The purposes of the MDS are to:

- Identify the drainage/flood control improvements needed to address existing drainage problems;
- Recommend drainage/flood control facilities needed to allow buildout of the City as projected in the 2030 General Plan without causing drainage/flooding impacts within the City or to the agricultural areas upstream or downstream of the City; and
- Identify the capital and operations and maintenance (O&M) costs of the recommended drainage/flood control facilities.

These purposes were achieved through accomplishing a series of more specific goals for the MDS.

DATA COLLECTION (CHAPTER 2)

Presented below is a summary of the major categories of data collected for use in this MDS.

- Previous Studies and Data Collected by Others.
- Design, As-Built, or Record Drawings Provided by the City of Live Oak.

- Field Evaluations Conducted by West Yost Associates' (West Yost) Staff. These evaluations included site visits to most of the RD 777 channels and culverts during February and March of 2006 to estimate Manning's roughness values for channels and measure culvert sizes and document the culvert entrance and exit conditions. Many City facilities were also evaluated. This data is provided on a CD in Attachment 2A to the MDS.
- Global Positioning Satellite (GPS) Survey. GPS survey data was collected by West Yost and Laughlin and Spence (L&S). In support of this MDS, L&S surveyed several drainage structures and facilities within the City of Live Oak in June 2008. In February and March 2006, West Yost surveyed the Main Canal and several laterals throughout the RD777 drainage system. The datums used in these surveys were:
    - Horizontal datum: North American Datum (NAD) of 1983, California State Plane Coordinates, Zone 2 (coordinates are given in grid coordinates).
    - Vertical Datum: North American Vertical Datum (NAVD) of 1988.
- Existing Land-Use Data Compiled by West Yost. This data was based on aerial photography and site visits.
- Buildout land use data from the City of Live Oak 2030 General Plan.

DESIGN CRITERIA (CHAPTER 3)

The drainage facility sizing and design criteria from the City of Live Oak, Yuba City, the City of Woodland, City of Dixon, City of Vacaville, the Vallejo Sanitation and Flood Control District, and Solano County were summarized. These criteria were then reviewed and compared to identify the design criteria for use in this study. The recommended design criteria that were used for sizing drainage facilities in this MDS are listed below:

- Model Calibration – The hydrologic and hydraulic evaluations in this MDS were prepared using the XP-SWMM model. The XP-SWMM model was calibrated to the City of Live Oaks's Rational Method design criteria.
- Land Use – Drainage facilities were sized to accommodate the runoff from the full buildout of the City of Live Oak 2030 General Plan.
- Storm Drain Conveyance Systems – All storm drainage pipeline conveyance facilities were designed to maintain the hydraulic grade line a minimum of one foot below the gutter flow line of all drain inlets during a 10-year, 24-hour storm event. However, this freeboard requirement was relaxed somewhat in existing City areas where achieving the criteria would be very expensive and disruptive to the City. All new storm drains shall be at least 18-inches in diameter. However, 12-inch pipe may be used to connect the storm drain to a single drain inlet.
- Street Flow – Storm drainage systems for new development shall be designed to convey the 10-year, 24-hour storm. During larger storms, flow greater than the capacity of the pipe system shall be conveyed or detained in the street section while maintaining a water surface at least 1 foot below the adjacent building pad elevations.

- Water Surface Elevation – Development may not cause an increase of the water surface elevation in the agricultural drainage channels either upstream or downstream of the development.
- Duration of Flooding – Development may not cause an increase of the duration of flooding along the agricultural drainage channels either upstream or downstream of the development.
- Open channels – Drainage channels and culverts will be sized for a 100-year, 4-day storm, with 1 foot of freeboard. Open channel side slopes shall be 4 horizontal to 1 vertical. Levees may not be used. If agricultural drainage channels are replaced with closed conduit facilities, the pipes or culverts shall be sized/designed for the 100-year, 4-day storm.
- Detention Basins – A 100-year, 4-day storm shall be used for sizing detention storage facilities. The detention basin release rate from a 100-year storm after development must be lower than the runoff rate from the detention basin's tributary area before development. Also, the detention basin release rate from a 10-year, 24-hour storm after development must be lower than the runoff rate from the detention basin's tributary area before development. The release rate from detention basins shall not exceed the capacity of the downstream channel system, with one foot of freeboard. This last criterion is necessary to prevent increasing the duration of flooding.
- Pump Stations – Pump stations will be sized for the 100-year storm to lift water into the receiving channel or river at a flow rate such that the criteria listed above for detention basins, open channels, or storm drains will be achieved. Also, the drainage pumping plant designs require the approval of the City Director of Public Works.

MODEL DEVELOPMENT (CHAPTER 4)

The XP-SWMM hydrologic model simulates the rainfall to runoff process. For the hydrologic model, the watershed was divided into over 185 subwatersheds. For each subwatershed, the following hydrologic model input data were developed: design storm rainfall; area; impervious percentage; ground slope; subshed width; initial rainfall loss; infiltration rate; and overland flow roughness.

The 10-year and 100-year design storm rainfall hyetographs (rainfall versus time) are presented in Figure ES-4.

The XP-SWMM hydraulic model simulates the flow in the storm drains, open channels, and culverts and estimates the resulting water surface elevations. The hydraulic model includes over 400 nodes and over 400 links. The links represent pipe segments, channel segments, culverts, pump stations or other water conveyance facilities. The nodes are the connections between links, and often represent maintenance holes, junctions of channels, or transitions between channels and culverts. Input data for nodes are the ground surface and invert elevations. Input data for links include the type (pipe, box culvert, open channel), Manning's roughness value, length, and upstream and downstream invert elevations.

The hydrologic model mathematically transforms rainfall into runoff and produces runoff hydrographs that are used as input data in the hydraulic model. For the 10-year storm, the unit runoff rates range from 0.09 cfs/acre for agricultural land to 1.66 cfs/acre for residential land. The 100-year unit runoff rates range from 0.16 cfs/acre for agricultural land to 2.64 cfs/acre for residential land. These runoff rates agree well with the City of Live Oak Rational Method runoff rates used for calibration of the hydrologic model as shown in Figure ES-5A and ES-5B for the 10-year design storm. City staff also indicated that the modeled water surface for the 10-year storm reasonably corresponds with the City's design standards and observed water levels during large storm events over the last several years. Consequently, it was concluded that the XP-SWMM model is reasonably accurate and can be used for planning drainage improvements to solve existing flooding problems and to plan drainage facilities for the future development of the City.

ANALYSIS OF EXISTING DRAINAGE INFRASTRUCTURE (CHAPTER 5)

The existing drainage infrastructure within the City of Live Oak was evaluated based on the following drainage criteria:

- 10-Year Storm: Pipeline conveyance systems shall maintain the hydraulic grade line a minimum of 1-foot below the gutter line. The results of this evaluation are shown in Figure ES-6. Model nodes that comply with this criterion have no circle. Inadequate freeboard and street flooding up to 1 foot deep is shown to occur in several older areas of town. This evaluation indicates that:
    - Apricot Street Pump Station and tributary storm drains: Much of the area served by this pump station-storm drain system would flood up to a depth of less than 1-foot.
    - Larkin Street Pump Station and tributary storm drains: In the 10-year storm, much of this pump station-storm drain system would have less than 1-foot of freeboard with some street flooding at drain inlets.
    - J Street and Fir Street: In the 10-year storm flooding along J Street, Fir Street, and Sinnard Avenue would occur at depths of less than 1-foot.
    - Pennington Ranch and Peachtree Estates: These newer areas of town fully comply with this criterion.
- 100-Year Storm; Flow shall be conveyed or detained in the street section while maintaining a water surface at least 1-foot below the adjacent building pad elevations. The results of this evaluation are shown in Figure ES-7. The elevations of the building pads were not available as part of this MDS. As determined through observations, the elevations of the several homes along many of the flooded storm drain systems are not significantly above the ground surface. However, many houses are built on raised foundations, so flooding depths of less than 1-foot may not actually enter the houses. Modeled flooding depths of over 2 feet could cause actual flood damage at the node where flooding is reported or at nearby locations. This evaluation indicates that:
    - During the 100-year storm, much of the City would experience flooding problems with flooding depths of up to 1 foot being common. Modeled flooding depths of up to 2 feet are reported at a few locations, but actual flooding depths may be lower because some of the flood water would probably flow to other locations.

- Pennington Ranch and Peachtree Estates: The streets in these areas would flood less than 1-foot. These are new neighborhoods, and it appears that the building pads have been raised about 2 feet above the street levels; so the homes should be protected from flooding during the 100-year storm.

Based on the model results described above, it appears the existing conditions models reasonably simulate the actual storm drain and open channels systems serving the City. Consequently, these models are considered adequate for developing solutions to the City's existing flooding problems and for planning improvements to serve the growth of the City planned in the 2030 General Plan.

IMPROVEMENTS TO SOLVE EXISTING DRAINAGE/FLOODING PROBLEMS (CHAPTER 6)

Improvements to solve the existing drainage/flooding problems at the following six locations were developed. These specific drainage problems were identified by City staff.

- J Street south of Pennington Road
- L Street between Birch Street and Pennington Road
- Several Highway 99 cross culverts (bubble up systems) that do not have connections to District or City drains
- De Ree Road and Luther School
- West of P Street from Pennington Road to Date Street, Gum, Fir, and Elm Streets – Currently drainage flows in ditches between houses. The ditches have been blocked by overgrown vegetation and fences and are difficult to maintain.
- Q Street

City staff also expressed a concern that the Larkin Road Storm Drain may not have adequate capacity from the City limits to its discharge to the ditch between Birch and Ash Streets. However, based on the modeling results presented in Chapter 5, this drain appears to have adequate capacity for existing conditions.

For solving these existing problems, existing land uses were assumed, and no excess capacity was included in the improvements for future development (future growth was evaluated in subsequent sections of the MDS). The overall performance of the City's storm drain system with these improvements for the 10-year storm is shown in Figure ES-8. The flooding shown in Figure ES-8 should be compared to that shown in Figure ES-6 for existing conditions.

Several of these improvements either redirect runoff into the RD 777 Main Canal or result in runoff reaching the Main Canal more quickly. These changes result in increased maximum water levels in the Main Canal and tributary channels downstream of the City by 0.1 feet to 0.2 feet. This increase represents a potential drainage impact to these agricultural areas. These increased water levels would be eliminated by additional channel maintenance funded by additional drainage fees paid to RD 777 by the residents of the City of Live Oak. See the discussion of RD 777 Funding and Channel Maintenance (in the summary of Chapter 14, below).

As shown in Table ES-1, the estimated total construction cost for all of the projects is $3.9 million. The estimated total capital cost for all of these projects, including land, engineering, CM, CEQA, and contract administration is $5.5 million.

Table ES-1. Estimated Costs for the Improvements to Solve Existing Drainage and Flooding Problems

Flooding Problem / Improvement	Improvement Construction Cost, dollars	Improvement Capital Cost, dollars
J Street south of Pennington Road	373,000	535,000
L Street between Birch Street and Pennington Road	452,000	632,000
Several Highway 99 cross culverts (bubble up systems) that do not have connections to District or City drains	638,000	893,000
De Ree Road and Luther School	1,621,000	2,270,000
West of P Street from Pennington Road to Date Street, Gum, Fir, and Elm Streets	582,000	815,000
Q Street	241,000	337,000
Total (rounded)	3,910,000	5,483,000

GENERAL PLAN BUILDOUT LAND USE (CHAPTER 7)

Drainage improvements were planned (see below) to allow the growth of the City as planned in the 2030 General Plan. To develop and evaluate these drainage improvements, the buildout land use was incorporated into the XPSWMM drainage model. The buildout land uses are shown on Figure ES-9.

DEVELOPMENT AND EVALUATION OF DRAINAGE ALTERNATIVES 1 THROUGH 4 FOR BUILDOUT OF THE CITY (CHAPTERS 8, 9, 10, 11)

Four alternative sets of improvements to provide drainage service for the City's General Plan Growth Area within the RD 777 service area were developed and evaluated. At Buildout, 85 percent of the City, not including the urban reserve area, will be within the RD777 service area. The goal of this evaluation was to identify a drainage plan that would allow the City to grow as defined in the 2030 General Plan without causing drainage related impacts. These alternatives included combinations of the several different types of drainage facilities, including new trunk storm drains, new or modifications to existing pump stations, new detention basins, and new or enlarged/modified open channels. Alternatives 1 through 4 are shown on Figures ES-10 through ES-13, respectively, and summarized below.

- Alternative 1 – The approach for this alternative was to replace open channels with trunk drains up to 72-inches in diameter. Where the capacity of a 72-inch drain would not be adequate to convey the flow, an open channel was used. Five detention basins were included in this alternative, with four of them located within the City's planned growth areas. This alternative also included diversion of the drainage from the northeast quadrant of the City eastward at Pennington Road to the Feather River. This diversion alleviates conveyance capacity problems in the RD 777 main canal downstream of Pennington Road. The construction cost for this alternative was estimated at $23.6 million, and the capital cost was estimated at $37.9 million.
- Alternative 2 – The approach for this alternative was to replace the multiple detention basins located within the City (from Alternative 1) with a single regional basin located south of the City. This required large channels to convey the undetained peak flows through the City and downstream to the regional detention basin. The construction cost for this alternative was estimated at $37.6 million, and the capital cost was estimated at $59.2 million.
- Alternative 3 – The approach for this alternative was to modify Alternative 1 with the goal of maximizing the potential for joint use of the drainage facilities and lowering the overall cost. This included:
    - Maximizing the use of open channels, but sizing them to allow for dense vegetation (providing wildlife habitat), slow water velocities, gentle side slopes (6 horizontal to 1 vertical, 6H:1V), and public access (and maintenance) paths along the tops of the banks.
    - Five detention basins were included in this alternative, with three of them located within the City's planned growth area and two just outside of the planned growth area. The basins were sized to allow public access for park facilities, sports fields or habitat. The basins would have gentle side slopes of 10H:1V to facilitate use of the basins by the public. The basins would also have a deep area that receives water in routine storms and a shallow area that only receives water in a large storm (approximately storms greater than a 10-year event). In a 100-year storm event the water in the deep area would be about 5 to 6 feet deep, but only 1 to 2 feet deep in the shallow areas. This approach resulted in the basins requiring very large areas (see Figure ES-12).
    - This alternative also included diversion of the drainage from the northeast quadrant of the City eastward at Pennington Road to the Feather River.

      The construction cost for this alternative was estimated at $21.8 million, and the capital cost was estimated at $40.1 million.
- Alternative 4 – The approach for this alternative was to modify Alternative 3 to use less area for the basins and to further reduce the overall cost. This included:
    - Maximizing the use of open channels, but sizing them to allow for dense vegetation (providing wildlife habitat), slow water velocities, gentle side slopes (6H:1V), and public access (and maintenance) paths along the tops of the banks.

- Five detention basins were included in this alternative, with three of them located within the City's planned growth area and two just outside of the planned growth area. Two basins (East and Caltrans) would have gentle side slopes of 10H:1V to facilitate use of the basins by the public. However, the shallow area was eliminated and the deep section was expanded. The other basins would be more traditional flood control basins with side slopes of (4H:1V). However, even these basins could be used for some types of joint uses like habitat viewing.
- This alternative also included diversion of the drainage from the northeast quadrant of the City eastward at Pennington Road to the Feather River.

  The construction cost for this alternative was estimated at $21.1 million, and the capital cost was estimated at $35.6 million.

COMPARISON OF ALTERNATIVES (CHAPTER 12)

Alternatives 1, 2, 3 and 4 were compared and Alternative 4 was identified as the recommended project. The comparison included:

- Life cycle costs, as summarized in Table ES-2.
- Land requirements.
- Groundwater issues that determined if the basin would be likely to intercept the groundwater table at a depth of 6 to 8 feet below the ground surface.
- Number and capacity of pump stations.
- Ability to phase construction of the facilities.
- Environmental issues and permitting.

Presented in Table ES-3 is a summary comparison of the major issues related to the alternatives. Presented in Table ES-4 is a ranking of the alternatives based on point scores associated with these issues listed above. Presented in the top row of Table ES-4 are the points assigned to each issue, with higher points meaning the issue is more important. Capital cost and land requirements were given a maximum point value of 10 points each. Intrusion into the groundwater table was also another major issue, so it was assigned a maximum value of 10 points. Pump stations, phasing potential, and permitting/environmental issues were each assigned a value of 5 points.

Each alternative was then given a point score for each of the major issues. A maximum score of 45 points is possible. For each alternative, the point scores are totaled in the far right column of Table ES-4, with higher scores being better than lower scores. As shown, Alternative 1 has the lowest point score with 26.1 points, while Alternative 4 has the highest ranking with 33.9 points.

Table ES-2. Life Cycle Cost Comparison, dollars

Cost Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial Capital Costs	37,910,000	57,880,000	40,140,000	35,590,000
Present Value of O&M Costs	1,742,000	2,402,000	1,969,000	1,586,000
Present Value of Replacement Costs	8,650,000	6,330,000	7,000,000	7,230,000
Total	48,302,000	66,612,000	49,109,000	44,406,000

Alternatives 1 through 4 were presented to the City of Live Oak City Council and Planning Commission at a General Plan Update workshop covering stormwater, potable water, and wastewater on April 28, 2010. At the time of the presentation, the life cycle cost evaluation presented above had not been completed. A copy of the stormwater presentation is provided as Appendix 12-A of the MDS. The goals for the presentation were to present the alternatives, compare the alternatives, answer questions about the alternatives, and determine if the City Council and Planning Commission generally support the concept of including joint use channels and detention basins in the recommended project.

Neither the City Council nor the Planning Commission took official action to adopt Alternative 4 as the recommended project. However, they were generally supportive of the concept of joint use channels and detention basins.

Based on the comparison and rating of the alternatives, Alternative 4, was selected as the preferred alternative.

DETENTION FACILITIES FOR RD 2056 (CHAPTER 13)

The northwest corner of the City's General Plan buildout area is within the RD 2056 service area. This area represents about 15 percent of the City's total urban area (not including Urban Reserve) at buildout of the 2030 General Plan. This area was divided into six subwatersheds based upon their current drainage patterns. These areas drain into Morrison Slough, which in turn flows to the East Interceptor Canal, the Wadsworth Canal, the Sutter Bypass, and finally to the Sacramento River. The RD 2056 channels were originally sized for a runoff rate of 15 cfs per square mile, or 0.0234 cfs per acre. The drainage plan for this area includes the use of channels and detention basins that have been sized to reduce the post development flow into Morrison Slough to be less than the original design runoff rate. The locations of these basins are shown on Figure ES-14. The basins are currently located west of Township Road, outside the City's planning area to preserve land within the City's growth boundary for future development and to use lower cost land for the detention basins. However, the basins could be relocated to be inside the City's planning area.

Table ES-3. Comparison of Alternatives

Alternative	Brief Description	Capital Cost, millions dollars	Land Requirements, acres						Max Basin Depth , ft [a]	No. of Pump Stations	Pump Station Capacities & Locations	Ability to Phase Construction of Facilities	Environmental Issues & Permits
			Basin	Channel	Total	Land Located Inside of City Growth Area	Land Located Outside of City Growth Area	Land Available for Joint Uses					
1	Five flood control detention basins throughout City growth area, enlarged Lateral 2 channel, diversion to Feather River, piping of Main Canal and Larkin Road Ditch	37.9	80.2	42.9	123.1	105.7	7.6	0	14	3	▪20 cfs to Feather River at Pennington Rd ▪10 cfs at Caltrans Basin to Lateral 2 ▪5 cfs to Lateral 2 at Township Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	High: ▪Extensive piping of channels, including the Main Canal, results in loss of habitat.
2	One large regional detention basin outside City growth area, channel improvements for increased conveyance	57.9	85.7	155.1	240.8	77	99.2	0	7.2	0	None	Minimal: ▪To minimize habitat impacts, full channel widening would be done initially and would not be phased. ▪Regional basin excavation can be phased.	High: ▪Extensive channel modification to convey flows efficiently could affect giant garter snake habitat.
3	Four dual-use detention basins that function for flood control and recreational purposes, one flood control basin, piping of Lateral 2, diversion to Feather River	40.1	197.1	42.5	239.6	209.9	40.4	222.3	8(b)	1	▪20 cfs to Feather River at Pennington Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	Moderate: ▪Replacement of Lateral 2 with piping results in loss of some habitat.
4	Two dual-use detention basins that function for flood control and recreational purposes, three flood control basins, Lateral 2 channel widening, diversion to Feather River	35.6	106.7	59.1	165.8	120.1	40.4	91.7	8(b)	2	▪20 cfs to Feather River at Pennington Rd ▪5 cfs to Lateral 2 at Township Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	Minimal : ▪Dual use functions of improved channels may enhance habitat. ▪Minimal piping of existing channels

(a) Groundwater is typically encountered at depths of 6 to 8 feet in the City of Live Oak area.

(b) Only a small portion of the North Basin bottom (2.2 acres) is at depth of 8 feet. The rest of the basin is at depth of 6 feet. The deep section of the North Basin was necessary to match the bottom elevations of the channels flowing into and out of the basin.

Table ES-4. Ranking of Alternatives 1-4

Alternative	Capital Cost (10 points)		Land Requirements (10 points)		Groundwater (10 points)		Pump Stations (5 points)		Phasing Potential (5 points)		Environmental Issues & Permitting (5 points)		Total Score (45 points)
	Capital Cost, millions dollars	Point Score	Total Land, acres	Point Score	Max Basin Depth, ft	Point Score	No. of Pump Stations	Point Score	Relative Ranking	Point Score	Relative Ranking	Point Score	
1	37.9	9.6	123.1	10.0	14	1.5	3	0.0	High	5	Moderate	2	26.1
2	57.9	6.1	240.8	5.1	7.2	10.0	0	5.0	Low	1	High	1	27.3
3	40.1	9.2	239.6	5.2	8	9.0	1	3.3	High	5	Moderate	2	31.7
4	35.6	10.0	165.8	8.2	8	9.0	2	1.7	High	5	Minimal	4	33.9

Each of the detention basin systems was configured to include a channel (12 foot bottom width and 4H:1V side slopes) from Township Road to near Morrison Slough. This large channel both conveys the peak flows and provides the first increment of detention storage. At the west end of the channel a small culvert restricts the flow into Morrison Slough to slightly less than the original design runoff rate. Also, a side flow weir directs the peak flows from the channel into a detention basin located adjacent to the channel.

Each detention basin was configured to have a deep section with a depth of 5.0 to 5.5 feet, and a shallow section with a depth of about 2.0 to 2.5 feet. This approach was used to allow the shallow section to continue to be farmed. In a 10-year storm, the water will remain in the deep section of the basin. In a 100-year storm, both sections are completely filled with water, leaving about one foot of freeboard. This two step approach results in conserving some land for continued farming, but also results in the overall basin foot print being larger than if the entire basin was excavated to a depth of 5.0 to 5.5 feet.

When the basins are to be designed and constructed, the final basin locations and configurations should be reevaluated in cooperation with the individual land owners. There are many potential configurations that could be used to minimize the impacts to the property and farming operations.

The North Basin provides detention storage for a tributary area of 283 acres, resulting in an original design runoff rate of 6.6 cfs. The channel/basin system requires 14.8 acres, and the basin provides 47 ac-ft of storage volume. Upstream of the detention basin, the peak 10-year and 100-year runoff rates are 230 cfs and 300 cfs, respectively. The peak release rates to Morrison Slough from the basin/channel system at the peak of the design storms are 5.4 cfs and 5.3 cfs, respectively. After the storm has passed and the water level in Morrison Slough has dropped, the release rates increase to 12.0 cfs and 11.2 cfs respectively. The estimated construction cost for this system is $702,000, and the estimated total capital cost is $1.35 million.

The Mid Basin provides detention storage for a tributary area of 135 acres, resulting in an original design runoff rate of 3.2 cfs. The channel/basin system requires 9.1 acres, and the basin provides 17.6 ac-ft of storage volume. Upstream of the detention basin, the peak 10-year and 100-year runoff rates are 123 cfs and 162 cfs, respectively. The peak release rates to Morrison Slough from the basin/channel system at the peak of these storms are 3.2 cfs and 3.1 cfs, respectively. After the storm has passed and the water level in Morrison Slough has dropped, the release rates increase to 8 cfs and 14 cfs respectively. The estimated construction cost for this system is $490,000, and the estimated total capital cost is $910,000.

The South Basin provides detention storage for a tributary area of 304 acres, resulting in an original design runoff rate of 7.1 cfs. The channel/basin system requires 19.0 acres, and the basin provides 34 ac-ft of storage volume. Upstream of the detention basin, the peak 10-year and 100-year runoff rates are 307 cfs and 402 cfs, respectively. The peak release rates to Morrison Slough from the basin/channel system at the peak of these storms are 5.1 cfs and 5.0 cfs, respectively. After the storm has passed and the water level in Morrison Slough has dropped, the release rate increases to 5.7 cfs and 16 cfs respectively. This system also includes 2,500 feet of 72-inch trunk drain that would be funded and constructed by the developer. The estimated construction cost for this system is $1.2 million, and the estimated total capital cost is $2.1 million.

RECOMMENDED PROJECT (CHAPTER 14)

The Recommended Project (RP) is shown on Figures ES-14A and 14B. The RP includes:

- All of the facilities from Alternative 4 as described in Chapter 11. These facilities are within the RD 777 service area. These facilities would be funded by development impact fees and constructed by the City.
- All of the facilities described in Chapter 13, which are within the RD 2056 service area. These facilities would be funded by development impact fees and constructed by the City.
- Additional trunk drains within the City that would likely serve more than one individual development project. These drains are described and sized below. These drains would be funded and constructed by the development projects that use the drains.
- Increased channel maintenance to achieve a Manning's n value of 0.035 and increase culvert maintenance to keep the culverts free of sediment. These reaches of drains that require increased maintenance are shaded yellow on Figure 14-1B. The increased maintenance would be funded through increased fees collected by RD 777 from the new growth areas of the City (see discussion below).

The estimated construction cost for the RP is $23.5 million, and the estimated total capital cost is $40.0 million.

As the City develops to full buildout of the 2030 General Plan, RD 777 will collect increased fees through its existing fee program, and RD 777 will have reduced overall channel maintenance responsibility. RD 777 collects fees annually from each parcel within its boundaries. The fees are the larger of $2 per acre or $25 per parcel. For example, a 40 acre agricultural parcel would pay $80 per year, and a 0.25 acre residential lot would pay $25 per year. As the City develops, larger agricultural parcels will be converted to smaller urban parcels. The fees collected by RD 777 as the City area develops would increase from about $15,000 per year to about $345,000 per year. Additionally, several of the channels that currently are maintained by RD 777 will be converted to joint use channels, which will have improved landscaping and pedestrian/bike pathways. As the channels are improved, the City will take over maintenance of the channels. Also, some existing channels will be replaced with trunk drains, which will be maintained by the City. RD 777 will be relieved of maintenance responsibility for 5 miles of channels.

The RP consists of storm drains, pump stations, open channel improvements, and detention basins. The construction of these facilities has the potential to cause environmental impacts. From a project permitting perspective, the potential biological impacts are most critical. Important biological resources include plants, animals, or habitat areas. The City has prepared a CEQA review of the General Plan Update and associated infrastructure requirements.

Four special status plant species were identified for which suitable habitat occurs in the City and RD 777 areas, and consequently, these species could be impacted by construction of the RP facilities. These species include Fox sedge, Rose-mallow, Sanford's arrowhead, and Columbian watermeal. Each of these plant species could occur in the sloughs, drainage channels, and irrigation canals in the City and RD 777 areas.

There are 23 special status wildlife species that could occur in the City and RD 777 areas. The species that occur in the sloughs, drainage channels, and irrigation canals include Valley elderberry longhorn beetle, Northwestern pond turtle, Giant garter snake (GGS), Tricolored blackbird, and Song sparrow (Modesto population). The detention basins will be constructed in agricultural land areas that are either orchards or cropland. The species that occur in orchards are Loggerhead shrike, White-tailed kite, and Western red bat. The species that occur in cropland are Western burrowing owl, Swainson's hawk, Lesser sandhill crane, and Greater sandhill crane.

The special status fish species that could be impacted are Central Valley spring run Chinook salmon and Central Valley steelhead. These fish use the Feather River for migration and spawning. The east detention basin and pump station will discharge to the Feather River. The force main will end at the water side toe of the existing levee, which is over 1,050 feet from the active river channel and significantly above the summertime water level in the river. The flow will be conveyed to the active river by an existing channel and culverts. Thus, construction of the force main should not impact the river or these special status fish.

The City has prepared an Environmental Impact Report covering implementation of the 2030 General Plan. The EIR evaluated the following impacts related to stormwater facilities: on-site and downstream erosion and sedimentation; construction related water quality impacts; exposure of people or structures to flood hazards from increased stormwater runoff; impacts to special status plant species; impacts to special status wildlife and fish species; loss and degradation of federally and state protected wetlands and/or riparian vegetation; and the requirement for construction of new or expanded stormwater drainage facilities. Implementation of City policies associated with the 2030 General Plan results in all of these impacts receiving a less-than-significant evaluation.

Although the impacts associated with these stormwater drainage facilities have been evaluated and found to be less-than-significant, several permits will be required for the implementation of these stormwater facilities, including:

- Delineation of the Waters and Wetlands of the US
- US Army Corps of Engineers Clean Water Act Section 404 Individual Discharge Permit
- California Central Valley RWQCB Clean Water Act Section 401 Water Quality Certification
- Endangered Species Act Section 7 USFWS Consultation
- California Department of Fish and Game Section 1602 Streambed Alteration Agreement
- California Central Valley Flood Protection Board Encroachment Permit
- California Construction General Permit Order 2009-0009-DWQ
- RD 777 and RD 2056 Encroachment Permits

It is likely that the terms established in these permits will require measures to protect endangered or threatened species or habitats that could be harmed by construction of elements of the recommended project.

CONCLUSIONS AND RECOMMENDATIONS (CHAPTER 15)

Several conclusions and recommendations were identified, and the most critical are summarized below:

- The Recommended Project (RP), as described in Chapter 13, achieves the design criteria identified for the project (in Chapter 3), primarily sizing open channels and detention basins for the 100-year, 4-day storm, and sizing trunk storm drains to convey the peak 10-year storm flow.
- The RP was selected primarily because it achieves the design criteria at the lowest cost. It also enables many of the drainage channels and detention basins to serve as joint use facilities, providing space for sports fields, pedestrian/bike paths, and riparian habitat.
- The Highway 99 Improvements will eliminate flooding that occurs on a major Caltrans highway. Consequently, cost sharing with Caltrans for this project should be explored.
- The City recently purchased from Caltrans the Caltrans Property Detention Basin site. Since this basin site is now owned by the City, preliminary design (including soils testing) of the basin could be performed to identify exactly where and how much excavation will be needed. This would allow the City to sell soil from this site when there is a demand for soil elsewhere. In particular, as levee projects are implemented in the future by the State or other agencies, there may be a significant demand for soil that is suitable for levee construction/repair. The sale of this material could result in this basin being constructed at a low cost to the City.
- Land prices have been unusually low in recent years, and to the extent funding is available, land for the proposed basins and channels should be acquired soon to capitalize on the lower-than-normal land costs. The purchased land could be leased for farming until it is needed.

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Brianne Way Detention Basin

Brianne Way Pump Station

Landmark Church Detention Basin

Larkin Road Pump Station

Apricot Street Pump Station

Belle Street Pump Station

Ash Street Detention Basin

Pennington Ranch Detention Basin

Kristen Street Detention Basin

LEGEND

- CITY LIMITS
- STORM DRAIN
- FORCE MAIN
- DETENTION BASIN
- DRAINAGE DITCH
- PUMP STATION

N

0 450 900

SCALE IN FEET

Figure ES-1

City of Live Oak
Master Drainage Plan
EXISTING DRAINAGE FACILITIES

WEST YOST ASSOCIATES
Consulting Engineers

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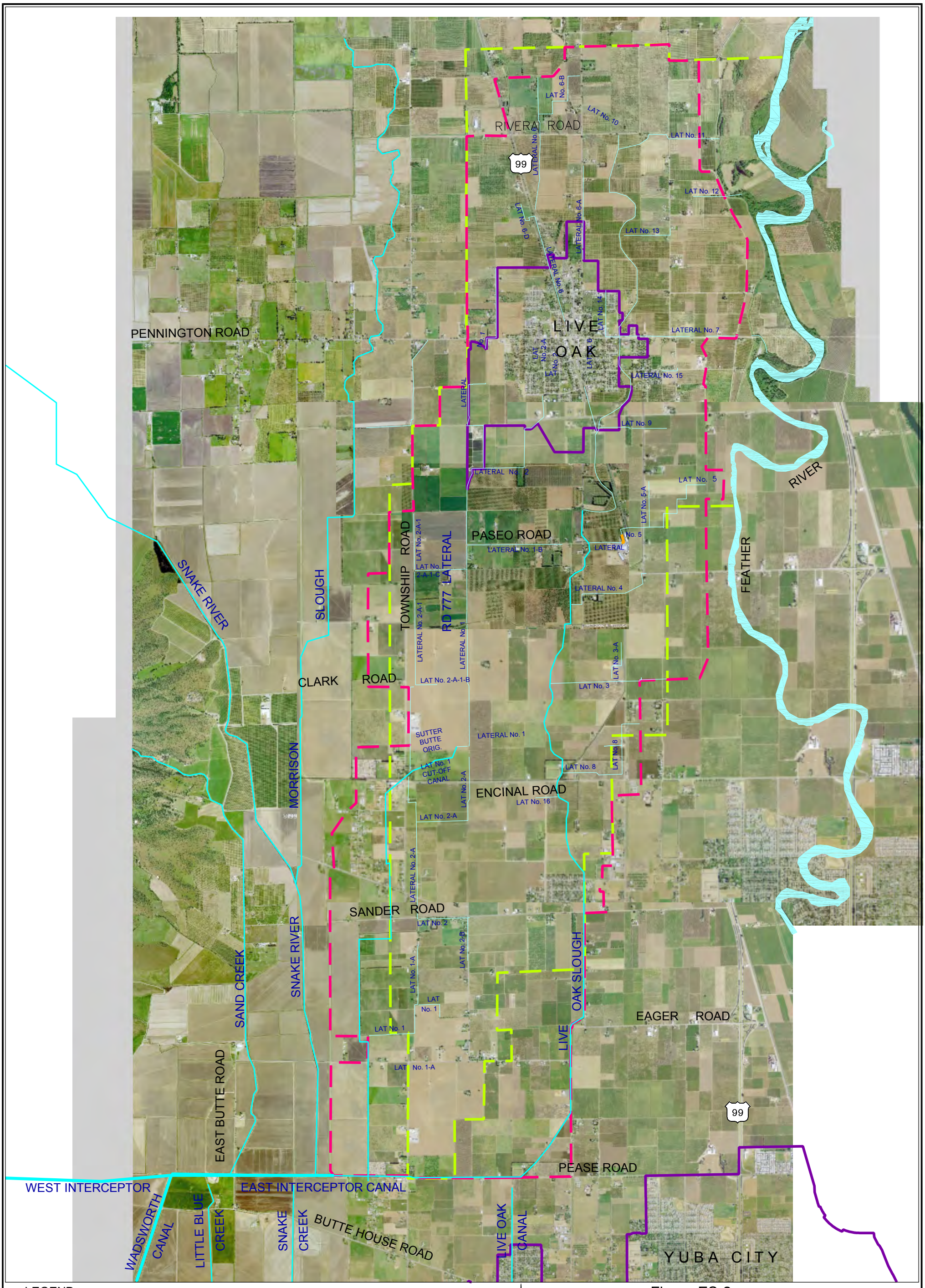

LEGEND

- STORM DRAIN PIPE
- MAIN CHANNELS & RD777 LATERALS
- RD777 WATERSHED BOUNDARY
- DISTRICT BOUNDARY
- CITY LIMITS

N

0 2000 4000

SCALE IN FEET

Figure ES-2

City of Live Oak
Master Drainage Study
EXISTING RD777
DRAINAGE FACILITIES

WEST YOST ASSOCIATES
Consulting Engineers

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RIVERA ROAD
99
RD 2056
LIVE OAK
PENNINGTON ROAD
SNAKE RIVER
SLOUGH
TOWNSHIP ROAD
RD 777 LATERAL
PASEO ROAD
FEATHER RIVER
CLARK ROAD
MORRISON
ENCINAL ROAD
SAND CREEK
SANDER ROAD
OAK SLOUGH
EAST BUTTE ROAD
EAGER ROAD
LIVE
99
WEST INTERCEPTOR
EAST INTERCEPTOR CANAL
PEASE ROAD
BUTTE HOUSE ROAD
CREEK
BLUE
RIVER
20
YUBA CITY
SUTTER BYPASS
WADSWORTH CANAL
LITTLE
HUMPHREY ROAD
SNAKE
FRANKLIN ROAD
LIVE OAK CANAL
TOWNSHIP ROAD
LINCOLN ROAD
BOGUE ROAD
99

LEGEND

- WADSWORTH WATERSHED
- CITY PLANNING AREA
- RD777 WATERSHED BOUNDARY
- DISTRICT BOUNDARY
- MAIN CHANNELS & RD777 LATERALS
- CITY LIMITS

N

0 3500 7000
SCALE IN FEET

Figure ES-3

City of Live Oak
Master Drainage Study
REGIONAL WATERSHED

WEST YOST ASSOCIATES
Consulting Engineers

Figure ES-4. Design Storm Hyetographs in 5 Minute Time Increments

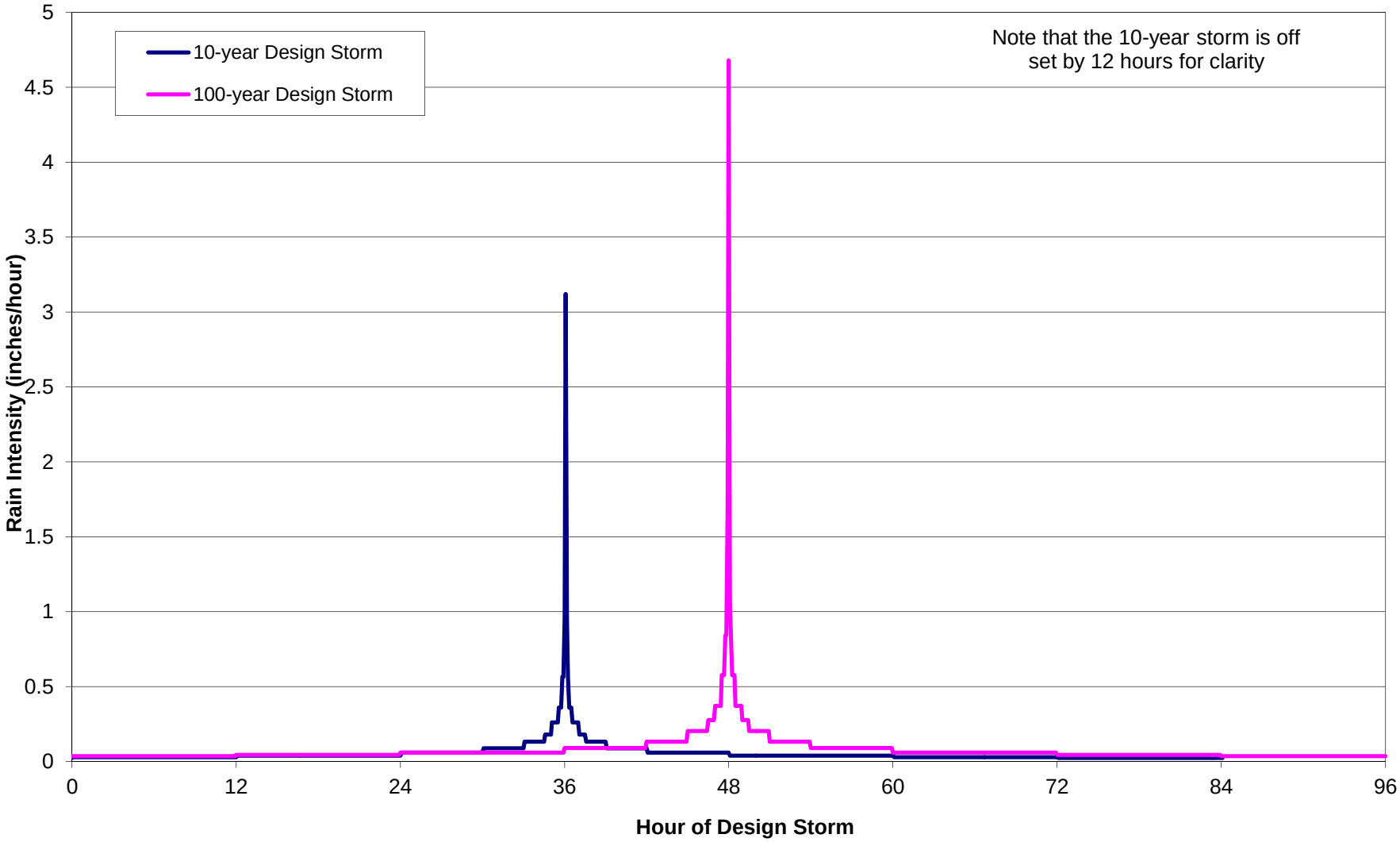


Figure ES-5A. Sutter County Runoff Calibration Curves for a 10-year Design Storm with Model Subshed Data

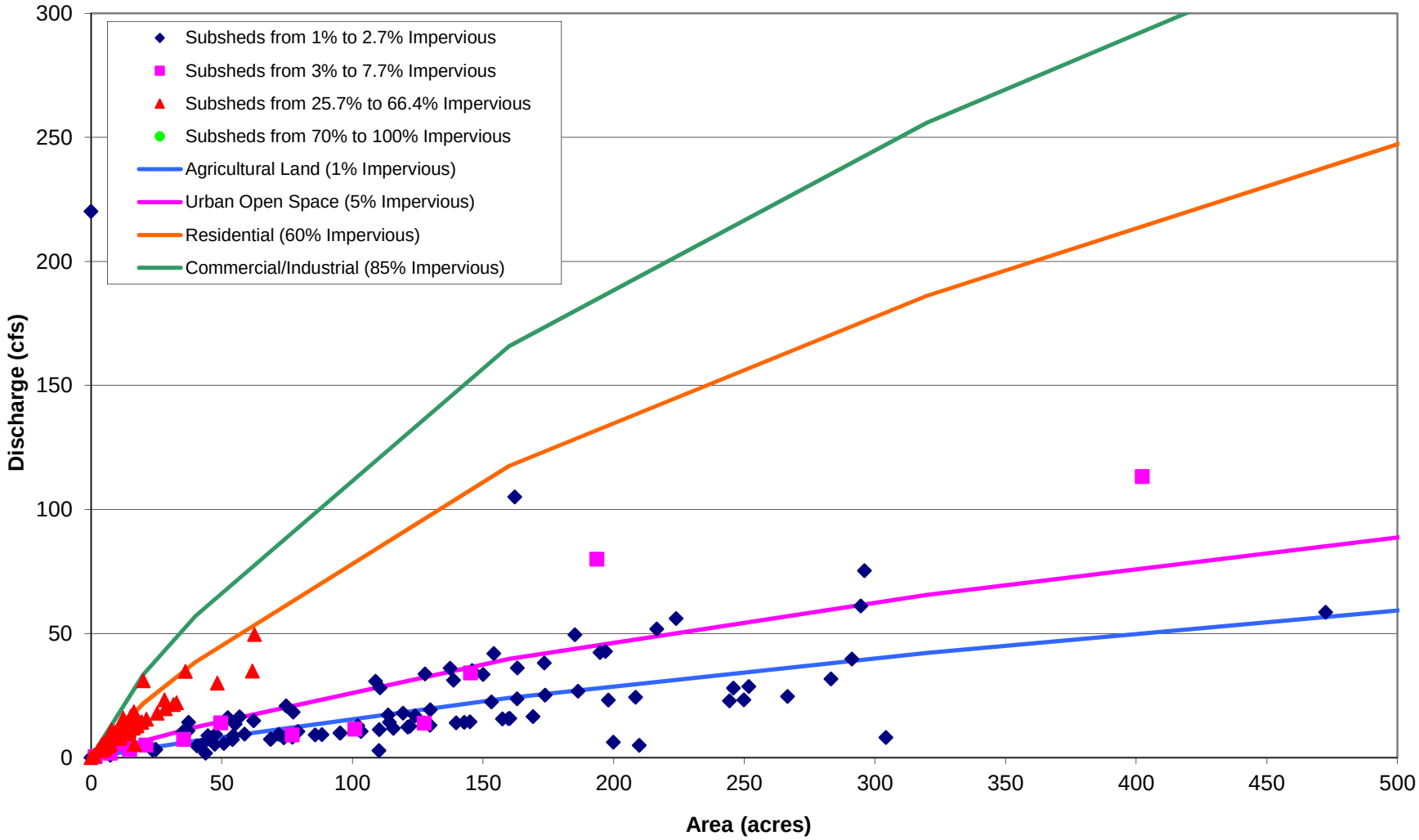
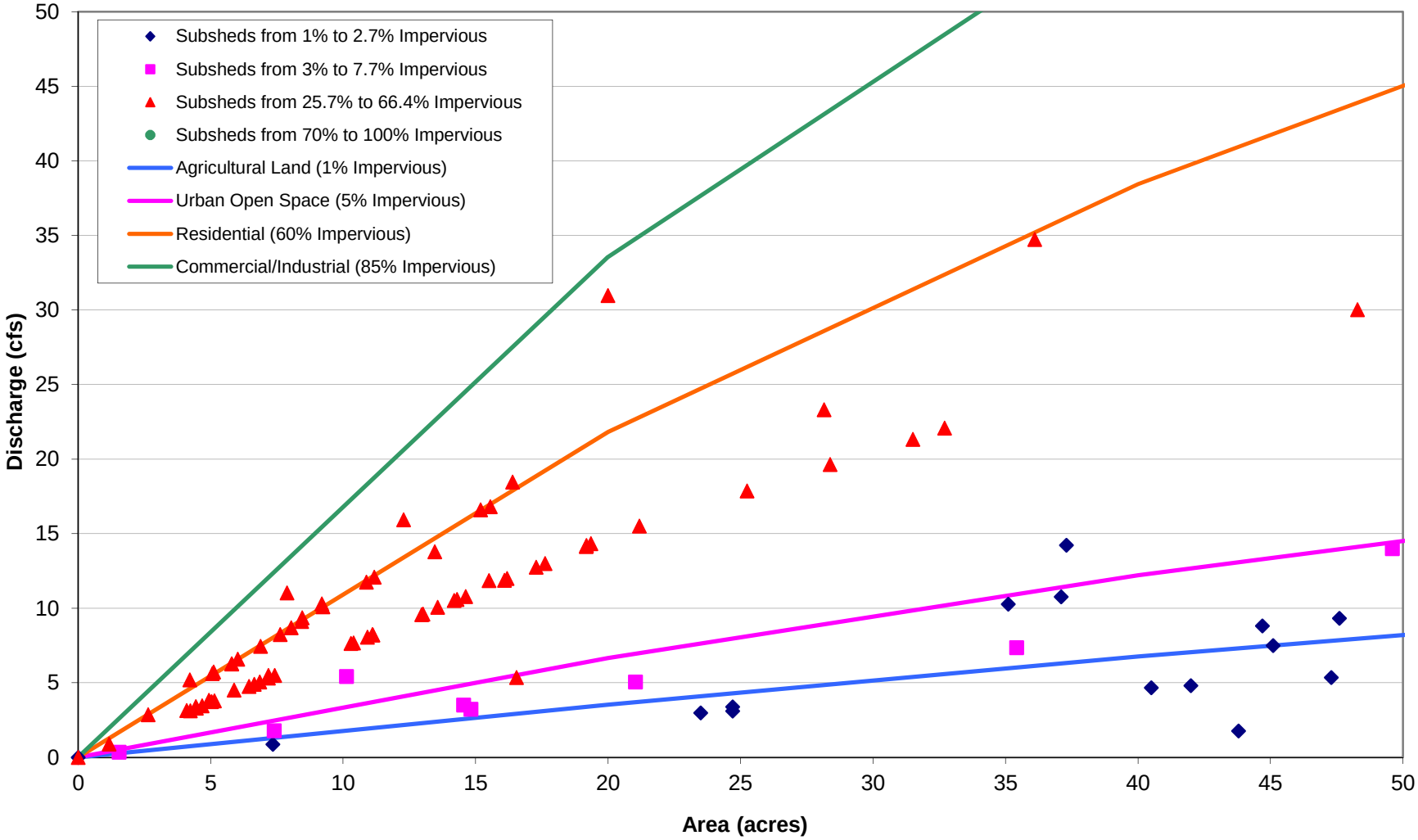


Figure ES-5B. Sutter County Runoff Calibration Curves for a 10-year Design Storm with Model Subshed Data



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LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK
- FLOOD DEPTH 1 - 2 FT
- FLOOD DEPTH 0 TO 1 FT
- FREEBOARD 0 TO 1 FT

N

0 450 900

SCALE IN FEET

Figure ES-6

City of Live Oak
Master Drainage Study
10-YEAR DESIGN STORM FLOODING
FOR EXISTING SYSTEM

WEST YOST ASSOCIATES
Consulting Engineers

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LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK
- FLOOD DEPTH > 2 FT
- FLOOD DEPTH 1 - 2 FT
- FLOOD DEPTH 0 TO 1 FT
- FREEBOARD 0 TO 1 FT

N

0 450 900

SCALE IN FEET

Figure ES-7

City of Live Oak
Master Drainage Study
100-YEAR DESIGN STORM FLOODING
FOR EXISTING SYSTEM

WEST YOST ASSOCIATES
Consulting Engineers

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LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK
- FLOOD DEPTH 1 - 2 FT
- FLOOD DEPTH 0 TO 1 FT
- FREEBOARD 0 TO 1 FT

N

0 450 900

SCALE IN FEET

Figure ES-8

City of Live Oake
Master Drainage Study
10-YEAR DESIGN STORM FLOODING WITH PROPOSED IMPROVEMENTS TO SOLVE EXISTING DRAINAGE/FLOODING PROBLEMS

WEST YOST ASSOCIATES
Consulting Engineers

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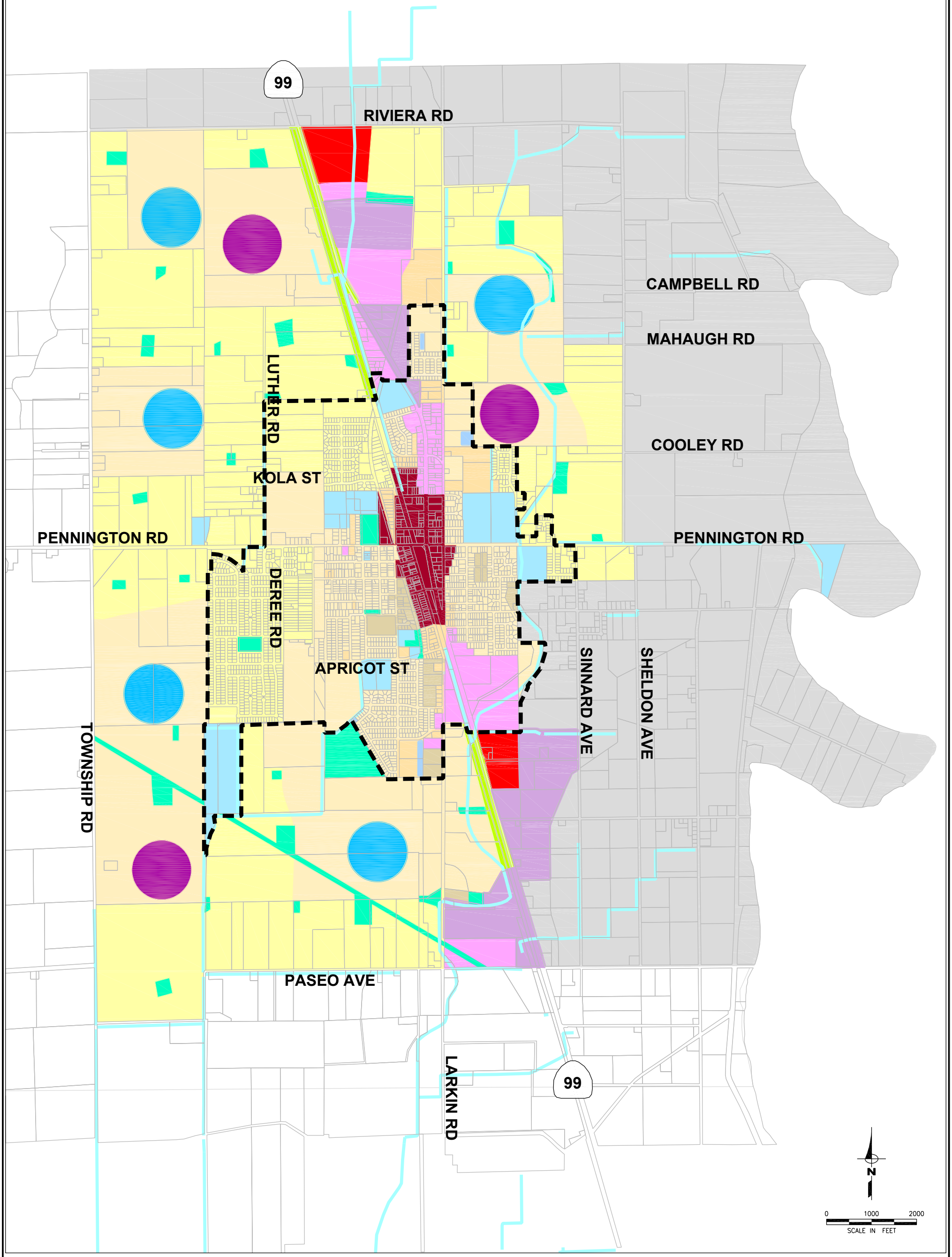

LEGEND

- CITY LIMITS
- CHANNEL
- LOW-DENSITY RESIDENTIAL
- SMALL-LOT RESIDENTIAL
- MEDIUM-DENSITY RESIDENTIAL
- HIGH-DENSITY RESIDENTIAL
- COMMERCIAL MIXED USE
- DOWNTOWN MIXED USE
- COMMUNITY COMMERCIAL
- PARK
- CIVIC
- EMPLOYMENT
- URBAN RESERVE
- BUFFER
- NEIGHBORHOOD CENTER
- CIVIC CENTER

SOURCE: FUTURE LAND USE FROM THE CITY OF LIVE OAK GENERAL PLAN PROVIDED BY EDAW AECOM

Figure ES-9

City of Live Oak
Master Drainage Study
GENERAL PLAN LAND USE CONDITIONS

WEST YOST ASSOCIATES
Consulting Engineers

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99

RIVIERA RD

6 LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN

2 LARKIN ROAD STORM DRAIN SYSTEM

1 MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN

CAMPBELL RD

MAHAUGH RD

CHANNEL SIZE
BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

LUTHER RD

7 NORTH DETENTION BASIN

18" RCP OUTLET

CHANNEL SIZE
BOTTOM WIDTH: 25'
SIDE SLOPE: 4H:1V

COOLEY RD

20 CFS PUMPED TO THE FEATHER RIVER

36" FORCE MAIN

30" RESTRICTIVE CULVERT

KOLA ST

GARDEN GLEN DIVISION

18" ORIFICE

PENNINGTON RD

DEREE RD

3 EAST DETENTION BASIN

SINNARD AVE

SHELDON AVE

APRICOT ST

CHANNEL SIZE
BOTTOM WIDTH: 60'
SIDE SLOPE: 5H:1V

INLET WEIR

TOWNSHIP RD

10 CFS PUMPED DISCHARGE

12" ORIFICE

8 CALTRANS PROPERTY DETENTION BASIN

CHANNEL SIZE
BOTTOM WIDTH: 15'
SIDE SLOPE: 3H:1V

CHANNEL SIZE
BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

4

10 LATERAL 2 IMPROVEMENTS AT TOWNSHIP RD

9 LATERAL 2 IMPROVEMENTS

LATERAL 5 STORM DRAIN

CHANNEL SIZE
BOTTOM WIDTH: 60'
SIDE SLOPE: 5H:1V

PASEO AVE

INLET WEIR

5 SOUTH DETENTION BASIN

24" RCP OUTLET WITH FLAP GATE

11 WEST DETENTION BASIN

5 CFS PUMPED DISCHARGE

99

LARKIN RD

0 750 1500
SCALE IN FEET

LEGEND

- CITY LIMITS
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL
- PROPOSED STORM DRAIN
- 1 IMPROVEMENT IDENTIFICATION

Figure ES-10

City of Live Oak
Master Drainage Study
ALTERNATIVE 1
IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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RIVIERA RD

UPRR

2 LARKIN ROAD STORM DRAIN

60"

5 LATERAL 6 NORTH OF DIVERSION CHANNEL

72"

LUTHER RD

LARKIN RD

BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

1 MAIN CANAL IMPROVEMENT

36"

CAMPBELL RD

30"

MAHAUGH RD

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

48"

BOTTOM WIDTH: 12'
SIDE SLOPE: 4H:1V

6 DIVERSION CHANNEL

COOLEY RD

DIVERSION TO MAIN CANAL

KOLA ST

GARDEN GLEN DIVISION

3 PENNINGTON RD STORM DRAIN

BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

PENNINGTON RD

TOWNSHIP RD

DERBY RD

TWIN 60"

ARCHER AVE

SINNARD AVE

SHELDON AVE

FEATHER RIVER

BOTTOM WIDTH: 15'
SIDE SLOPE: 4H:1V

APRICOT ST

INLET WEIR

WWTP

48" & EX 72"x72" BOX

7 LATERAL 2 IMPROVEMENT

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

9 LATERAL 2 IMPROVED CHANNEL AT TOWNSHIP RD

BOTTOM WIDTH: 20'
SIDE SLOPE: 4H:1V

4 LATERAL 5 IMPROVEMENTS

8 PASEO RD IMPROVEMENTS

TWIN 72"

PASEO AVE

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 20'
SIDE SLOPE: 4H:1V

99

LARKIN RD

SIPHON CHANNEL UNDER EXISTING IRRIGATION CANAL

10 DETENTION BASIN 82.0 ACRES 485 AC-FT

1 MAIN CANAL IMPROVEMENT

7 LATERAL 2 IMPROVEMENT

INLET CHANNEL
BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

ALT2_DB

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 12'
SIDE SLOPE: 4H:1V

SIPHON CHANNEL UNDER EXISTING IRRIGATION CANAL

INLET CHANNEL
BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

36" OUTLET PIPE WITH FLAPGATE

N

0 1000 2000
SCALE IN FEET

LEGEND

- CITY LIMITS
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL
- PROPOSED STORM DRAIN
- 1 IMPROVEMENT IDENTIFICATION

Figure ES-11

City of Live Oak
Master Drainage Study
ALTERNATIVE 2
IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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99

RIVIERA RD

5 LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN

66"

72"

CHANNEL SIZE
BOTTOM WIDTH: 10'
SIDE SLOPE: 6H:1V

1 MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN

36"

CAMPBELL RD

MAHAUGH RD

LUTHER RD

6 NORTH DETENTION BASIN

NBSN

5'x6' RCP BOX CULVERTS
USE EX 5'X6' BOX AT HWY 99

54"

18" RCP OUTLET

36"

CHANNEL SIZE
BOTTOM WIDTH: 10'
SIDE SLOPE: 6H:1V

COOLEY RD

TWIN 42"

20 CFS PUMPED TO THE FEATHER RIVER

60"

36" FORCE MAIN

EBSN

KOLA ST
GARDEN GLEN DIVISION

30" RESTRICTIVE CULVERT

18" ORIFICE

PENNINGTON RD

DEREE RD

2 EAST DETENTION BASIN

ADJUST OPERATION OF APRICOT ST PUMP STATION

APRICOT ST

SINNARD AVE

SHELDON AVE

INLET WEIR

TOWNSHIP RD

24" OUTLET

7 CALTRANS PROPERTY DETENTION BASIN

SBSN

72"

8 LATERAL 2 STORM DRAIN

3 LATERAL 5 STORM DRAIN

INLET WEIR

60"

48"

PASEO AVE

9 WEST DETENTION BASIN

WBSN

54" IN ADDITION TO EXISTING

4 SOUTH DETENTION BASIN

INLET WEIR

24" RCP OUTLET WITH FLAP GATE

24" OUTLET

99

PARKIN RD

0 750 1500
SCALE IN FEET

LEGEND

- CITY LIMITS
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL
- PROPOSED STORM DRAIN
- 1 IMPROVEMENT IDENTIFICATION

Figure ES-12

City of Live Oak
Master Drainage Study
ALTERNATIVE 3
IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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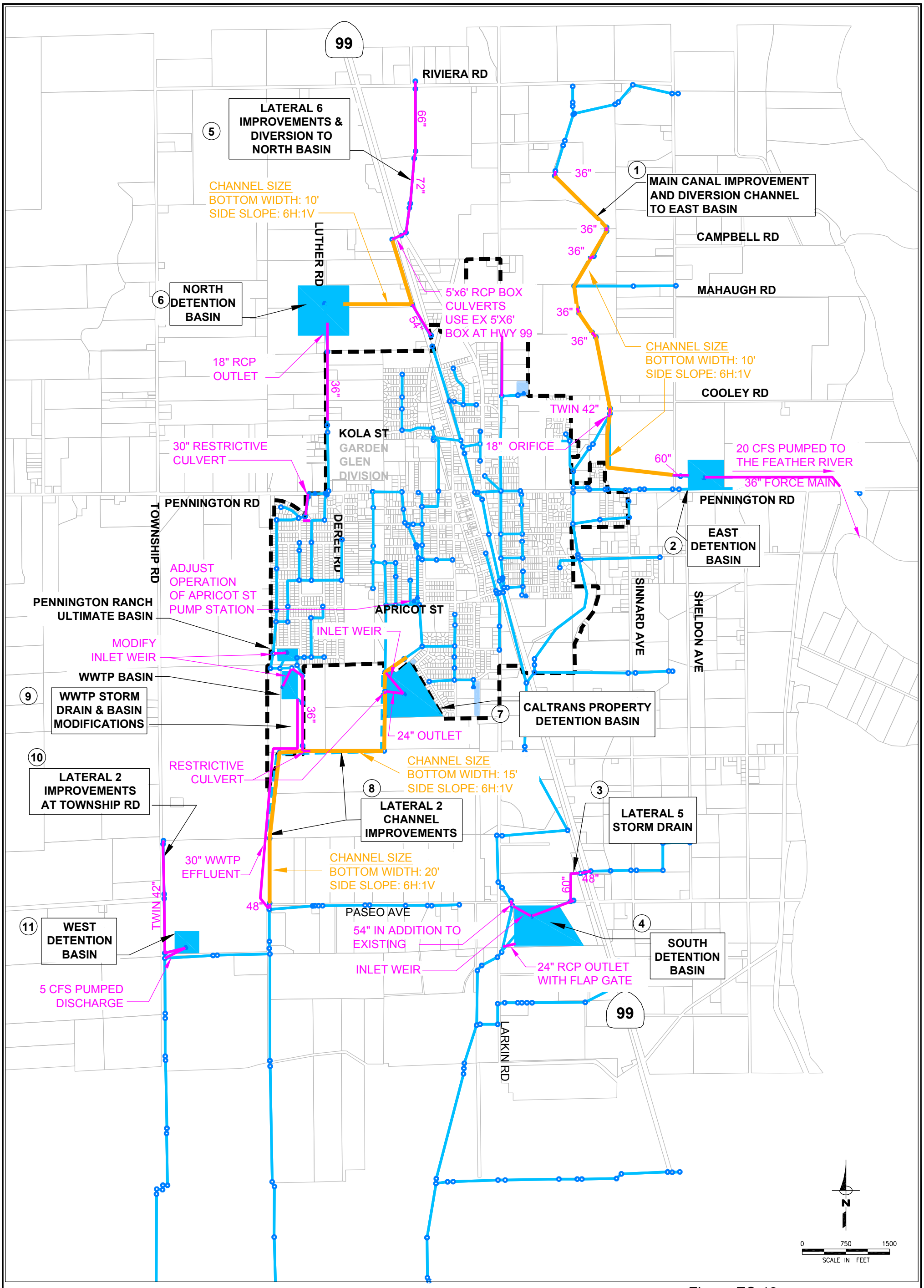

LEGEND

- CITY LIMITS
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL
- PROPOSED STORM DRAIN
- (1) IMPROVEMENT IDENTIFICATION

Figure ES-13

City of Live Oak
Master Drainage Study
ALTERNATIVE 4
IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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RD 2056
RD 777
99
5
LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN
RIVIERA RD
L06-0480-2
L06-0480-1
L02-0530A-2
L02-0530A-1
L02-0460
RD 2056 NORTH DETENTION BASIN
RD 2056-7
1
MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN
CAMPBELL RD
MAHAUGH RD
6
NORTH DETENTION BASIN
NBSN
RD 2056 MID DETENTION BASIN
LUTHER RD
TOWNSHIP RD
KOLA ST
GARDEN GLEN DIVISION
COOLEY RD
2
EAST DETENTION BASIN
EBSN
PENNINGTON RD
DEREE RD
RD 2056 SOUTH DETENTION BASIN
(72" DRAIN SEE CHAPTER 14)
PENNINGTON RANCH ULTIMATE BASIN
APRICOT ST
SINNARD AVE
SHELDON AVE
WWTP BASIN
WWTP_DB
9
WWTP STORM DRAIN & BASIN MODIFICATIONS
7
CALTRANS PROPERTY DETENTION BASIN
SBSN
8
LATERAL 2 CHANNEL IMPROVEMENTS
30" WWTP EFFLUENT LINE
L02-0250
L02-0240
L05-0050-2
3
LATERAL 5 STORM DRAIN
10
LATERAL 2 IMPROVEMENTS AT TOWNSHIP RD
PASEO AVE
11
WEST DETENTION BASIN
WBSN
4
SOUTH DETENTION BASIN
99
LARKIN RD
RD 2056
RD 777
LEVEE DISTRICT 9
RD 777
N
0 1000 2000
SCALE IN FEET

LEGEND
- CITY LIMITS
- RD777 BOUNDARY
- CITY PLANNING AREA
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL IMPROVEMENTS
- PROPOSED STORM DRAIN
- ADDITIONAL PROPOSED TRUNK DRAINS (SEE TABLE 13-1)
- 11 IMPROVEMENT IDENTIFICATION

Figure ES-14A

City of Live Oak
Master Drainage Study
RECOMMENDED PROJECT

WEST YOST ASSOCIATES
Consulting Engineers

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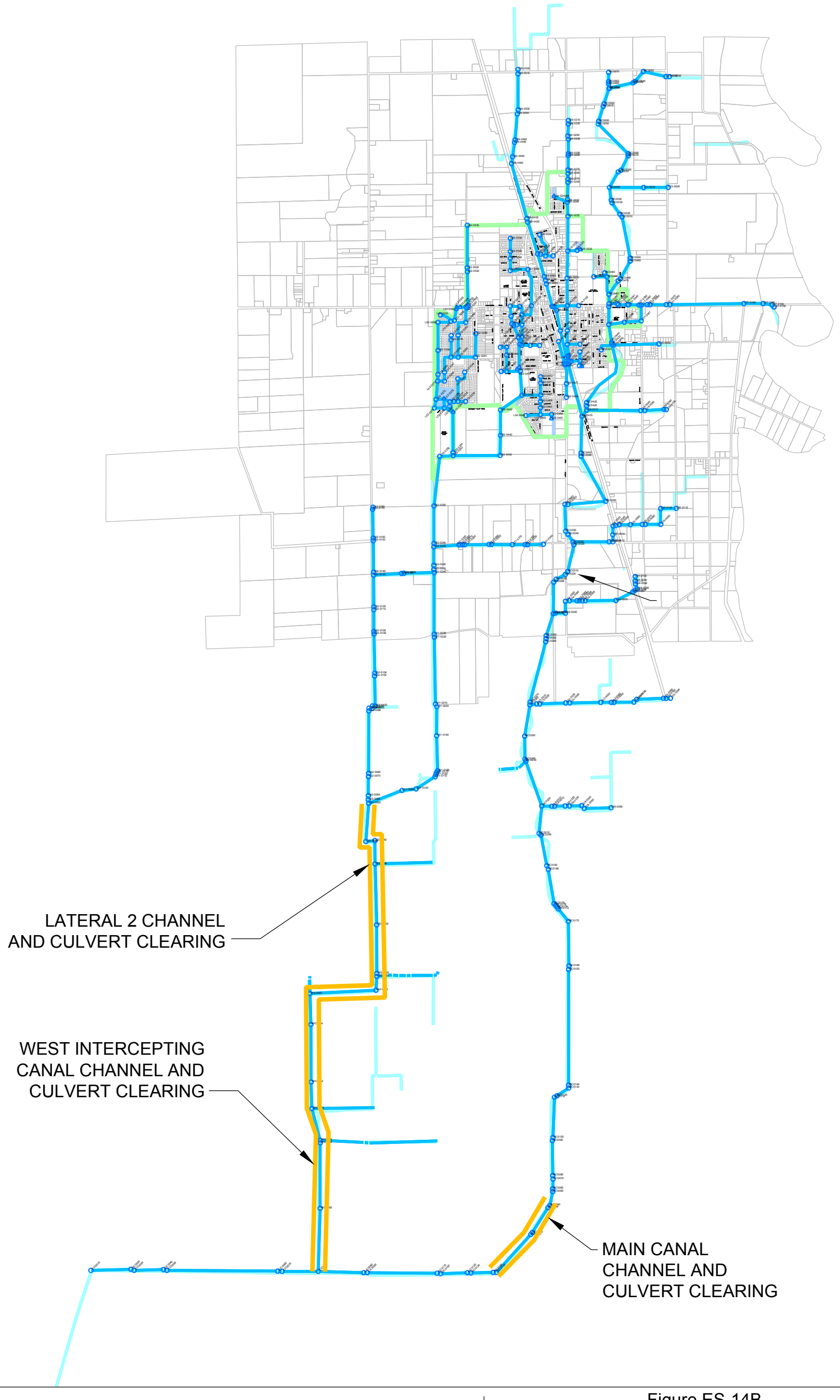

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK

N

0 2000 4000

SCALE IN FEET

Figure ES-14B

City of Live Oak
Master Drainage Study
RECOMMENDED PROJECT

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 1. INTRODUCTION

The purpose and goals of the City of Live Oak (City) Master Drainage Study (MDS) are presented in this chapter. Also presented are brief descriptions of the City's drainage facilities and how the City's facilities discharge into Reclamation District 777 (RD 777) open channel drainage system. The regional drainage systems are also discussed.

PURPOSES OF THIS MASTER DRAINAGE STUDY

The purposes of the MDS are to:

- Identify the drainage/flood control improvements needed to address existing drainage problems,
- Recommend drainage/flood control facilities needed to allow build out of the City's revised General Plan without causing drainage/flooding impacts within the City or to the existing agricultural areas upstream or downstream of the City, and
- Identify the capital and operations and maintenance (O&M) costs of the recommended drainage/flood control facilities.

Significant development has occurred within the City over the last few years, and additional growth of the City is anticipated in the City's revised General Plan, particularly in/around the southwest, northwest, and northeast quadrants of the City. A critical element in planning for the City's new growth is determining infrastructure needs and funding mechanisms to pay for the required infrastructure. Development of agricultural lands results in constructing buildings and pavement, which greatly increases the runoff rate and total volume of runoff. Consequently, new drainage facilities, including storm drain collection systems, open channels, detention basins, and pump stations, are needed to manage the increased runoff and to prevent flooding.

GOALS OF THIS MASTER DRAINAGE STUDY

The MDS will accomplish its purposes by achieving the following goals:

- Quantitatively evaluate the causes of the existing flooding problems and develop planning level improvement projects to eliminate the flooding problems.
- Quantitatively determine the current runoff rate and volume from the areas identified for future growth and determine the increase in the rate and volume of runoff resulting from the anticipated development.
- Estimate the flow capacity of the City's existing drain systems and RD 777's existing channels and culverts.
- Identify a preferred drainage plan and the City/RD 777 facilities required to manage the increased runoff and to prevent flooding within the City or RD 777.
- Develop capital cost estimates for the planned drainage facilities at a level of detail sufficient for use in a Capital Improvement Plan (CIP).

- Develop a CIP that identifies which drainage facilities are needed to provide adequate drainage service for which development areas. The CIP will serve as the basis for drainage facilities funding requirements.

REGIONAL DRAINAGE

The City owns and maintains storm drain pipe systems, detention basins, and pump stations to prevent flooding within the City and convey runoff to the RD 777 open channel drainage system. City facilities are shown in Figure 1-1. RD 777's facilities consist of a series of drainage channels along with culverts and some piping, and these facilities are shown on Figure 1-2. RD 777's system conveys flows to the south and west to the Eastern Intercepting Canal and then to the Wadsworth Canal. The Wadsworth Canal flows to the Sutter Bypass, which in turn flows to the Sacramento River. The regional drainage is shown in Figure 1-3.

The northwest corner of City's General Plan Growth Area is not within the RD 777 boundary. Instead, this northwest corner is within RD 2056 boundaries. This area drains to the west into Morrison Slough. Morrison Slough also drains to the south and west into the Eastern Intercepting Canal and then to the Wadsworth Canal.

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Brianne Way Detention Basin

Brianne Way Pump Station

Landmark Church Detention Basin

Larkin Road Pump Station

Apricot Street Pump Station

Belle Street Pump Station

Ash Street Detention Basin

Pennington Ranch Detention Basin

Kristen Street Detention Basin

UNION PACIFIC RAILROAD

99

STATE HIGHWAY 99

PENNINGTON RD

DEREE RD

APRICOT ST

LIVE OAK BLVD

LARKIN RD

ARCHER AVE

LIVE OAK SLOUGH

RD 777 LAT NO 9

LEGEND

- CITY LIMITS
- STORM DRAIN
- FORCE MAIN
- DETENTION BASIN
- DRAINAGE DITCH
- PUMP STATION

N

0 450 900

SCALE IN FEET

Figure 1-1

City of Live Oak
Master Drainage Plan
DRAINAGE FACILITIES

WEST YOST ASSOCIATES
Consulting Engineers

N:\Clients\047 EDAW\00-08-15 LOGP-MDS\CAD\Figures\047-08-15Fig1-2&ES-2.dwg 11-09-10 01:30:11 PM jfugitt

RIVERA ROAD
PENNINGTON ROAD
LIVE OAK
PASEO ROAD
TOWNSHIP ROAD
RD 777 LATERAL
SLOUGH
SNAKE RIVER
MORRISON
CLARK ROAD
SUTTER BUTTE ORIG.
ENCINAL ROAD
FEATHER RIVER
SANDER ROAD
SAND CREEK
SNAKE RIVER
OAK SLOUGH
EAGER ROAD
EAST BUTTE ROAD
LIVE OAK CANAL
PEASE ROAD
WEST INTERCEPTOR
EAST INTERCEPTOR CANAL
WADSWORTH CANAL
LITTLE BLUE CREEK
SNAKE CREEK
BUTTE HOUSE ROAD
YUBA CITY
99

LAT No. 6-B
LAT No. 10
LAT No. 11
LATERAL No. 6
LAT No. 12
LAT No. 6-D
LAT No. 6-A
LAT No. 13
LATERAL No. 6
LAT No. 14
LATERAL No. 7
LAT No. 2-A
LAT No. 8
LATERAL No. 15
LATERAL No. 1
LAT No. 9
LATERAL No. 2
LAT No. 5
LAT No. 5-A
No. 5
LATERAL
LATERAL No. 1-B
LAT No. 2-A-1
LAT No. 2-A-1-C
LATERAL No. 4
LAT No. 2-A-1
LATERAL No. 1
LAT No. 3-A
LAT No. 3
LAT No. 2-A-1-B
LATERAL No. 1
LAT No. 8
LAT No. 1 CUT-OFF CANAL
LAT No. 2-A
LAT No. 16
LAT No. 2-A
LATERAL No. 2-A
LAT No. 2
LAT No. 2-B
LAT No. 1-A
LAT No. 1
LAT No. 1
LAT No. 1-A

LEGEND
- STORM DRAIN PIPE
- MAIN CHANNELS & RD777 LATERALS
- RD777 WATERSHED BOUNDARY
- DISTRICT BOUNDARY
- CITY LIMITS

N

0 2000 4000
SCALE IN FEET

Figure 1-2

City of Live Oak
Master Drainage Study
EXISTING RD777
DRAINAGE FACILITIES

WEST YOST ASSOCIATES
Consulting Engineers

N:\Clients\047 EDAW\00-08-15 LOGP-MDS\CAD\Figures\047-08-15Fig1-3&ES-3.dwg 11-09-10 01:31:40 PM jfugitt

RIVERA ROAD
99
RD 2056
LIVE OAK
PENNINGTON ROAD
SNAKE RIVER
SLOUGH
TOWNSHIP ROAD
RD 777 LATERAL
PASEO ROAD
FEATHER RIVER
CLARK ROAD
MORRISON
ENCINAL ROAD
SAND CREEK
SANDER ROAD
OAK SLOUGH
EAST BUTTE ROAD
EAGER ROAD
LIVE
99
WEST INTERCEPTOR
EAST INTERCEPTOR CANAL
PEASE ROAD
BUTTE HOUSE ROAD
CREEK
RIVER
BLUE
20
YUBA CITY
SUTTER BYPASS
WADSWORTH CANAL
LITTLE
HUMPHREY ROAD
SNAKE
FRANKLIN ROAD
LIVE OAK CANAL
TOWNSHIP ROAD
LINCOLN ROAD
99
BOGUE ROAD

LEGEND

- WADSWORTH SHED
- GILSIZER SHED
- LOWER SNAKE RIVER SHED
- RD777 WATERSHED BOUNDARY
- DISTRICT BOUNDARY
- MAIN CHANNELS & RD777 LATERALS
- CITY LIMITS

N

0 3500 7000

SCALE IN FEET

Figure 1-3

City of Live Oak
Master Drainage Study
REGIONAL WATERSHEDS

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 2. DATA COLLECTION

Presented in this chapter is a summary of the data collected for use in this MDS. The data generally fits into one of five categories as follows:

- Previous Studies and Data Collected by Others
- Design, As-Built, or Record Drawings Provided by the City of Live Oak
- Field Evaluations Conducted by West Yost Staff
- Global Positioning Satellite Survey Data Collected by West Yost and Laughlin and Spence (L&S)
- Existing Land-Use Data Compiled by West Yost

For each category, the specific data collected is described below.

PREVIOUS STUDIES AND DATA COLLECTED BY OTHERS

Several previous studies relevant to this MDS have been prepared by others. To the extent appropriate, some of the previous information has been used in this MDS where current information was not available. The sources of this information are summarized below:

- Reference 1: City of Live Oak Public Works Improvement Standards, June 2003.
- Reference 2: City of Live Oak Standard Special Provisions and Technical Specifications, June 2003.
- Reference 3: RD 777's Drainage System design/as-built channel profiles, August 1939. Although the original drainage system has likely been modified since 1939, the slopes and channel widths for some of the smaller channels were obtained from these channel profiles in cases where current survey and field collection data was not available.
- The City's new general plan buildout land use map was provided by the City's General Plan Update consultant (EDAW). This map is presented and used in Chapter 7.

DESIGN, AS-BUILT, OR RECORD DRAWINGS PROVIDED BY THE CITY OF LIVE OAK

The plan sets shown in Table 2-1 were provided from the City of Live Oak, and data (pipe sizes, pipe materials, invert elevations, detention basins sizing, pump information…) from these drawings were used in this analysis. The vertical datums used in some of these drawings was other than NAVD 1988, and in those cases, elevations were converted to NAVD 1988 by surveying at least one structure shown on the drawings.

Table 2-1. Plan Sets Used to Develop Live Oak Master Drainage Study

Engineer	Year	Plan Set Title
Baker-Williams	2004	Pennington Ranch Unit No. 1
Baker-Williams	2005	Pennington Ranch Unit No. 2
Baker-Williams	2006	Pennington Ranch Unit No. 3
Baker-Williams	2006	Pennington Ranch Unit No. 4
California Engineering Company	2002	Landmark Church Project
City of Live Oak	Before 1993	Storm Drain Improvements on O St., P St., Fir St., Gum St., and Pennington Rd
Duane Miller	1984	Ramsdell Estates
GHD Assoc.	1985	Plans for Construction on Pennington Rd from Southern Pacific Railway to Larkin Rd and on Larkin Rd from Pennington Rd to Birch St
Gillet Harris Duranceau Assoc.	1985	Highway 99 Storm Water Pumping Plant and Storm Drain
Gillet Harris Duranceau Assoc.	1981	Larkin Rd Storm Water Pumping Plant
Gillet Harris Duranceau Assoc.	1981	Plans for Construction on Larkin Road from Pennington Road to Vicinity of Nevada St
Gillet Harris Duranceau Assoc.	Unknown	Plans for Construction on Pennington Road from Larkin Road to Sinnard Avenue
Gillet Harris Duranceau Assoc.	1982	Plans for reconstruction on Larkin Road and Broadway
Key & Assoc.	1994	American Dream Homes Unit II
Key & Assoc.	2004	Home First Estates
Key & Assoc.	1992	Dunham Wingfield Estates
Key & Assoc.	2003	Offsite Plans for L&R Gas & Food-- HWY 99 and Ash Street
Laughlin & Co.	1989	Peachtree Subdivision Unit No. 1
Laughlin & Co.	1994	Peachtree Unit II-- Phase 3
Laughlin & Co.	1993	Peachtree Unit II--Phase 2
Laughlin & Co.	1992	Orchard Estates

Table 2-1. Plan Sets Used to Develop Live Oak Master Drainage Study, cont'd…

Engineer	Year	Plan Set Title
MHM	2005	Peachtree Estates Unit No. 3
MHM Inc	1995	Street Improvements Proposition 116 Bikelanes Pennington Rd, O St. to Broadway
MHM Inc	1990	Improvement Plans for Walnut Grove Estates
Rolls Anderson & Rolls	2002	Street, Storm Drain & Water Main Improvements
Ryan Engineering	1992	Improvement Plans Quitiquit Subdivision-- Phase 1
Shasta Design Group	2004	Larkin Rd Sanitary Sewer Line Construction
Shasta Design Group	2004	Premier Meadows
Sutcliffe	1983	Improvement Plans for Schmidl Estates
Unknown	Unknown	P St Drain from Date St to Gum St

FIELD EVALUATIONS CONDUCTED BY WEST YOST STAFF

Field evaluations within the City were conducted by West Yost staff on May 16, 2008. The sites visited and photographed included the City's known drainage problem areas, existing detention basins, and stormwater pump stations. Photographs and collected data are provided on the CD in Attachment 2A.

During February and March 2006, field evaluations were performed on most of the RD 777 facilities, including the entire length of the Main Canal, Lateral 1, Lateral 1A, Lateral 1B, Lateral 2, Lateral 2A-1, Lateral 3, Lateral 4, Lateral 5, Lateral 6, Lateral 7, Lateral 8, Lateral 9, Lateral 13, Lateral 15, parts of the East Interceptor Canal and West Interceptor Canal, and some canal lengths, just to the west of the northern portion of the RD 777 boundary, which drain into the Morrison Slough. During the field evaluations, culvert data sheets were completed. At the culvert sites, the culvert sizes were measured, materials noted, culvert inlet conditions were noted, overland flow release points were identified, and photographs were taken.

Figure 2-1 shows the location of the culverts and culvert data sheets, photographs of culverts, channels, and other structures and survey data. The CD provided in Attachment 2A includes the AutoCAD file of Figure 2-1 as well as pdfs of the culvert data sheets and photographs. The data sheets are arranged by drain system using the node numbering consistent with the model node numbering (see Chapter 4) progressing from the downstream end to the upstream end of the channels and the field site numbering. The photographs are arranged by drain system using the node numbering consistent with the model node numbering (see Chapter 4) and the field visit site numbering progressing from the downstream end to the upstream end of the channels.

GLOBAL POSITIONING SATELLITE SURVEY DATA COLLECTED BY WEST YOST

In support of this MDS, L&S surveyed several drainage structures and facilities within the City of Live Oak in June 2008. In February and March 2006, West Yost surveyed the Main Canal and several laterals throughout the RD777 drainage system. The datums used in these surveys were:

- Horizontal datum: North American Datum (NAD) of 1983, California State Plane Coordinates, Zone 2 (coordinates are given in grid coordinates).
- Vertical Datum: North American Vertical Datum (NAVD) of 1988.

The horizontal/vertical control was based on the following control points:

- Horizontal control – NAD 83, California State Plane Coordinates, Zone 2, Primary NGS control point, LOMO (KS1832), N 2206777.19', E 6663165.07', grid coordinates.
- Vertical control – NAVD 88, Primary NGS control point, H18 RESET (KS1965), Elev 78.53'.

In this report, all elevations are referenced using NAVD 1988 unless otherwise noted.

Another vertical datum historically used in the area was the National Geodetic Vertical Datum (NGVD) of 1929. The conversion from NGVD to NAVD was about 2.29 feet. To convert an elevation given in the NGVD to the NAVD, add 2.29 feet. For example, survey point EIC0010 is at elevation 53.00 feet NGVD and is at elevation 55.29 feet NAVD.

Another vertical datum historically used in the City of Live Oak was the "City Datum". The conversion from the City Datum to NAVD was about 2.998 feet. To convert an elevation given in the City Datum to the NAVD, add 2.998 feet. For example, the pad of the Apricot Street Pump Station was surveyed at elevation 76.9 feet in NAVD and is at elevation 73.9 feet in the City Datum.

The locations of the surveyed cross sections and structures are shown in Figure 2-1. The survey data sheets include survey point numbers, X and Y coordinates, channel stationing, point elevations, and point descriptions. Point descriptions include:

- TOP: top of channel or top of levee or top of berm
- TOE: toe of channel or toe of levee or toe of berm
- GS: ground shot
- FL: flow line
- CL: center line
- GB: grade break
- EDGROAD: edge of road
- FEN: fence
- TOEFL: Toe Flow Line
- CLFL: Center Line – Flow Line

- FLCL: Flow Line – Center Line
- TOEGS: Toe of Channel or Levee or Berm – Ground Shot
- GSTOE: Ground Shot at Toe of Levee or Channel or Berm
- TOB: Top of Bank
- TOPWEIR: Top of Weir
- FLBOX: Flow Line of Box
- BOTWEIR: Bottom of Weir
- HWATTOP: Head Wall at Top
- FLSO: Flow Line – South
- FLNO: Flow Line – North
- BRDECKENDATTOP: Bridge Deck – End at Top
- CLPIER: Center Line at Pier
- PIERCL: Pier of Bridge at Center Line
- TOPHW: Top of Headwall
- TOPHWATTOP: Top of Headwall at Top
- TOPCONCBOX: Top of Concrete Box
- FLLOWFLOW: Flow Line at Low Flow Channel
- TOELOWFLOW: Toe of Low Flow Channel
- TOPDITCH: Top of Ditch
- FLDITCH: Flow Line of Ditch
- EDGRD: Edge of Road
- TOPENDCONCWEIR: Top End of Concrete Weir
- TOPATBRFACE: Top at Bridge Face
- CL1.2DCPIER: Center Line, 1.2-foot Diam Pier

An AutoCAD drawing of the survey information and a Microsoft Excel spreadsheet of the cross sections and structure information are included in the CD in Attachment 2A (provided at end of report).

EXISTING LAND USE DATA COMPILED BY WEST YOST

West Yost compiled land-use data based on an aerial photograph from April 2004 and from March 2006 and May 2008 field observations (to incorporate more recent developments). Figure 2-2 shows the approximate current land-use designations.

Figure 2-1. Model Schematic and Survey/Site Data

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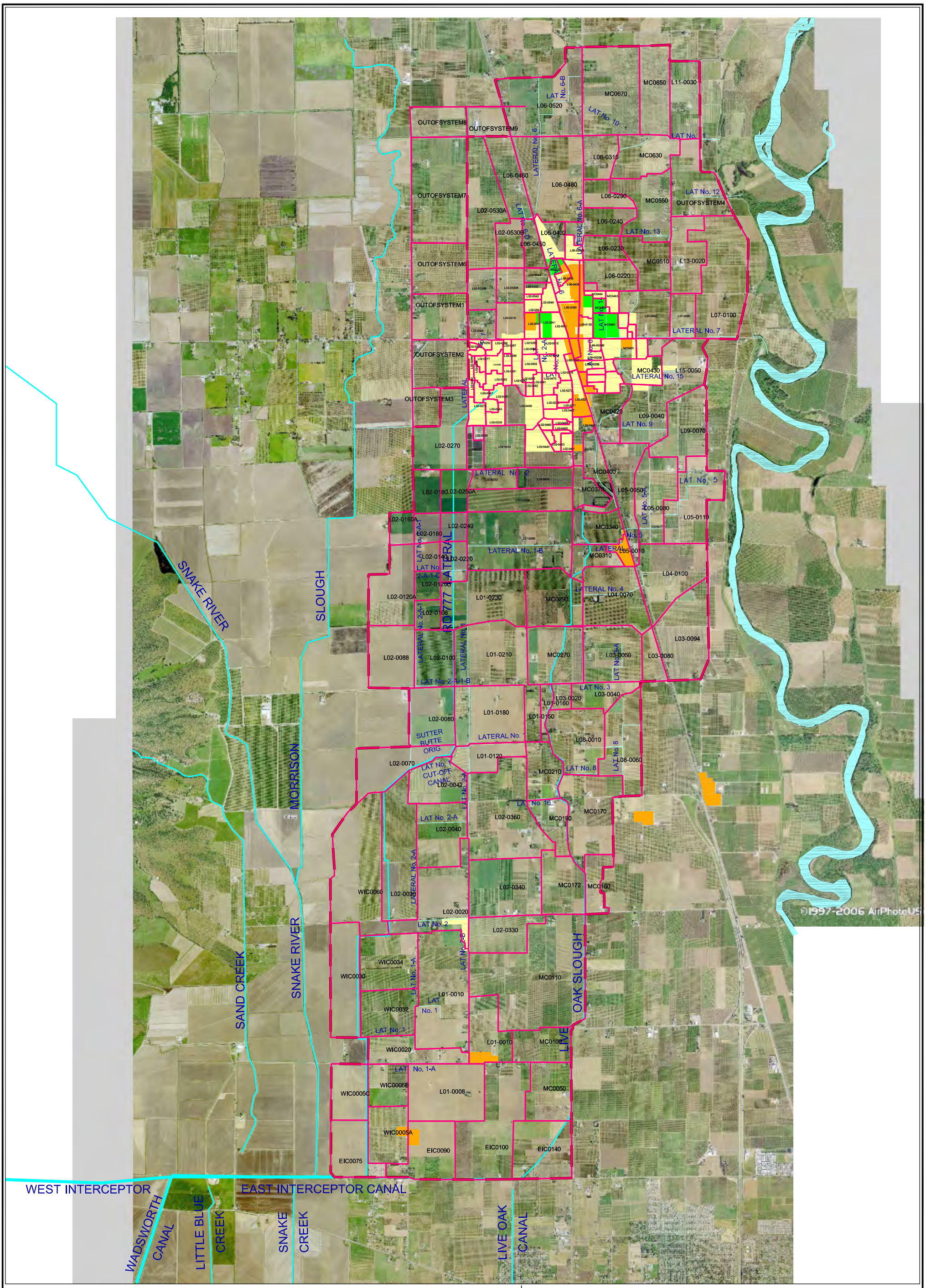


LEGEND

- RD 777 BOUNDARY
- MAIN CHANNELS & RD777 LATERALS
- AGRICULTURE (NO SHADING)
- COMMERCIAL/INDUSTRIAL
- OPEN SPACE
- RESIDENTIAL
- WIC0005C SUBSHED BOUNDARY AND LABEL

N

0 2000 4000

SCALE IN FEET

Figure 2-2

City of Live Oak
Master Drainage Study
EXISTING CONDITIONS
MODEL LAND USES

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 3. DESIGN CRITERIA

Presented in this chapter is a summary of current drainage design criteria for the City, RD 777, and Sutter County. For comparison purposes, the design criteria for Yuba City, the City of Woodland, City of Dixon, City of Vacaville, the Vallejo Sanitation and Flood Control District, and Solano County are also provided. Also provided in this chapter are the recommended design criteria that were used for sizing drainage facilities in this MDS.

CITY OF LIVE OAK DRAINAGE DESIGN CRITERIA

City of Live Oak drainage design criteria were published in the June 2003 *City of Live Oak Public Works Improvement Standards*. The criteria are summarized below:

- Placement of fills of any magnitude across an existing drainage course shall incorporate a means by which excess flows not handled by the design drainage system can flow overland via essentially the same course as prior to placing the fill across the drainage course without inundating or damaging any structure.
- The rational formula shall be used for calculating hydrologic and pipe and/or channel design characteristics, i.e., size, type, slope, velocities and entrance, and outlet structures, etc.
- When the flow of water in gutters, caused by a 10-year storm, extends more than eight feet from the face of the curb or overtops the curb underground storm drains are required. Inlet spacing shall not exceed 500 feet. Valley gutters, flow across sidewalks (except on streets abutting single family residential development), and concentrated discharges of drainage onto the street shall be eliminated.
- Building pads shall not be inundated during a 100-year frequency (1% probability) storm. Traffic lanes shall not be inundated during a design frequency storm. All existing streets shall be assumed to be constructed to ultimate standards. All major drainage channels and natural streams shall be assumed to be constructed to ultimate standards.
- Culverts shall be analyzed using a ponded (i.e. zero velocity) condition upstream unless a definite channel exists or is proposed upstream. Inlet and outlet transition structures shall be provided to minimize entrance and exit losses.
- Minimize size of proposed culverts shall be 12-inches in diameter. The minimum size of pipes shall also be 12-inches in diameter if the City is to maintain the pipes.
- Areas less than forty acres, and where the proposed drainage structure will not be placed in a natural or constructed sump, shall be protected from a 10-year frequency storm. Culverts under moderate fills are to pass a ten-year storm without static head, and under high fills to pass a 25-year storm with head; however, no damage due to ponding is to occur.
- Areas larger than 40 acres and less than 160 acres shall be protected from a 25-year frequency storm. Culverts under moderate fills on collector and local streets are to pass a 25-year storm without static head, and under high fills to pass a 100-year storm with head; however, no damage due to ponding is to occur.

- Areas larger than 160 acres, or where culverts are to be placed under high fills – where a sump condition exists and damage would result due to ponding and where major streets or a freeway are to be crossed, shall be protected from a 100-year frequency storm. Culverts are to pass a 100-year storm with head; however, no damage due to ponding is to occur.
- The minimum time of concentration shall be 10 minutes.
- Storm drain pipelines shall be accurately constructed to the design lines and grades. The extremely flat grades necessary in the City require particularly careful construction to maintain invert grades within ±0.05 feet vertically. All storm drains should be designed for a minimum velocity of 2 feet per second, flowing full. Precast pipes 24" or larger in diameter may be laid on a horizontal curve. The radius of curve shall not be less than 300' unless special pipe joints with longer lips are used. D-Load criteria shall be used to design all pipes. Precast RCP drains are required in all roadway areas unless top of pipe is more than 36" below subgrade. For non-traffic areas non-reinforced concrete pipe may be allowed.
- Existing drainage ditches and channels belonging to RD 777 adjoining the City shall be piped, improved, or graded and/or enlarged as necessary to carry the design flows listed in the City of Live Oak Master Drainage Plan at the design grade of the channels. Headwalls and wingwalls shall be provided at each end of pipes or box culverts and cleanout access structures shall be provided at intervals of 1,000 feet maximum. Roadway crossings of existing ditches shall be a reinforced concrete pipe, box culvert, or slab bridge with headwalls and wingwalls, sized to carry the design flow of the ditch, at the design grade of the ditch.
- Detention basins shall be sized so that the 100-year flow (for any duration) from the site with full development does not exceed the predevelopment 100-year flow from the site. Detention basins shall be sized to have adequate freeboard and shall be subject to the approval of the City Engineer.
- No pump station criteria are provided.

RD 777 DRAINAGE DESIGN CRITERIA

The original RD 777 drainage channel capacities were documented in a letter to the RD 777 Board of Trustees from the year 1921. The drainage channels were sized to provide a capacity of 15 cfs per square mile (0.023 cfs/acre) of tributary area. This flow rate was based on a daily runoff of 0.5 inches.

SUTTER COUNTY DRAINAGE DESIGN CRITERIA

Sutter County's storm drainage design criteria are published on the County's web site (http://www.co.sutter.ca.us/doc/government/depts/pw/design_standards). The criteria are summarized below (as of January 24, 2008):

- Habitable structures shall be protected from the 100-year flood. For arterial roads, two travel lanes in each direction shall be protected from the 100-year flood. For other roads, one travel lane in each direction shall be protected from the 10-year flood.

- Drainage systems shall be designed to accommodate the ultimate development of the entire upstream watershed.
- The grading plan shall ensure that the flow from a 100-year design storm can flow through the development without flooding structures even in the event of a failure of the storm drain collection system.
- Runoff rates shall be calculated using the rational method for areas less than 100 acres. For areas greater than 100 acres, or watersheds of any size using runoff detention storage, a unit hydrograph method (using a rainfall-runoff computer model like HEC-1) shall be used with a storm duration of 24 hours.
- Storm drains (closed conduits) shall be designed for the peak 10-year runoff with the maximum hydraulic grade line shall be at least 0.50 feet below the inlet grate/maintenance hole covers. The minimum pipe size shall be 12 inches. The minimum velocity shall be 2 feet per second (fps). The pipe slope shall equal the hydraulic gradient and the pipe shall be sized with full flow.
- Open channels shall be designed for the peak 100-year flood event. The minimum velocity shall be 2 fps for the 100-year flow rate. The maximum velocity shall be 6 fps for earthen channels, 8 fps for bottom-lined channels and 10 fps for fully lined channels. No channel freeboard requirements are provided.
- No detention basin criteria are provided.

YUBA CITY DRAINAGE DESIGN CRITERIA

The Yuba City drainage design criteria are summarized below. Although these criteria are not provided in a specific document, these criteria represent the general design approach used by the City for storm drain facilities.[1]

- Habitable structures shall be protected from the 100-year flood. All roads shall be protected from the 10-year flood, with the water level at least 1 foot below the gutter elevation. All flow greater than the capacity of the pipe system shall be conveyed or detained in the street section while maintaining a water surface below the adjacent building pad elevation.
- Drainage systems shall be designed to accommodate the ultimate development of the entire upstream watershed.
- The grading plan shall ensure that the flow from a 100-year design storm can flow through the development without flooding structures even in the event of a failure of the storm drain collection system.
- Runoff rates shall be calculated using the rational method for areas less than 100 acres. For areas greater than 100 acres, or watersheds of any size using runoff detention storage, a unit hydrograph method (using a rainfall-runoff computer model like HEC-1) shall be used with a storm duration of 24 hours, 48 hours, or whichever time period is the most critical.

1 Musallam, George, Yuba City Public Works Director, January 22, 2008.

- The minimum storm drain pipe size shall be 18 inches. The minimum velocity shall be 2 fps. The pipe slope shall equal the hydraulic gradient and the pipe shall be sized with full flow.
- Detention basins shall be sized to hold a 24-hour, 100-year storm event without pumping, maintaining a water elevation one foot below the lowest drain inlet.

CITY OF WOODLAND DRAINAGE DESIGN CRITERIA

The City of Woodland storm drain design criteria are defined in the *City of Woodland Standard Specifications and Details, 2007*, dated November 9, 2007, and include:

- Storm Drain Systems – All pipeline conveyance facilities shall be designed to convey the 10-year storm event while maintaining the hydraulic grade line (hgl) with a minimum of one foot below the inlet grates and maintenance hole covers. The minimum size of storm drains shall be 18-inches. The minimum water velocity shall be 2 fps.
- Open channels shall be designed to convey the 100-year peak flow with a freeboard of 1 foot in cut channels and 3 feet of freeboard in leveed channels. The maximum velocity shall be 6 fps for earthen channels, 8 fps for bottom-lined channels and 10 fps for fully lined channels. The maximum channel side slopes shall be 1 horizontal to 1 vertical for full lined channels and 3 horizontal to 1 vertical for earth sided channels.
- Bridges shall pass the 100-year storm while maintaining 1 foot of freeboard to the low chord.
- Culverts shall pass the design flow while maintaining the freeboard requirements.
- Detention facilities shall be sized for a long duration (1-day, 3-day, 5-day, and 10-day) 10-year storm while maintaining at least 3 feet of freeboard.
- Storm drainage systems for new development shall be designed to convey the 100-year storm. All flow greater than the capacity of the pipe system shall be conveyed or detained in the street section while maintaining a water surface at least 1 foot below the adjacent building pad elevations.

Thus, the City of Woodland design standards allow street flooding for storms larger than a 10-year event, but buildings and houses are protected even in the 100-year storm.

CITY OF DIXON DRAINAGE DESIGN CRITERIA

The City of Dixon storm drain design criteria are defined in the *City of Dixon Engineering Standards and Specifications*, dated April 2007, and include:

- Storm Drain Conveyance Systems – All pipeline conveyance facilities shall be designed to maintain the hgl a minimum of one foot below the gutter flow line of all drain inlets during a 10-year, 24-hour storm event.

- Street Flow – Storm drainage systems for new development shall be designed to convey the 10-year storm. During a 100-year storm event, flow greater than the capacity of the pipe system shall be conveyed or detained in the street section while maintaining a water surface at least 1 foot below the adjacent building pad elevations.
- Open channels – If allowed by the City Engineer, open channels shall be designed to convey the 100-year peak flow with a freeboard of 1 foot if the design water level is below the adjacent ground surface and with 3 feet of freeboard if the design water surface is above the adjacent ground.
- Detention Basins – A 100-year, 4-day storm shall be used for sizing major detention storage facilities. Minimum freeboard during the 100-year storm shall be 1 foot if the design water level is below the surrounding ground surface, and 3 feet if the design water level is above the surrounding ground surface. The release rate from detention basin must be authorized by the City Engineer on a case-by-case basis.

CITY OF VACAVILLE DRAINAGE DESIGN CRITERIA

The City of Vacaville drainage design standards are specified in the City of Vacaville Standard Specifications, adopted September 11, 1990. However, the City of Vacaville is currently considering revisions to these standards, as summarized below:

- Calculation Methods – For determining runoff quantities, the rational method shall be used. The time of concentration shall be determined using the Solano County Drainage Design Manual and the rainfall intensities from Figure 4-01 of the City of Vacaville Standard Specifications (a duration intensity chart). The revised standards may include reference to the SCWA Hydrology Manual for the design rainfall intensities.
- Storm drainage conveyance systems – A 10-year storm shall be used for design of piped systems with the HGL to remain at least 1.5 feet below the top of curb. The revised standards may allow the HGL to be up to 1 foot below the grate or gutter invert. For storm drains discharging to creeks, the 100-year water level in the creek shall be used as the tail water elevation. In the revised standards, the 10-year creek water elevation may be allowed in some circumstances.
- Detention Basins – For detention basins, the 10-year and 100-year runoff from the site shall not be increased over the predevelopment flow rates. In the Alamo Creek watershed upstream of Peabody Road, the 10-year and 100-year peak flows shall be reduced to 90 percent of the predevelopment peak flow rates. The revised standards may also require 1 to 2 feet of freeboard in detention basins.
- Open Channels – If accepted by the City Engineer/Director of Public Works, open ditches shall be sized for a 100-year storm with at least 6 inches of freeboard (2 feet of freeboard for temporary ditches). The revised standards may require at least 1 foot of freeboard for open channels.
- Pump Stations – Currently no pump station criteria are provided, but the City of Vacaville is considering adding pump station design criteria.

VALLEJO SANITATION AND FLOOD CONTROL DISTRICT

- Level of Protection – For tributary areas less than 640 acres, the level of protection shall be based on the 15-year storm. For areas greater than 640 acres, the level of protection shall be based on the 100-year storm.
- Runoff Calculation Methods – For tributary areas less than 200 acres, the rational method shall be used. For tributary areas greater than 200 acres a unit hydrograph method shall be used. Drainage facilities shall be sized for the ultimate development of all upstream tributary areas.
- Storm Drain Systems – For the design of all pipeline conveyance facilities, the hgl shall be maintained a minimum of two feet below the inlet grates and maintenance hole covers during a 15-year storm event. The minimum size of storm drains shall be 15 inches. The maximum design velocity shall be 10 fps, and the minimum design water velocity shall be 2.5 fps.
- Street Flow – Although streets are primarily for vehicle traffic, the street sections shall be designed to convey or store floodwater from storms greater than the storm drain capacity.
- Detention Basins – Detention basins may be used to reduce the downstream storm drain costs and problems. However, no detention basin design criteria are provided.

SOLANO COUNTY DRAINAGE DESIGN CRITERIA

For drainage facilities located in or affecting roadways, the design criteria are established in Solano County's *Road Improvement Standards and Land Development and Subdivision Requirements*, adopted June 12, 2001. These criteria include:

- Open channels are appropriate in rural areas, and shall be sized for:
  - 100-year storm with no freeboard for drainage areas greater than 3,200 acres 100-year storm with no freeboard for drainage areas from 640 to 3,200 acres if urbanization exceeds 75 percent.
  - 25-year storm with 0.5 ft freeboard for drainage areas from 640 to 3,200 acres if urbanization is under 75 percent.
  - 10-year storm with 1.0 ft freeboard for drainage areas smaller than 640 acres.
- Culverts shall be sized for a 10-year storm without head on the inlet under free outfall conditions, and a 100-year storm with a head not higher than the outside edge of the graded road shoulder.
- Pipe drainage systems shall be sized for a 10-year storm without head, and a 100-year storm using the available head in the appurtenant structures.
- Bridges shall be designed to convey a 50-year storm flow with 2 feet of freeboard and a 100-year storm flow with no freeboard.

RECOMMENDED DESIGN CRITERIA FOR THE CITY OF LIVE OAK MDS

- Design Storm Rainfall Depths – Presented in Table 3-1 is a comparison of the Sutter County Public Works design storm rainfall depths for the 10-year and 100-year storms for durations of 5 minutes to 4 days. Also presented in Table 3-1 are the 10-year and 100-year rainfall depths from the City of Live Oak drainage design standards. As shown, for the 10-year storm, the County design rainfall depths are 3 to 16 percent higher than the City's depths. For the 100-year storm, the County's rainfall depths are 1 to 6 percent higher than the City's depths. For this MDS, 10-year and 100-year design storms will be defined using the City's design rainfall depths because they are consistent with other on-going drainage planning within and near the City.

Table 3-1. Comparison of County and City Design Rainfall Depths

	Sutter County Design Standards		City of Live Oak Design Standards		Ratio of County to City Design Rainfall Depths	
	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year
5 min	0.29	0.42	—	—	—	—
10 min	0.39	0.56	0.34	0.53	1.16	1.06
15 min	0.47	0.66	0.42	0.62	1.13	1.06
30 min	0.62	0.88	0.56	0.83	1.11	1.05
1 hr	0.83	1.18	0.74	1.12	1.12	1.06
2 hr	1.11	1.57	1.00	1.49	1.11	1.05
3 hr	1.31	1.86	1.18	1.77	1.11	1.05
6hr	1.76	2.49	1.58	2.37	1.12	1.05
12 hr	2.35	3.33	2.11	3.17	1.11	1.05
1 day	3.13	4.44	2.83	4.25	1.11	1.05
2 day	3.98	5.88	3.78	5.68	1.05	1.04
3 day	4.69	6.96	4.49	6.73	1.05	1.03
4 day	5.22	7.68	5.06	7.59	1.03	1.01

Note: The Sutter County design rainfall standards will be used in the MDS.

- For the XP-SWMM modeling performed for this Master Drainage Study, watershed or subshed runoff rates are calibrated to the runoff curves provided in Figures 3-1A and 3-1B for a 10-year storm and Figures 3-2A and 3-2B for a 100-year storm. These runoff curves were developed using the City of Live Oaks's Rational Method design criteria, as summarized in Table 3-2. For comparison purposes, data from the Sacramento Method are also shown on these figures (from the Sacramento City/County Drainage Manual, Volume 2, Hydrology Standards).
- Drainage facilities shall be designed to accommodate the runoff from the full buildout of the City of Live Oak General Plan currently under preparation.

- Storm Drain Conveyance Systems - All pipeline conveyance facilities shall be designed to maintain the hydraulic grade line a minimum of one foot below the gutter flow line of all drain inlets during a 10-year, 24-hour storm event. All storm drains shall be at least 18-inches in diameter. However, 12-inch pipe may be used to connect the storm drain to a single drain inlet.
- Street Flow – Storm drainage systems for new development shall be designed to convey the 10-year storm. During a 100-year storm event, flow greater than the capacity of the pipe system shall be conveyed or detained in the street section while maintaining a water surface at least 1 foot below the adjacent building pad elevations.
- Development may not cause an increase of the water surface elevation in the agricultural drainage channels either upstream or downstream of the development.
- Development may not cause an increase of the duration of flooding along the agricultural drainage channels either upstream or downstream of the development.
- Open channels – Drainage channels and culverts will be sized for a 100-year, 4-day storm, with 1 foot of freeboard. Open channel side slopes shall be 4 horizontal to 1 vertical. Levees may not be used.
- If agricultural drainage channels are replaced with pipe systems, the pipe systems shall be sized/designed for the 100-year, 4-day storm.
- Detention Basins - A 100-year, 4-day storm shall be used for sizing detention storage facilities. The detention basin release rate from a 100-year storm after development must be lower than the runoff rate from the detention basin's tributary area before development. Also, the detention basin release rate from a 10-year storm after development must be lower than the runoff rate from the detention basin's tributary area before development. The release rate from detention basins shall not exceed the capacity of the downstream channel system, with one foot of freeboard. This last criteria is necessary to prevent increasing the duration of flooding.
- Pump Stations – If used in this MDS, pump stations will be sized for the 100-year storm to lift water into the receiving channel or river at a flow rate such that the criteria listed above for detention basins, open channels, or storm drains will be achieved. Also, the drainage pumping plant designs require the approval of the City Director of Public Works. The following minimum requirements apply:
    - Pump stations shall be sized using the 100-year storm.
    - Each pumping station shall be equipped with 3 or 4 peak flow pumps. One of the pump shall act as a backup. The remaining pumps together shall be capable of pumping the design/maximum station discharge.
    - A low flow pump shall be provided to pump dry weather flows.
    - Pump stations shall be provided with a heavy-duty mechanical trash rack.
    - Pump stations shall be provided with standby power systems.
    - Pump stations shall be provided with a building to house the electrical controls and backup generator, and shall include an area for equipment storage.
    - Pump stations sites shall be fenced.

The criteria listed above were developed for sizing of the City's storm drainage facilities evaluated in this MDS. It is further recommended that individual development projects be allowed to proceed using temporary on-site detention basins. The temporary basins should be sized to ensure they prevent upstream and downstream impacts. This would be accomplished by sizing the basins to produce a 10 percent decrease increase in the peak flow leaving the development site in a 2-year, 24-hour storm event, a 10-year, 24-hour storm event, and a 100-year 4-day storm event. The temporary basins could be refilled and the basin site used for development after the relevant facilities from this MDS were constructed. Developments using temporary detention basins would still pay their full stormwater impact fees.

Table 3-2. Development of XP-SWMM Model Calibration Curves Using the City of Live Oak Rational Method

Area (acres)	Land Use	C	Overland Flow Length (ft)	Overland Flow Slope (%)	Overland Flow Time (min)	Overland Flow Velocity (ft/sec)	Length of channel/ Gutter (ft)	Channel/ Gutter Velocity (ft/sec)	Channel/Gutter Flow Time (min)	Length of Pipe (ft)	Pipe Flow Velocity (ft/sec)	Pipe Flow Time (min)	Total Time of Concentration (min)	Rainfall Intensity (in/hr)	Live Oak Rational Method Runoff Rate (cfs)	Sacramento Method Runoff Rate (cfs)	Ratio of Live Oak to Sacramento Method
10-Year Design Storm																	
20	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	1,000	2	8.3	0			65.4	0.71	3.5	10	0.35
20	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	1,000	3.0	5.6	22.0	1.33	6.7	10	0.67
20	Residential	0.65	100	1	8.1	0.21	400	6	1.1	1,000	3.0	5.6	14.8	1.68	21.8	20	1.09
20	Commercial / Industrial	0.85	100	1	4.5	0.37	400	6	1.1	1,000	3.0	5.6	11.2	1.97	33.6	24	1.40
40	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	1,650	2	13.8	0		0.0	70.8	0.68	6.8	14	0.48
40	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	1,650	3.0	9.2	25.6	1.22	12.2	14	0.87
40	Residential	0.65	100	1	8.1	0.21	400	6	1.1	1,650	3.0	9.2	18.4	1.48	38.4	36	1.07
40	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	1,650	3.0	9.2	14.8	1.68	57.0	42	1.36
160	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	3,600	2	30.0	0			87.0	0.60	24.0	50	0.48
160	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	3,600	3.0	20.0	36.4	0.99	39.8	50	0.80
160	Residential	0.65	100	1	8.1	0.21	400	6	1.1	3,600	3.0	20.0	29.2	1.13	117.5	110	1.07
160	Commercial / Industrial	0.85	100	1	4.5	0.37	400	6	1.1	3,600	3.0	20.0	25.6	1.22	165.9	133	1.25
320	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	6,200	2	51.7	0			108.7	0.53	42.2	87	0.48
320	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	6,200	3.0	34.4	50.9	0.82	65.5	87	0.75
320	Residential	0.65	100	1	8.1	0.21	400	6	1.1	6,200	3.0	34.4	43.7	0.90	186.2	192	0.97
320	Commercial / Industrial	0.85	100	1	4.5	0.37	400	6	1.1	6,200	3.0	34.4	40.1	0.94	255.9	192	1.33
640	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	10,100	2	84.2	0			141.2	0.45	72.5	148	0.49
640	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	10,100	3.0	56.1	72.5	0.67	106.7	148	0.72
640	Residential	0.65	100	1	8.1	0.21	400	6	1.1	10,100	3.0	56.1	65.3	0.71	294.7	338	0.87
640	Commercial / Industrial	0.85	100	1	4.5	0.37	400	6	1.1	10,100	3.0	56.1	61.7	0.73	398.3	420	0.95
100-Year Design Storm																	
20	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	1,000	2	8.3			0.0	65.4	1.06	5.3	18	0.30
20	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	1,000	4	4.2	20.6	2.08	10.4	18	0.58
20	Residential	0.65	100	1	8.1	0.21	400	6	1.1	1,000	4	4.2	13.4	2.67	34.7	30	1.16
20	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	1,000	4	4.2	10.0	3.16	53.7	35	1.53
40	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	1,650	2	13.8			0.0	70.8	1.01	10.1	31	0.33
40	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	1,650	4	6.9	23.3	1.93	19.3	31	0.62
40	Residential	0.65	100	1	8.1	0.21	400	6	1.1	1,650	4	6.9	16.1	2.40	62.3	51	1.22
40	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	1,650	4	6.9	12.5	2.77	94.3	61	1.55
160	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	3,600	2	30.0			0.0	87.0	0.90	36.0	85	0.42
160	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	3,600	4	15.0	31.4	1.63	65.0	85	0.76
160	Residential	0.65	100	1	8.1	0.21	400	6	1.1	3,600	4	15.0	24.2	1.89	196.6	160	1.23
160	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	3,600	4	15.0	20.6	2.07	282.2	181	1.56
320	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	6,200	2	51.7			0.0	108.7	0.79	63.3	150	0.42
320	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	6,200	4	25.8	42.2	1.37	109.5	150	0.73
320	Residential	0.65	100	1	8.1	0.21	400	6	1.1	6,200	4	25.8	35.0	1.53	317.2	265	1.20
320	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	6,200	4	25.8	31.4	1.62	441.7	325	1.36
640	Unsaturated Agricultural	0.25	300	0.1	57.0	0.09	10,100	2	84.2			0.0	141.2	0.68	108.7	250	0.43
640	Urban Open Space	0.25	100	1	15.3	0.11	400	6	1.1	10,100	4	42.1	58.5	1.13	181.3	250	0.73
640	Residential	0.65	100	1	8.1	0.21	400	6	1.1	10,100	4	42.1	51.3	1.22	508.7	460	1.11
640	Commercial	0.85	100	1	4.5	0.37	400	6	1.1	10,100	4	42.1	47.7	1.28	693.9	570	1.22

Figure 3-1A. Sutter County Runoff Computation Methods and Model Calibration Curves for a 10-year Design Storm

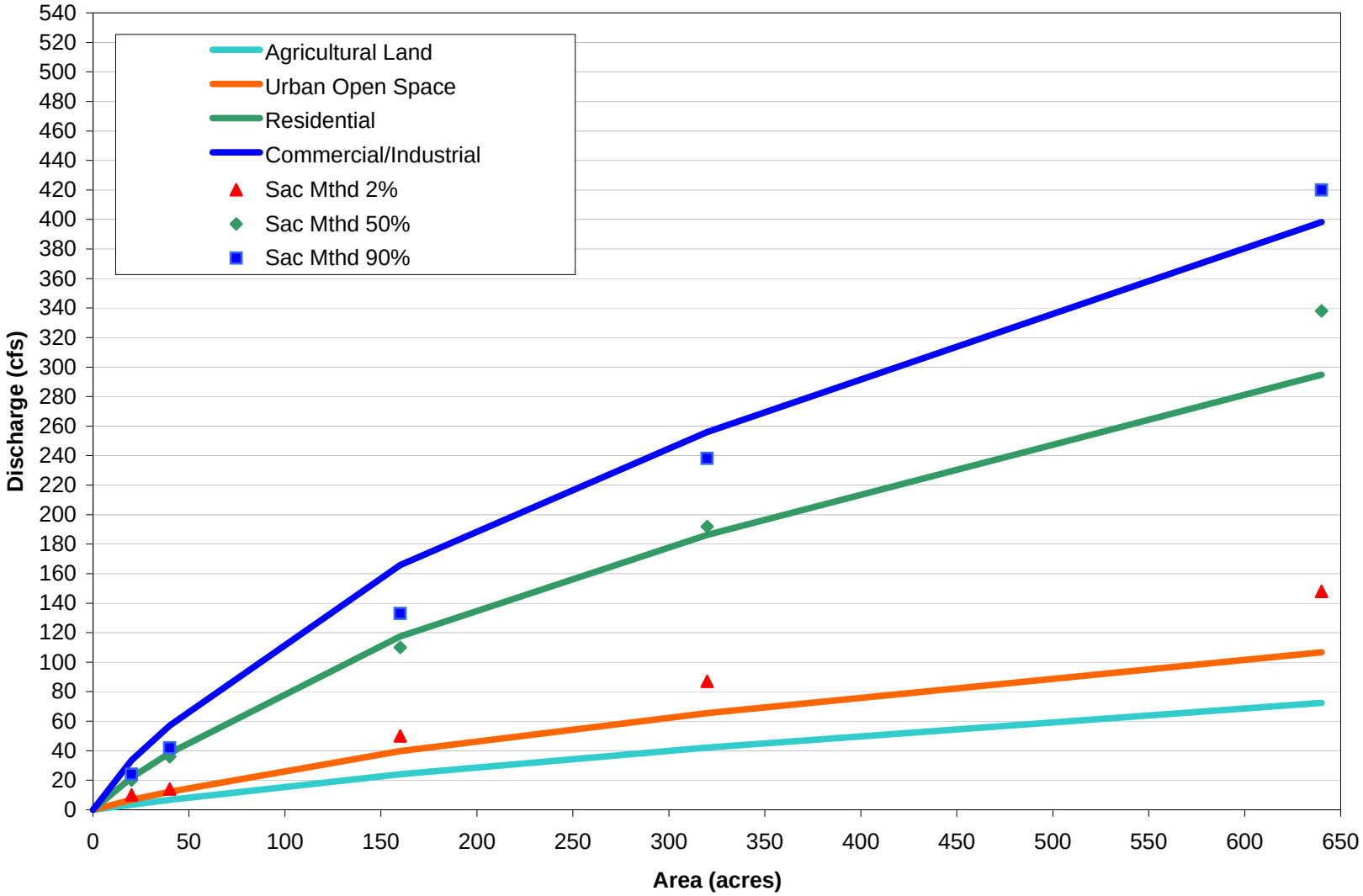


Figure 3-1B. Sutter County Runoff Computation Methods and Model Calibration Curves for a 10-year Design Storm

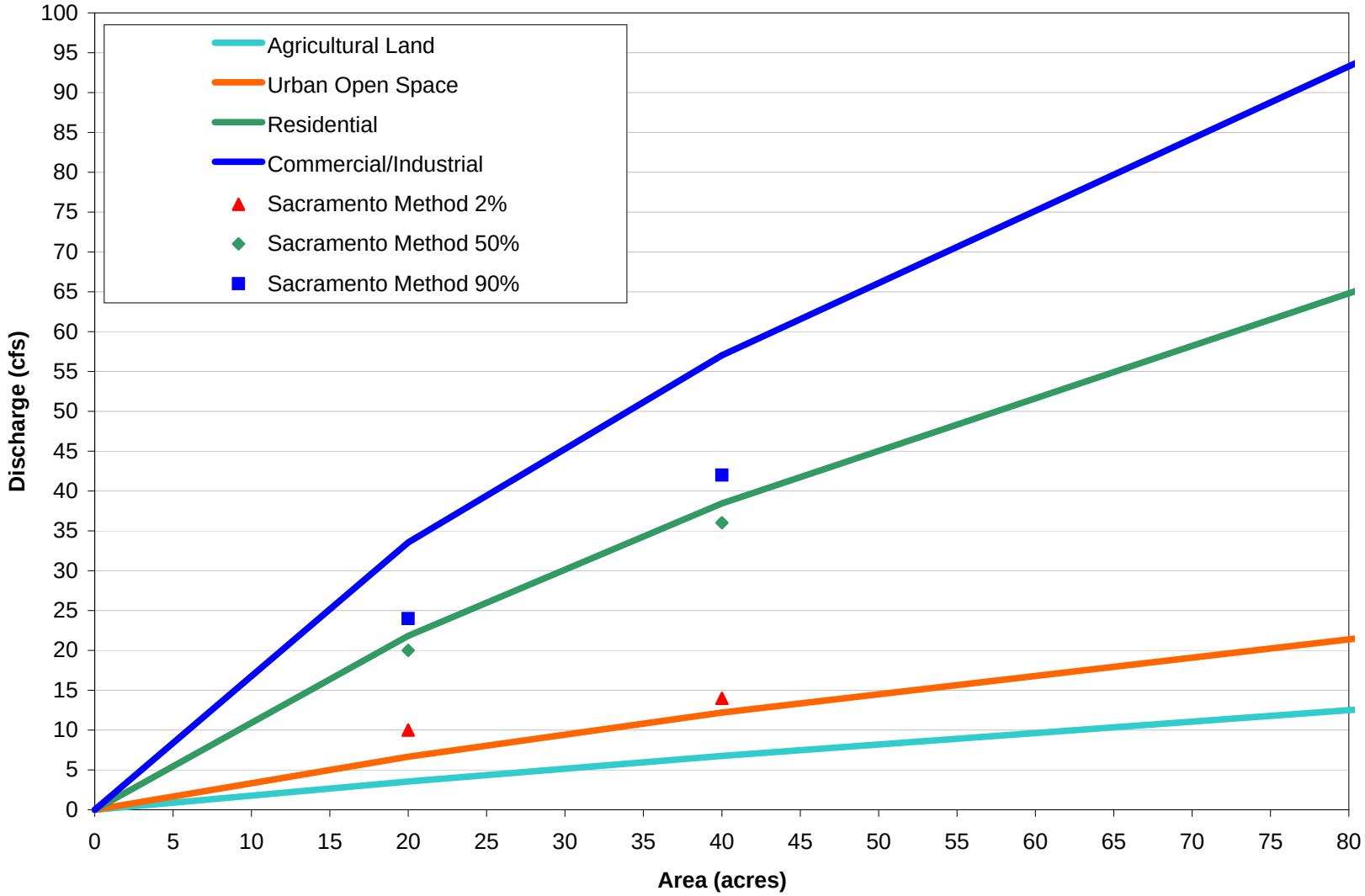


Figure 3-2A. Model Calibration Curves for a 100-year Design Storm

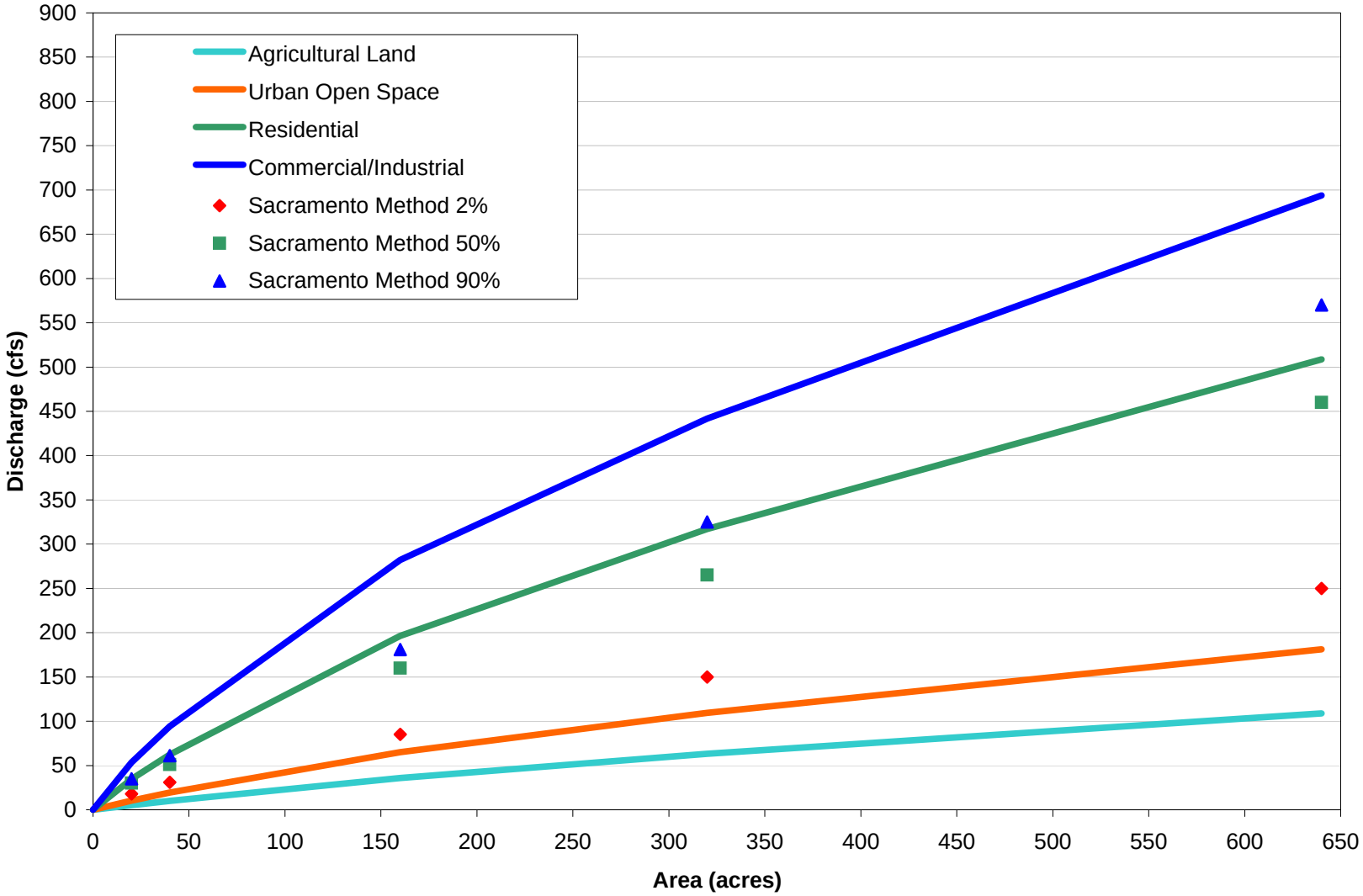
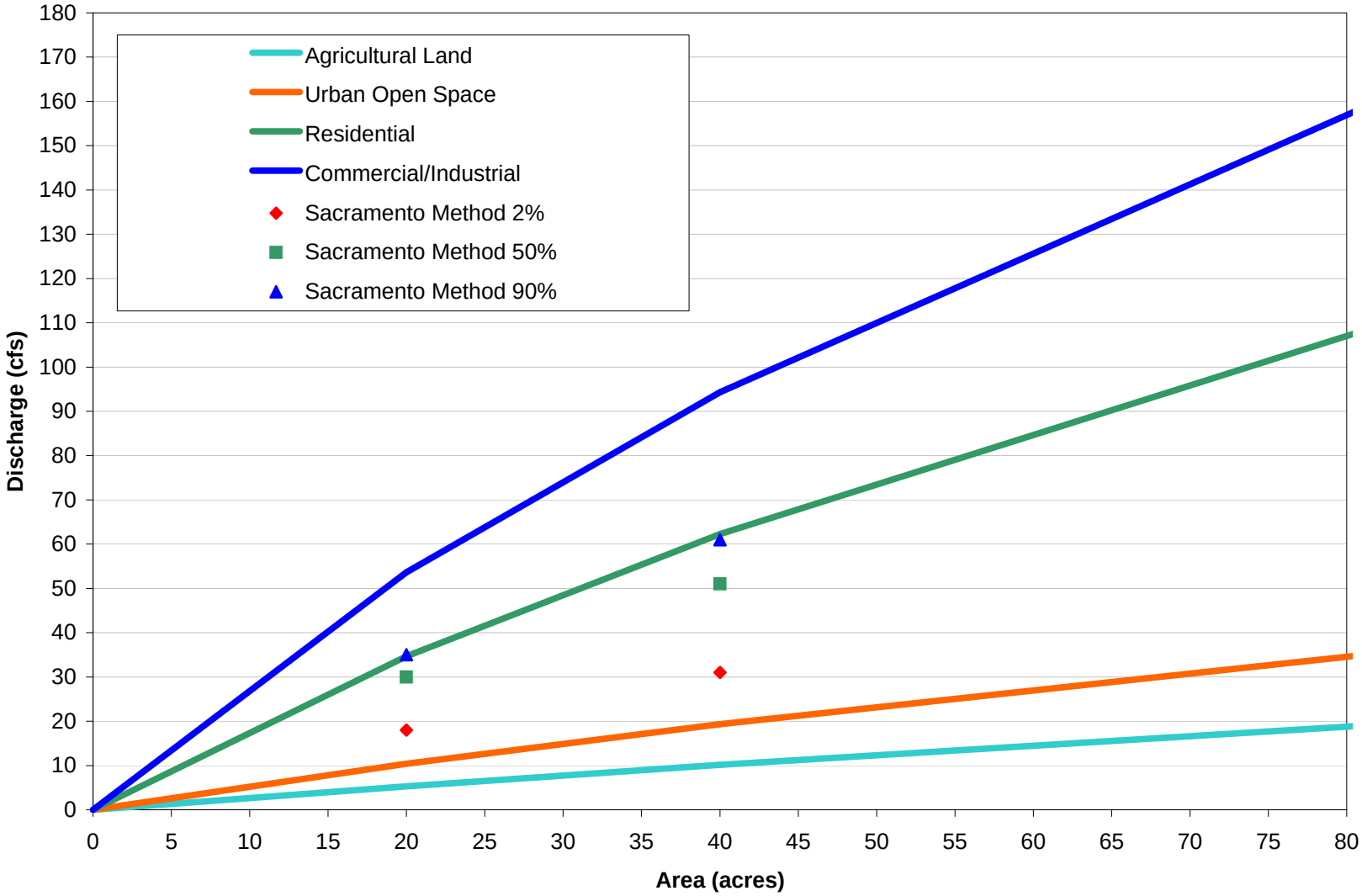


Figure 3-2B. Model Calibration Curves for a 100-year Design Storm



CHAPTER 4. MODEL DEVELOPMENT

This chapter presents the development of the existing conditions hydrologic and hydraulic model. A model schematic of the entire network is shown on Figure 4-1A including the facilities, node locations and subsheds. The model network for the City is shown in Figure 4-1B.

DESIGN STORMS

The mean annual precipitation (MAP) within the RD 777 boundary ranges from about 19 inches along the west boundary to about 20 inches along the east boundary. The MAP for the City of Live Oak is about 20 inches per year. The 10-year and 100-year design storms for this MDS were developed from the City of Live Oak Public Works Improvement Standards, and were previously summarized in Table 3-1. To illustrate the differences between the 10-year and 100-year design storms, the design storm hyetographs are presented in Figure 4-2.

HYDROLOGIC MODEL INPUT DATA

The watershed has been divided into 185 subsheds as shown in Figure 4-1A and 4-1B. The hydrologic data for each subshed is summarized in Table 4-1. For each subshed the following data were developed:

Subshed area – The area of each subshed is summarized in Table 4-1.

Subshed impervious percentage and ground slope – These values are based on the land uses within the subshed. The land use data throughout the study area were based on aerial photographs and field inspections. The impervious percentages for each land use type are presented in Table 4-2.

Within RD 777, the ground generally slopes to the southwest with an average drop of about 3 feet per mile, or a slope of 0.0005 ft/ft. However, most lands in the District have been graded for agricultural uses or urban uses. As shown in Table 4-2, the average ground slope used in the model for agricultural land uses was 0.001 ft/ft. Most new urban developments require building pads to be graded, resulting in average ground slopes of about 1 percent.

After review of the preliminary model results by City staff (using the calibration described in the "Subshed width" section), it was concluded that the modeled 10-year flooding depths were not consistent with the historically observed street flooding in the older areas of the City. The "older areas of the City" were considered to be most of the City, exclusive of Pennington Ranch, Peach Tree Estates, and Premier Meadows. Many of the older areas of the City have larger yards and more open space, and consequently the impervious percentages for residential and commercial land uses were reduced (see Table 4-2). Also, in many of the older areas of the City, building pads were not constructed, resulting in average ground slopes of about 0.5 percent, versus 1 percent for the newer areas of town (see Table 4-2). After these revisions, City staff confirmed that the model results reasonable reproduced the historically observed street flooding in the older areas of the City.

Table 4-1. Hydrologic Model Input Data for Existing Conditions

Subshed/ Tributary Node	Subcatchment No.	Land Use	Subshed Area, ac	Impervious Area %	Subshed Width for 10-Year Storm, ft	Subshed Width for 100-Year Storm, ft	Average Ground Slope, (ft/ft)	Soil Type Group
EIC0075	1	Ag	113.7	1	42,755	10,091	0.001	BBCC
EIC0090	1	Ag	145.2	5.7	50,137	11,973	0.001	BBCC
EIC0100	1	Ag	283.2	1	92,778	21,895	0.001	BBBC
EIC0140	1	Ag	163.1	1	58,412	13,803	0.001	BBCC
L01-0008	1	Ag	209.8	1	72,403	17,107	0.001	BBBB
L01-0010	1	Ag	402.3	3.8	117,903	27,828	0.001	BBBD
L01-0120	1	Ag	77.4	1	30,682	7,219	0.001	CCCC
L01-0150	1	Ag	43.8	1	19,123	4,463	0.001	BBCC
L01-0160	1	Ag	24.7	1	12,345	2,845	0.001	BBBB
L01-0180	1	Ag	194.8	1	67,987	16,066	0.001	CCCC
L01-0210	1	Ag	216.5	1	74,349	17,566	0.001	CCCD
L01-0230	1	Ag	208.4	1	71,983	17,008	0.001	BBBC
L01-0290	1	Ag	294.6	1	95,798	22,600	0.001	CCCC
L02-0020	1	Ag	193.6	5.2	62,992	15,009	0.002	BDDD
L02-0030	1	Ag	223.9	1	76,474	18,066	0.001	CCDD
L02-0040	1	Ag	145.8	1	53,031	12,528	0.001	CCCC
L02-0042	1	Ag	110.6	1	41,738	9,849	0.001	CCCD
L02-0070	1	Ag	137.4	1	50,373	11,898	0.001	CCDD
L02-0080	1	Ag	127.8	1	47,306	11,171	0.001	CCDD
L02-0088	1	Ag	138.7	1	50,786	11,996	0.001	CCCC
L02-0100	1	Ag	108.9	1	41,172	9,714	0.001	CDDD
L02-0108	1	Ag	37.1	1	16,749	3,897	0.001	CCCD
L02-0120	1	Ag	185.2	1	65,118	15,388	0.001	CDDD
L02-0140	1	Ag	35.1	1	16,031	3,725	0.001	CCCD
L02-0160	1	Ag	74.7	1	29,773	7,003	0.001	CCDD
L02-0180	1	Ag	56.8	1	23,651	5,544	0.001	CCDD
L02-0220	1	Ag	52.3	1	22,080	5,169	0.001	BDDD
L02-0239	1	Res	15.56	60	669	459	0.010	BBBB
L02-0240	1	Ag	37.3	1	16,821	3,914	0.001	DDDD
L02-0243	1	Res	8.04	60	346	237	0.010	BBBB
L02-0244	1	Res	11.18	60	481	330	0.010	BBBB
L02-0247	1	Res	10.88	60	468	321	0.010	BBBB
L02-0250	1	Ag	173.5	1	61,585	14,553	0.001	CCCC
L02-0252	1	Ag	44.7	1	19,424	4,535	0.001	BCCC
L02-0253	1	Ag	129.8	1	47,913	11,316	0.001	BBCC
L02-0255	1	Res	36.1	59.3	1,193	866	0.010	BBBB
L02-0260	1	Ag	7.35	1	3,455	809	0.001	BBBB
L02-0270	1	Ag	163.2	1	58,440	13,809	0.001	CCCC
L02-0275	1	OS	21.03	5	7,434	1,178	0.010	BBBB
L02-0277	1	Res	6.89	60	296	203	0.010	BBBB
L02-0279	1	Res	8.44	60	363	249	0.010	BBBB
L02-0280	1	Res	5.8	60	249	171	0.010	BBBB
L02-0281	1	Res	8.46	40	943	283	0.010	BBBB
L02-0282	1	OS	14.55	5	5,238	815	0.010	BBBB
L02-0283	1	Res	15.19	60	653	448	0.010	BBCC
L02-0284	1	Res	7.63	60	328	225	0.010	BBBB
L02-0286	1	Res	9.24	60	397	273	0.010	BBCC
L02-0287	1	Res	6.03	60	259	178	0.010	BBCC
L02-0288	1	mix	5.07	40	565	170	0.010	BBBB
L02-0290	1	Res	5.8	60	249	171	0.010	BBBB
L02-0292	1	OS	7.4	5	2,664	414	0.010	BBBB
L02-0293	1	Res	2.64	60	114	78	0.010	BBBB
L02-0304	1	Ag	40.5	1	17,952	4,184	0.001	BBBB
L02-0310	1	mix	49.6	7.7	18,918	4,510	0.002	BBBB
L02-0320	1	Ag	103.3	1	39,359	9,283	0.001	BBBB
L02-0330	1	Ag	110.2	1.1	41,545	9,805	0.001	BBBB
L02-0340	1	Ag	199.9	1	69,501	16,423	0.001	BBBD
L02-0360	1	Ag	304.2	1	98,295	23,183	0.001	BBBC
L02-0421	1	Res	28.38	40	1,032	732	0.005	BBBC
L02-0422	1	Res	7.18	40	309	212	0.005	BBBC
L02-0424	1	mix	13.46	40	1,500	930	0.005	BBBC
L02-0430	1	Ag	55.1	1	23,043	5,399	0.001	CCCC
L02-0440	1	Ag	62.27	1	25,795	5,983	0.001	CCCC
L02-0450	1	mix	62.5	25.7	9,245	2,482	0.005	BBCC
L02-0460	1	Res	7.18	40	309	212	0.005	CCCC
L02-0461	1	OS	10.13	5	3,647	567	0.010	CCCC
L02-0462	1	Res	5.12	60	220	151	0.010	CCCC
L02-0463	1	Res	9.2	60	396	271	0.010	CCCC
L02-0464	1	Res	1.17	40	50	35	0.005	CCCC
L02-0465	1	Res	5.89	40	253	174	0.005	CCCC
L02-0467	1	Res	15.51	40	667	458	0.005	CCCC
L02-0468	1	Res	4.1	40	176	121	0.005	CCCC
L02-0470	1	Res	9.73	40	418	287	0.005	BBBC
L02-0470	2	Res	9.62	40	414	284	0.005	BBBC
L02-0471	1	Res	4.44	40	191	131	0.005	CCCC
L02-0472	1	mix	16.47	20	1,836	551	0.005	CCCC
L02-0481	1	Res	5.04	40	217	149	0.005	BBBC
L02-0482	1	mix	26.88	20	2,680	816	0.005	BBBC
L02-0485	1	Res	7.42	40	319	319	0.005	BBBC
L02-0490	1	Res	16.19	40	696	478	0.005	BBBC
L02-0502	1	Res	14.3	40	615	422	0.005	BBBC

Table 4-1. Hydrologic Model Input Data for Existing Conditions

Subshed/ Tributary Node	Subcatchment No.	Land Use	Subshed Area, ac	Impervious Area %	Subshed Width for 10-Year Storm, ft	Subshed Width for 100-Year Storm, ft	Average Ground Slope, (ft/ft)	Soil Type Group
L02-0507	1	Res	10.3	40	443	304	0.005	BBBC
L02-0510	1	Res	14.19	40	610	419	0.005	BBBC
L02-0513	1	Res	19.19	40	825	566	0.005	BBBC
L02-0514	1	Res	13.57	40	584	400	0.005	BBBC
L02-0516	1	Res	25.25	40	968	679	0.005	BBBC
L02-0522	1	Ag	103.3	1	39,359	9,283	0.001	BBBB
L02-0530	1	Ag	249.8	1	83,754	19,778	0.001	BBBB
L02-0538	1	Res	31.51	40	1,096	786	0.005	BBBB
L02-0540	1	Res	19.18	40	825	566	0.005	BBBB
L02-0541	1	Res	10.4	40	447	307	0.005	BBBB
L02-0542	1	Res	4.46	40	192	132	0.005	BBBB
L02-0543	1	Res	11.13	40	479	328	0.005	BBBB
L02-0544	1	mix	17.66	20	1,969	591	0.005	BBBB
L03-0020	1	Ag	23.5	1	11,905	2,740	0.001	BBBB
L03-0040	1	Ag	68.8	1	27,776	6,527	0.001	BBBB
L03-0050	1	Ag	157.4	1	56,639	13,383	0.001	BBBB
L03-0080	1	Ag	45.1	1	19,565	4,569	0.001	BBCC
L03-0094	1	Ag	196.9	1	68,613	16,214	0.001	CCCC
L04-0070	1	Ag	173.8	1	61,672	14,574	0.001	BBCC
L04-0100	1	Ag	186.4	1	65,487	15,476	0.001	BBCC
L05-0010	1	mix	20	66.4	2,185	1,737	0.008	BBBB
L05-0050	1	Ag	122	1.4	45,238	10,690	0.001	BBBB
L05-0080	1	Ag	145	1	52,762	12,465	0.001	BBBB
L05-0110	1	Ag	169.2	1	60,282	14,245	0.001	BBBB
L06-0140	1	Res	4.68	40	201	138	0.005	BBBB
L06-0142	1	Res	12.97	40	558	383	0.005	BBBB
L06-0143	1	Res	5.15	40	221	152	0.005	BBBB
L06-0144	1	Res	6.65	40	286	196	0.005	BBBB
L06-0145	1	Res	6.45	40	277	190	0.005	BBBB
L06-0147	1	CI	4.22	65	317	226	0.005	BBBB
L06-0150	1	Res	14.63	40	629	432	0.005	BBBB
L06-0151	1	Res	17.29	40	743	510	0.005	BBBB
L06-0152	1	Res	6.86	40	295	202	0.005	BBBB
L06-0200	1	Res	21.18	40	884	610	0.005	BBBC
L06-0220	1	Ag	73.75	1	29,813	6,955	0.001	BBBB
L06-0222	1	CI	4.94	65	371	264	0.005	BBBB
L06-0230	1	Ag	47.3	1.1	20,312	4,748	0.001	BBBB
L06-0240	1	Ag	77.1	1	30,609	7,202	0.001	BBBB
L06-0240AA	1	Res	16.4	60	782	526	0.010	BBBB
L06-0290	1	Ag	50.8	1	21,552	5,043	0.001	BBBB
L06-0310	1	Ag	68.6	1	27,696	6,508	0.001	BBBB
L06-0350	1	CI	7.88	65	591	422	0.010	BBBB
L06-0360	1	Res	28.15	40	1,646	729	0.005	BBBB
L06-0430	1	Ag	42	1	18,489	4,312	0.001	BBBB
L06-0432	1	Res	48.28	40	1,376	1,022	0.005	BBBB
L06-0435	1	Res	12.28	40	528	362	0.005	BBBC
L06-0436	1	Res	11.11	40	478	328	0.005	BBBC
L06-0438	1	Res	32.7	40	1,120	806	0.005	BBBC
L06-0460	1	Ag	102.1	1	38,942	9,184	0.001	BBBC
L06-0480	1	Ag	245.8	1	82,615	19,512	0.001	BBBC
L06-0520	1	Ag	251.7	1	84,294	19,905	0.001	BBBC
L07-0041	1	Res	4.24	40	182	125	0.005	BBBB
L07-0042	1	OS	1.55	5	558	87	0.005	BBBB
L07-0060	1	OS	101	3.4	37,128	8,806	0.001	BBBB
L07-0061	1	Res	10.92	40	470	322	0.005	BBBB
L07-0062	1	OS	14.83	5	5,339	1,631	0.005	BBBB
L07-0080	1	Ag	54.1	1	22,707	5,318	0.001	BBBC
L07-0100	1	Ag	266.6	1	88,375	20,862	0.001	BBBB
L08-0010	1	Ag	159.7	1	57,356	13,553	0.001	BBBB
L08-0060	1	Ag	160.2	1	57,514	13,590	0.001	BBBB
L09-0040	1	Ag	127.5	3	45,738	10,848	0.001	BBBB
L09-0070	1	Ag	139.7	1	51,103	12,072	0.001	BBBB
L11-0030	1	Ag	110.3	1	41,637	9,825	0.001	BBBB
L13-0020	1	Ag	114.2	1	42,914	10,128	0.001	BBBC
L15-0050	1	Ag	102.4	2.7	38,048	9,010	0.001	BBBB
MC0050	1	Ag	121.2	1	45,188	10,668	0.001	BBBB
MC0100	1	Ag	95.4	1	36,734	8,659	0.001	BBBB
MC0110	1	Ag	472.5	1	136,521	32,008	0.001	BBCC
MC0160	1	Ag	58.7	1	24,297	5,698	0.001	BBCC
MC0170	1	Ag	198	1	68,938	16,290	0.001	BBBC
MC0172	1	Ag	119.4	1	44,607	10,530	0.001	BBCC
MC0190	1	Ag	71.8	1	28,778	6,766	0.001	BBBC
MC0210	1	Ag	88.4	1	34,386	8,101	0.001	BBBB
MC0230	1	Ag	24.7	1	12,345	12,345	0.001	BBBB
MC0270	1	Ag	153.2	1	55,354	13,079	0.001	BBCC
MC0290	1	Ag	150	1	54,339	12,838	0.001	CCCC
MC0310	1	Ag	54.4	1	22,801	5,341	0.001	BBCC
MC0340	1	Ag	79.2	1.8	31,030	7,318	0.001	BBBC
MC0370	1	Ag	47.6	1	20,448	4,780	0.001	BCCC
MC0400	1	Ag	85.74	1	34,009	6,502	0.001	BBBB
MC0420	1	Ag	77	3.6	29,655	7,028	0.001	BBBB

Table 4-1. Hydrologic Model Input Data for Existing Conditions

Subshed/ Tributary Node	Subcatchment No.	Land Use	Subshed Area, ac	Impervious Area %	Subshed Width for 10-Year Storm, ft	Subshed Width for 100-Year Storm, ft	Average Ground Slope, (ft/ft)	Soil Type Group
MC0430	1	Res	5.7	40	245	168	0.005	BBBB
MC0430	2	Res	56	20	4,188	1,325	0.005	BBBB
MC0431	1	Res	16.09	40	692	475	0.005	BBBB
MC0450	1	Res	17.62	40	758	520	0.005	BBBB
MC0451	1	mix	16.12	20	1,797	539	0.005	BBBB
MC0460	1	OS	35.42	5	10,708	1,741	0.005	BBBB
MC0461	1	mix	7.27	20	811	243	0.005	BBBB
MC0463	1	Res	13.02	40	560	384	0.005	BBBB
MC0464	1	Res	6.35	40	273	187	0.005	BBBB
MC0464	2	OS	10.2	1	4,794	1,122	0.001	BBBB
MC0510	1	Ag	95.3	1	36,702	8,652	0.001	BBBB
MC0550	1	Ag	142.8	1	52,089	12,305	0.001	BBBB
MC0630	1	Ag	115.7	1	43,418	10,248	0.001	BBBB
MC0650	1	Ag	129.7	1	47,923	11,317	0.001	BBBB
MC0670	1	Ag	244.3	1	82,236	19,422	0.001	BBBB
WIC0005	1	Ag	291.2	2.4	93,418	22,088	0.001	BBCC
WIC0020	1	Ag	101.1	1	38,624	9,109	0.001	BBBB
WIC0030	1	Ag	162.2	1	58,130	13,736	0.001	DDDD
WIC0032	1	Ag	124	1	46,092	10,883	0.001	BBBD
WIC0034	1	Ag	154.1	1	55,622	13,142	0.001	BDDD
WIC0040	1	Ag	296	1	96,161	22,685	0.001	CDDD

Use of the values in Table 4-2 for newer and future developments, along with the planned/constructed drainage systems, resulted in model results that were consistent the City current storm drainage design criteria. Consequently, these data have been verified as appropriate for the new and future developments within the City.

Table 4-2. Land Use Categories and Associated Hydrologic Data

Land Use	Impervious Percentage	Average Ground Slope
Newer and Future Developments		
Agriculture	1	0.001
Residential	60	0.010
Commercial/Industrial	85	0.010
Urban Open Space	5	0.010
Older Parts of City		
Agriculture	1	0.001
Residential	40	0.005
Commercial/Industrial	65	0.005
Urban Open Space	5	0.010

Subshed width – This variable is used as the model calibration variable. The model was calibrated to the runoff curves provided in Figures 3-1A/B and 3-2A/B (using the data for newer and future development from Table 4-2). These figures were developed from the City's rational method. Figures 4-3 and 4-4 show 10-year and 100-year watershed widths versus acreage for impervious percentages of 1 percent, 5 percent, 60 percent, and 85 percent. A separate 10-year and 100-year calibration is needed because the runoff curves differ for each scenario. For other impervious percentages, the watershed width was interpolated between the widths from the two most representative curves. The calibration of the model included developing the subshed widths for each subshed.

Initial Rainfall Losses – Initial rainfall losses account for the first rain that falls but does not generate runoff. Initial losses account for wetting of the ground surface, filling of puddles, and rainfall intercepted by leaves and grass. Typical initial losses are summarized in Table 4-3. An initial loss of 0.10 inches was used for impervious areas and an initial loss of 0.35 inches was used for pervious areas.

Figure 4-1A. Model Schematic

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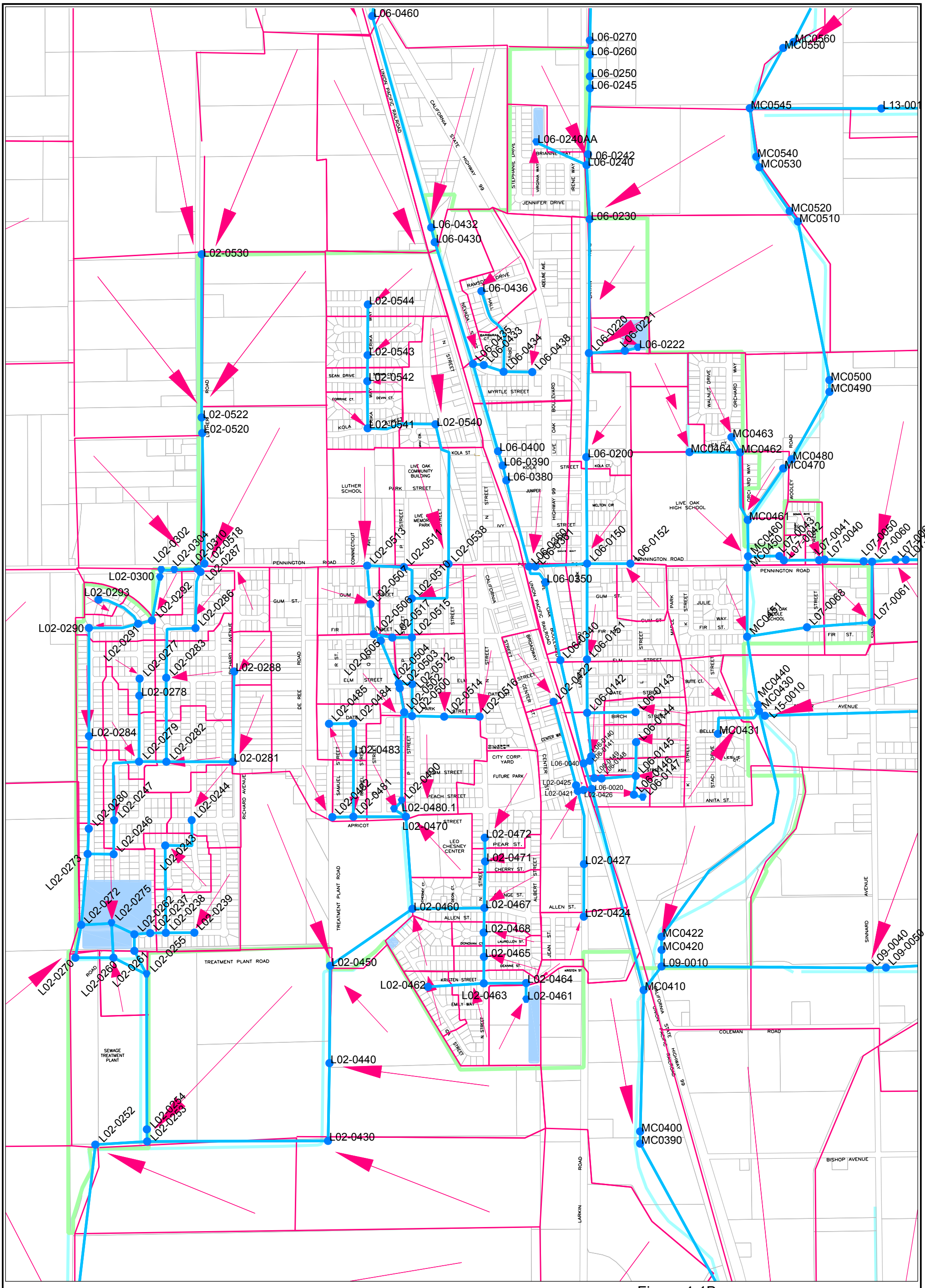


Figure 4-1B

City of Live Oak
Master Drainage Study
CITY OF LIVE OAK
MODEL SCHEMATIC

WEST YOST ASSOCIATES
Consulting Engineers

Figure 4-2. Design Storm Hyetographs in 5 Minute Time Increments

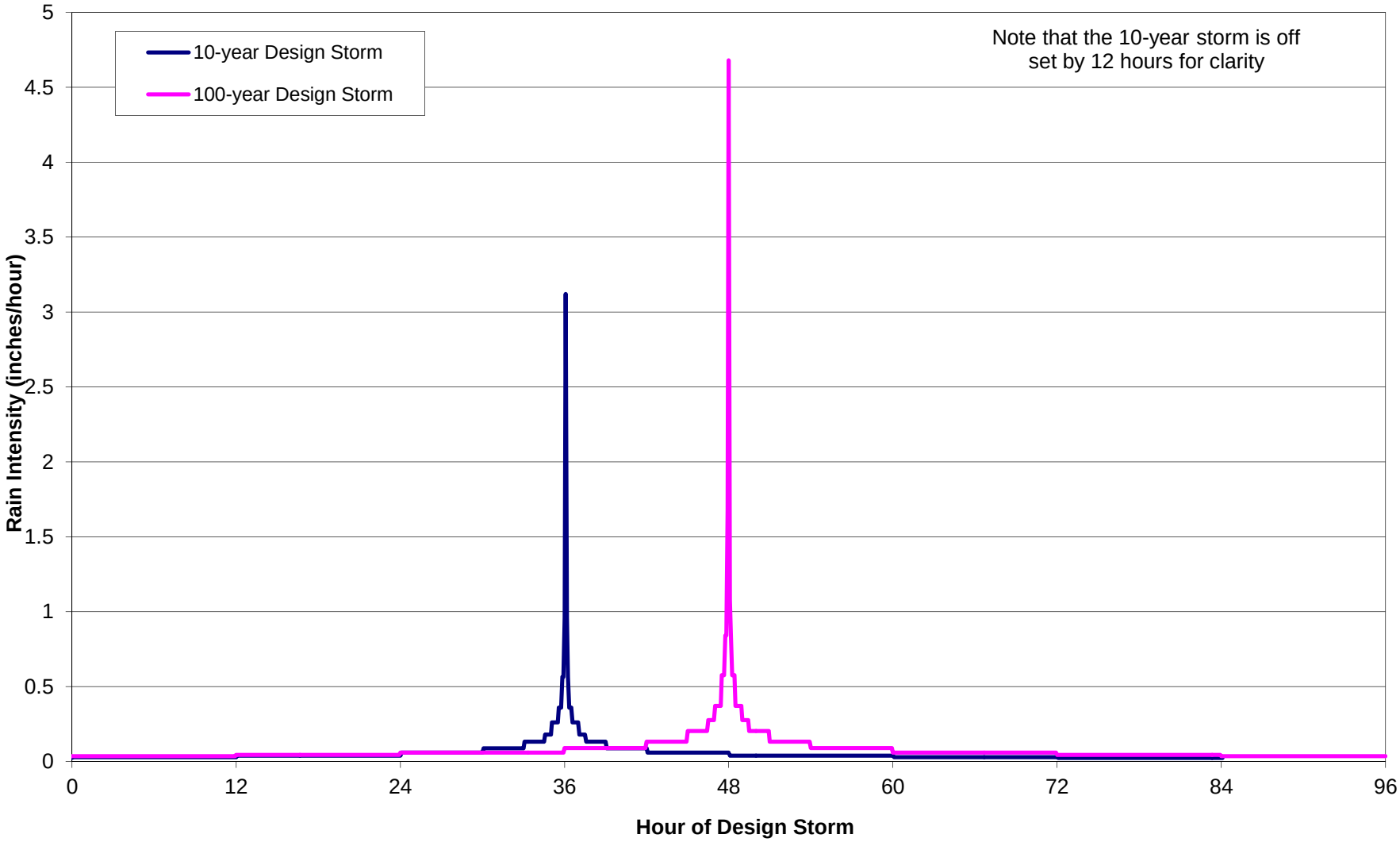


Figure 4-3. Watershed Widths for the 10-Year Design Storm

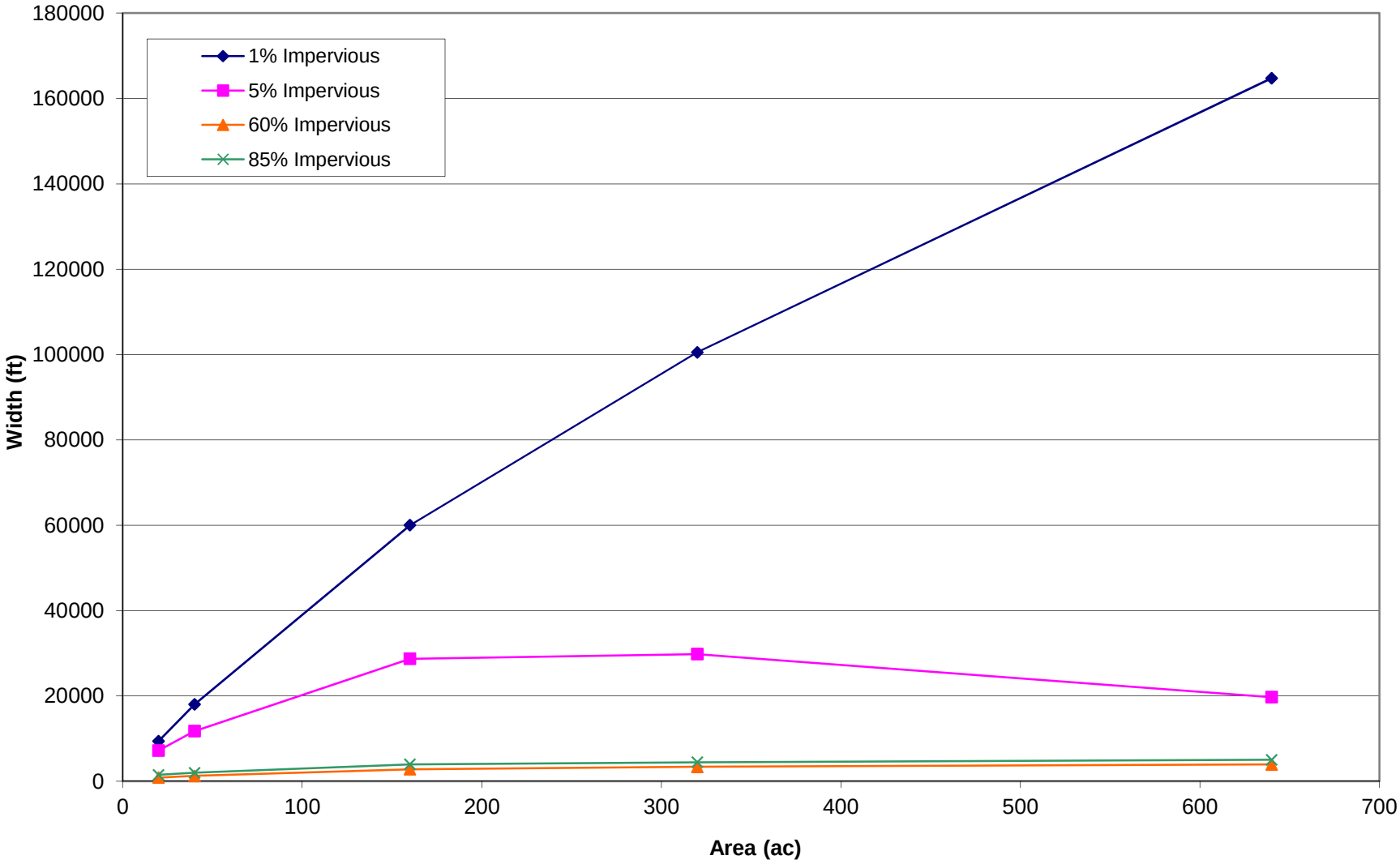


Figure 4-4. Watershed Widths for the 100-Year Design Storm

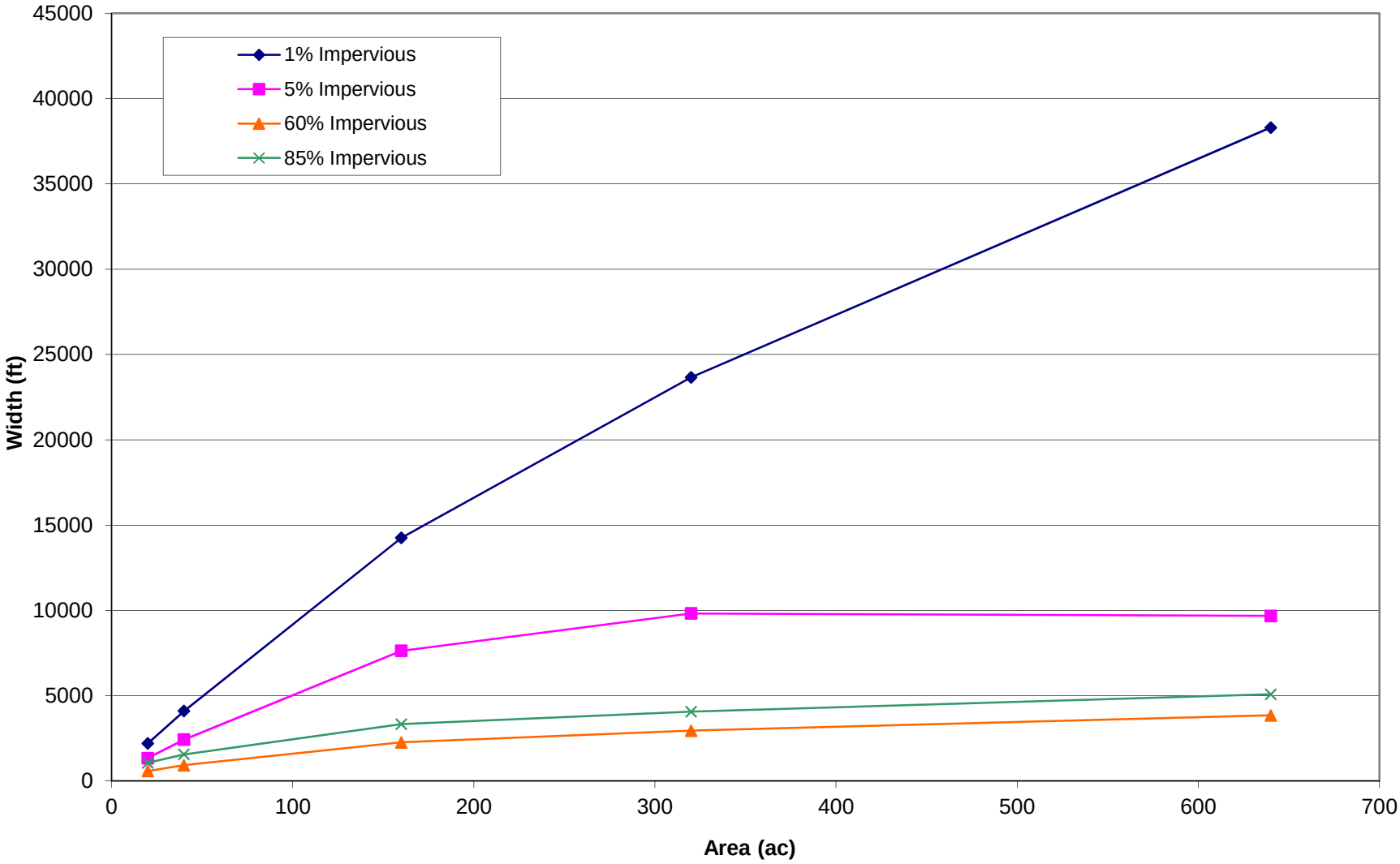


Table 4-3. Standard Values for Initial Storage/Losses

Land Cover	Recommended Storage Values, inches
Paved areas	0.10
Flat roofs	0.10
Sloped roofs	0.05
Lawn grass	0.35
Wooded areas and open fields	0.40

Source: City of Sacramento SSWMM94 User's Manual, 1994

Infiltration Rate – Infiltration was modeled using the Horton infiltration method. The infiltration rate is dependent upon the soil hydrologic group as defined on the Soil Conservation Service's Soil Survey of Sutter County, California (issued July 1988). The study area includes soils from hydrologic groups B, C, and D. The infiltration rate parameters for each soil hydrologic group are summarized in Table 4-4. Overall, the District lands are about 50% soil group B, 40% soil group C, and 10% soil group D. Calibration charts (Figures 4-3 and 4-4), were prepared using a subshed with soil group BBCC. However, many sheds have different soil groups, and consequently have different infiltration rates and consequently have peak runoff rates that somewhat vary from the design runoff curves. For each subshed, the soil type group is shown in Table 4-1. For example, subshed EIC0075 (Group BBCC) is about 50 percent soil group B and 50 percent soil group C. Similarly, subshed L01-0010 (Group BBBC) is about 75 percent soil group B and about 25 percent soil group D. The infiltration rate used for each individual shed causes the peak runoff rate for the shed to vary above or below the calibration curves.

Table 4-4. Standard Values for Infiltration Rate Parameters

SCS Soil Type	Initial Infiltration, in/hr	Final Infiltration, in/hr	Decay Coefficient
A	1.0	0.35	0.0007
B	1.0	0.19	0.0018
C	1.0	0.11	0.0018
D	1.0	0.08	0.0018

Source: City of Sacramento SSWMM94 User's Manual, Montgomery Watson, 1994

Overland Flow Roughness – The overland flow roughness accounts for the roughness of the ground surface. Typical overland flow roughness values are summarized in Table 4-5. For this study an overland flow roughness of 0.016 was used for impervious areas and a roughness of 0.20 was used for pervious areas.

Table 4-5. Manning's *n* Values for Overland Flow

Ground Cover	Manning's *n*
Smooth asphalt	0.016
Asphalt or concrete paving	0.020
Urban lawns	0.25
Native grass	0.20
Bare Clay-Loam to Packed Clay	0.02 – 0.03
Dense shrubbery and forest litter	0.40

Source: City of Sacramento SSWMM94 User's Manual, 1994 and Storm Water Management Model, Version 4, User's manual, Oct 1992

HYDRAULIC MODEL INPUT DATA

The hydraulic model is a link-node model. Nodes are used to represent point data such as junctions or maintenance holes, transitions from pipes to open channels, or transitions from one channel cross-section to another channel cross-section. Links are used to represent the pipes or channels.

Node Data

The existing conditions hydraulic model includes 403 nodes. The node data are presented in Table 4-6. The node data required for the model are the invert elevation and the modeled ground elevation. All elevations used in the MDS are referenced to the NAVD 1988 datum. For nodes along storm drain pipe systems, the ground elevation represents the maintenance hole rim elevation. For nodes along open channels, the modeled ground elevation represents the elevation of the lower of the two channel banks, which is the elevation at which flooding of the adjacent fields would occur.

The node ground elevations and the channel/pipe invert elevations were primarily obtained from:

- Field evaluations by West Yost staff
- A Global Positioning Satellite (GPS) survey performed by West Yost or Laughlin & Spence.

For storm drain systems within the City of Live Oak, elevations were obtained from as-built and design drawings, and in these cases, the elevations were adjusted from whatever datum was used in the drawings to NAVD 1988 by comparison with GPS survey data for an identifiable structure shown on the drawing.

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5
EIC0020	44.4	55.7	54.8	-0.9	55.0	-0.8
EIC0030	44.8	55.8	54.8	-0.9	55.0	-0.7
EIC0040	44.9	56.1	54.8	-1.3	56.4	0.3
EIC0050	45.0	56.1	54.8	-1.3	56.4	0.3
EIC0060	46.6	57.4	54.8	-2.6	57.1	-0.3
EIC0070	46.6	57.4	54.8	-2.6	57.1	-0.4
EIC0075	47.2	57.9	54.8	-3.0	57.4	-0.4
EIC0080	48.1	58.5	54.9	-3.6	57.5	-1.0
EIC0090	48.2	58.6	54.9	-3.7	57.5	-1.1
EIC0100	50.1	57.8	55.6	-2.3	59.1	1.3
EIC0110	50.2	59.2	55.6	-3.7	59.1	-0.1
EIC0120	50.3	63.1	55.9	-7.2	59.4	-3.6
EIC0130	50.0	60.8	55.9	-4.9	59.4	-1.3
EIC0140	50.0	59.2	56.0	-3.2	59.6	0.4
EIC0150	49.8	58.6	56.0	-2.6	59.6	1.0
L01-0090	59.5	70.1	65.7	-4.4	67.3	-2.7
L01-0100	59.2	69.7	65.8	-4.0	67.4	-2.3
L01-0110	60.1	68.3	66.3	-2.1	67.8	-0.5
L01-0120	59.9	68.3	66.3	-2.0	67.9	-0.4
L01-0170	58.9	69.0	66.3	-2.7	67.9	-1.1
L01-0180	58.7	67.5	66.6	-0.9	68.4	0.9
L01-0190	60.2	68.6	67.0	-1.6	68.7	0.1
L01-0200	61.4	69.5	67.2	-2.3	68.8	-0.7
L01-0210	61.3	69.4	67.4	-2.0	69.1	-0.3
L01-0220	62.4	71.4	67.9	-3.5	69.4	-2.0
L01-0230	62.4	69.9	70.7	0.8	72.9	3.0
L01-0240	63.9	70.5	70.9	0.4	72.9	2.5
L01-0250	65.0	71.3	70.9	-0.4	73.0	1.6
L01-0260	65.2	71.4	72.8	1.4	74.6	3.2
L01-0270	65.3	71.5	72.8	1.4	74.6	3.1
L01-0280	65.5	71.6	73.1	1.5	74.8	3.2
L01-0290	67.6	72.4	73.1	0.6	74.8	2.4
L01-0300	67.9	73.2	73.1	-0.1	74.8	1.6
L01-0310	67.3	73.4	73.1	-0.3	74.8	1.4
L01-0320	66.9	73.5	73.1	-0.4	74.8	1.3
L01-0330	67.0	74.1	73.1	-1.0	74.8	0.7
L01-0340	69.9	72.6	73.1	0.5	74.8	2.2
L02-0010	55.4	63.3	62.0	-1.3	64.2	0.9
L02-0020	55.5	63.5	62.2	-1.3	64.4	0.9
L02-0030	55.1	63.7	62.2	-1.4	64.5	0.8
L02-0032	55.9	64.3	63.1	-1.1	65.2	0.9
L02-0040	56.8	65.0	64.2	-0.8	66.2	1.2
L02-0042	57.0	65.3	64.6	-0.7	66.5	1.2
L02-0044	57.1	65.4	64.7	-0.7	66.5	1.2
L02-0050	59.7	70.4	65.5	-4.9	67.1	-3.2
L02-0060	60.2	66.9	66.7	-0.1	68.3	1.4
L02-0064	60.3	66.2	67.8	1.6	69.6	3.4
L02-0070	58.9	65.5	67.8	2.3	69.6	4.1
L02-0080	59.3	66.0	68.2	2.2	70.3	4.3
L02-0086	59.2	68.9	68.2	-0.7	70.3	1.3
L02-0088	59.4	68.9	68.3	-0.7	70.3	1.4
L02-0090	62.5	68.2	68.3	0.1	70.3	2.2
L02-0095	62.7	68.6	68.3	-0.3	70.4	1.8
L02-0100	62.7	69.6	68.4	-1.2	70.5	1.0
L02-0102	64.2	68.8	68.5	-0.3	70.6	1.8
L02-0104	64.2	69.0	68.9	-0.1	71.0	2.1
L02-0106	64.0	68.5	68.9	0.4	71.1	2.5
L02-0108	64.1	68.6	69.7	1.1	72.0	3.4
L02-0110	64.9	69.5	69.7	0.2	72.0	2.5
L02-0120	64.4	71.4	70.1	-1.3	72.5	1.1
L02-0130	66.2	71.5	70.1	-1.4	72.5	1.0
L02-0140	66.1	72.0	70.2	-1.8	72.6	0.6
L02-0150	66.5	71.2	70.2	-1.0	72.6	1.5
L02-0160	66.0	71.3	70.4	-0.8	73.0	1.7
L02-0170	68.0	73.3	70.4	-2.9	73.0	-0.3
L02-0180	68.3	70.7	73.5	2.8	74.5	3.8
L02-0190	66.9	71.1	70.2	-0.9	72.5	1.4
L02-0200	66.5	70.9	70.9	0.0	72.9	2.1
L02-0210	64.0	70.5	70.9	0.4	72.9	2.5
L02-0220	63.7	71.1	70.9	-0.2	72.9	1.9
L02-0230	62.9	70.4	70.9	0.5	73.0	2.5
L02-0237	67.1	75.2	72.7	-2.5	73.9	-1.3
L02-0238	67.4	75.0	72.7	-2.3	73.9	-1.1
L02-0239	67.7	75.4	72.7	-2.7	73.9	-1.5
L02-0240	63.0	69.5	71.1	1.6	73.2	3.7
L02-0243	68.3	75.4	72.7	-2.7	73.9	-1.5
L02-0244	68.9	75.5	72.7	-2.8	73.9	-1.6
L02-0246	67.8	75.0	72.7	-2.3	73.9	-1.1

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L02-0247	68.0	75.2	72.7	-2.5	73.9	-1.3
L02-0250	64.1	72.7	71.1	-1.6	73.2	0.5
L02-0252	65.7	73.2	72.5	-0.8	73.7	0.5
L02-0253	66.1	73.9	72.7	-1.2	73.8	-0.1
L02-0254	68.0	73.9	72.7	-1.2	73.8	-0.1
L02-0255	66.5	74.2	72.7	-1.5	73.9	-0.4
L02-0260	67.1	74.7	72.7	-1.9	73.9	-0.7
L02-0261	66.9	76.0	72.7	-3.3	73.9	-2.1
L02-0262	67.1	75.0	72.7	-2.3	73.9	-1.1
L02-0270	67.0	74.2	72.7	-1.5	73.9	-0.3
L02-0272	66.6	73.8	72.7	-1.1	73.9	0.1
L02-0273	67.7	75.0	72.7	-2.3	73.9	-1.1
L02-0275	70.0	75.0	70.8	-4.2	73.9	-1.1
L02-0277	69.4	76.0	72.8	-3.2	75.3	-0.7
L02-0278	69.3	74.6	72.8	-1.9	74.8	0.1
L02-0279	68.3	75.6	72.8	-2.8	75.6	0.0
L02-0280	67.9	74.1	72.7	-1.4	73.9	-0.2
L02-0281	69.0	77.0	72.8	-4.2	77.0	0.0
L02-0282	68.4	75.8	72.8	-3.0	75.8	0.0
L02-0283	68.9	75.2	72.8	-2.4	75.5	0.3
L02-0284	68.3	74.9	72.8	-2.1	74.0	-0.9
L02-0286	69.4	76.2	72.8	-3.4	76.4	0.2
L02-0287	71.0	78.6	72.8	-5.8	78.5	-0.1
L02-0288	70.4	77.5	72.8	-4.7	77.5	0.0
L02-0290	68.7	76.3	72.9	-3.4	74.1	-2.2
L02-0291	68.9	76.0	73.0	-3.0	74.2	-1.8
L02-0292	69.0	76.0	73.0	-3.0	74.2	-1.8
L02-0293	69.9	75.3	73.0	-2.3	74.2	-1.1
L02-0300	70.8	78.0	73.1	-4.9	74.3	-3.7
L02-0302	72.8	78.3	75.3	-3.1	76.2	-2.1
L02-0304	73.2	76.7	75.6	-1.1	76.9	0.2
L02-0310	73.8	76.7	75.9	-0.7	77.0	0.4
L02-0421	69.4	76.8	75.5	-1.3	76.5	-0.3
L02-0422	70.7	76.8	76.8	0.0	77.0	0.2
L02-0424	70.5	76.9	77.2	0.2	77.7	0.8
L02-0425	69.5	76.1	75.5	-0.6	76.5	0.4
L02-0426	62.0	76.9	75.4	-1.5	76.4	-0.5
L02-0427	70.1	76.5	76.4	-0.1	77.1	0.6
L02-0428	72.1	77.0	76.1	-0.9	77.1	0.1
L02-0430	66.9	75.1	72.9	-2.3	73.9	-1.3
L02-0440	66.6	75.2	73.0	-2.2	74.1	-1.2
L02-0450	66.4	75.4	73.1	-2.3	74.2	-1.1
L02-0460	66.3	75.3	73.2	-2.1	74.4	-1.0
L02-0461	70.7	76.0	72.9	-3.1	74.3	-1.7
L02-0462	70.5	75.4	73.0	-2.4	75.4	0.0
L02-0463	70.1	76.1	72.9	-3.1	74.3	-1.7
L02-0464	70.7	76.0	72.9	-3.2	74.3	-1.7
L02-0465	69.9	75.4	73.1	-2.3	74.3	-1.1
L02-0467	69.1	75.4	73.2	-2.2	74.4	-1.0
L02-0468	69.6	75.2	73.2	-2.0	74.3	-0.8
L02-0470	67.0	75.3	73.3	-2.0	74.5	-0.9
L02-0470	67.0	75.3	73.3	-2.0	74.5	-0.9
L02-0471	70.9	75.2	73.3	-1.9	74.9	-0.3
L02-0472	71.2	75.7	73.3	-2.4	75.7	0.0
L02-0480.1	67.7	76.9	74.8	-2.0	75.7	-1.2
L02-0481	68.6	76.3	74.1	-2.2	75.0	-1.3
L02-0482	69.0	77.7	76.4	-1.2	77.7	0.1
L02-0483	69.1	74.4	74.4	0.0	75.0	0.7
L02-0484	69.6	75.2	74.7	-0.5	75.2	0.0
L02-0485	70.1	75.2	75.0	-0.2	75.4	0.2
L02-0490	59.5	76.9	73.4	-3.5	74.5	-2.3
L02-0500	66.1	75.3	74.8	-0.5	75.9	0.6
L02-0502	72.5	77.0	74.8	-2.2	75.9	-1.1
L02-0503	72.4	75.6	74.8	-0.8	75.9	0.3
L02-0504	72.4	75.4	75.0	-0.4	76.1	0.7
L02-0505	73.4	76.5	75.0	-1.5	76.1	-0.4
L02-0506	73.7	77.7	75.1	-2.5	76.2	-1.4
L02-0507	75.6	77.1	76.5	-0.6	76.7	-0.3
L02-0510	68.8	77.8	75.9	-1.8	77.2	-0.6
L02-0511	71.6	76.9	77.0	0.0	77.5	0.6
L02-0512	68.2	75.0	75.0	-0.1	76.1	1.1
L02-0513	72.2	77.8	77.9	0.1	78.5	0.7
L02-0514	68.5	75.3	75.1	-0.2	76.0	0.7
L02-0515	68.6	76.4	76.4	0.0	76.4	0.1
L02-0516	69.4	75.9	76.1	0.1	77.0	1.0
L02-0517	71.2	77.4	76.4	-1.0	76.4	-0.9
L02-0518	74.4	78.5	77.4	-1.1	79.1	0.6
L02-0520	74.5	78.4	77.6	-0.7	79.2	0.8
L02-0522	74.6	78.1	78.8	0.6	81.0	2.9

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L02-0530	76.4	79.2	79.3	0.1	81.0	1.9
L02-0538	68.6	76.0	76.3	0.3	77.2	1.2
L02-0540	70.2	78.1	78.3	0.2	78.4	0.3
L02-0541	70.7	77.7	78.3	0.6	79.0	1.3
L02-0542	71.2	78.4	78.5	0.1	79.2	0.8
L02-0543	71.5	79.2	79.2	0.0	79.4	0.2
L02-0544	72.0	79.9	79.9	0.1	80.1	0.3
L03-0010	63.0	71.6	68.9	-2.7	70.8	-0.8
L03-0020	63.1	71.6	69.1	-2.6	71.6	0.0
L03-0030	63.5	72.1	69.1	-2.9	71.6	-0.4
L03-0040	63.5	72.1	69.4	-2.7	72.5	0.4
L03-0050	64.0	72.6	69.4	-3.2	72.5	-0.1
L03-0060	64.6	73.2	69.4	-3.8	72.5	-0.7
L03-0062	64.7	73.3	69.6	-3.8	72.7	-0.6
L03-0070	65.9	74.5	69.7	-4.8	72.7	-1.8
L03-0080	66.1	74.7	71.7	-3.0	74.7	0.0
L03-0090	67.8	76.4	71.9	-4.5	74.8	-1.6
L03-0092	67.8	76.4	71.9	-4.5	74.8	-1.6
L03-0094	67.9	76.5	79.8	3.3	80.9	4.4
L04-0030	66.9	71.9	71.3	-0.6	73.9	2.0
L04-0040	67.0	71.6	71.3	-0.3	73.9	2.3
L04-0050	67.8	72.1	71.3	-0.7	73.9	1.9
L04-0060	68.3	71.4	71.4	0.0	73.9	2.6
L04-0062	68.2	73.1	71.4	-1.7	73.9	0.9
L04-0064	68.4	73.3	71.6	-1.7	74.0	0.7
L04-0066	68.0	71.7	71.6	-0.1	74.0	2.3
L04-0068	67.8	72.0	72.0	0.1	74.2	2.3
L04-0070	68.0	74.4	72.2	-2.3	74.2	-0.2
L04-0080	68.1	76.0	72.2	-3.8	74.3	-1.7
L04-0088	68.5	75.0	72.4	-2.7	74.4	-0.6
L04-0090	69.4	73.0	72.5	-0.5	74.5	1.5
L04-0092	69.5	73.6	72.6	-1.1	74.5	0.9
L04-0094	69.5	73.7	73.0	-0.7	75.1	1.3
L04-0100	69.6	73.8	73.0	-0.8	75.1	1.2
L05-0010	67.2	73.8	72.0	-1.8	75.0	1.2
L05-0012	67.9	73.0	72.0	-0.9	75.0	2.0
L05-0014	69.2	74.2	72.0	-2.2	75.0	0.8
L05-0020	69.1	75.9	72.0	-3.8	75.0	-0.9
L05-0040	69.2	74.0	72.0	-2.0	75.0	1.0
L05-0050	69.2	74.0	72.7	-1.3	75.6	1.6
L05-0060	69.3	74.2	72.8	-1.4	75.6	1.4
L05-0070	69.4	74.5	72.9	-1.6	75.7	1.2
L05-0080	69.4	74.5	72.9	-1.6	75.7	1.1
L05-0090	69.6	74.8	73.0	-1.9	75.7	0.8
L05-0100	69.7	75.1	73.0	-2.1	75.7	0.5
L05-0110	69.8	75.5	73.1	-2.4	75.7	0.2
L06-0020	69.0	77.2	73.5	-3.6	75.7	-1.5
L06-0040	68.5	77.2	73.7	-3.5	75.7	-1.5
L06-0140	69.6	77.6	73.7	-3.9	75.8	-1.8
L06-0141	69.4	77.2	73.7	-3.5	75.7	-1.5
L06-0142	69.7	78.2	73.8	-4.4	76.0	-2.2
L06-0143	71.3	78.2	73.8	-4.4	76.0	-2.2
L06-0144	72.6	78.1	78.1	0.0	78.4	0.4
L06-0145	72.3	78.3	76.6	-1.7	77.6	-0.6
L06-0146	72.8	75.0	75.6	0.6	76.6	1.6
L06-0147	75.0	79.0	76.8	-2.2	77.0	-2.0
L06-0148	71.8	77.5	73.7	-3.8	75.8	-1.8
L06-0149	71.5	77.5	73.7	-3.8	75.8	-1.7
L06-0150	71.6	77.7	74.2	-3.4	76.7	-1.0
L06-0151	69.9	77.6	74.0	-3.6	76.3	-1.2
L06-0152	74.0	76.7	76.9	0.2	77.3	0.6
L06-0200	73.0	79.7	76.6	-3.1	78.5	-1.2
L06-0220	73.5	79.0	78.3	-0.8	80.0	1.0
L06-0221	77.0	79.5	78.1	-1.4	80.0	0.5
L06-0222	77.0	79.5	77.9	-1.6	78.8	-0.7
L06-0230	75.1	80.5	79.4	-1.1	81.5	1.0
L06-0240	77.2	80.3	79.5	-0.8	81.5	1.2
L06-0240AA	67.3	80.5	74.7	-5.9	75.8	-4.7
L06-0242	77.2	80.8	79.5	-1.3	81.6	0.8
L06-0245	76.8	80.9	79.5	-1.3	81.6	0.7
L06-0250	77.2	81.4	79.7	-1.7	81.7	0.3
L06-0260	77.5	79.9	79.7	-0.2	81.7	1.9
L06-0270	77.5	81.3	79.7	-1.6	81.8	0.5
L06-0280	77.1	82.9	79.8	-3.2	81.8	-1.1
L06-0290	77.6	83.3	79.9	-3.3	82.1	-1.2
L06-0292	78.0	82.8	79.9	-2.8	82.1	-0.7
L06-0294	78.4	83.3	80.0	-3.3	82.1	-1.2
L06-0300	78.0	83.2	80.0	-3.2	82.1	-1.1
L06-0310	78.7	84.0	85.6	1.6	86.9	2.9

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L06-0340	68.3	77.1	74.1	-3.0	76.2	-0.9
L06-0350	69.1	78.1	74.5	-3.6	76.6	-1.5
L06-0360	70.0	79.1	74.6	-4.6	76.7	-2.4
L06-0361	70.0	79.1	74.3	-4.9	76.6	-2.5
L06-0380	70.9	76.7	75.6	-1.1	78.6	1.8
L06-0390	73.0	78.8	75.7	-3.1	78.6	-0.2
L06-0400	73.8	78.2	76.7	-1.5	79.7	1.5
L06-0430	73.2	81.8	76.9	-4.8	79.8	-2.0
L06-0432	73.3	81.8	77.0	-4.8	79.9	-1.9
L06-0433	71.2	80.4	76.8	-3.6	79.8	-0.6
L06-0434	72.2	80.5	76.8	-3.7	79.8	-0.7
L06-0435	72.0	80.2	76.8	-3.4	79.8	-0.4
L06-0436	73.3	80.4	77.4	-3.0	80.2	-0.2
L06-0438	73.7	79.5	80.1	0.7	81.0	1.5
L06-0460	71.8	80.5	77.1	-3.4	79.9	-0.5
L06-0480	71.9	80.8	77.1	-3.7	79.9	-0.9
L06-0490	72.7	81.0	77.1	-3.9	79.9	-1.1
L06-0492	72.8	81.1	77.6	-3.6	80.8	-0.3
L06-0500	74.4	81.5	77.6	-3.9	80.8	-0.7
L06-0502	74.6	81.0	77.7	-3.2	81.0	0.1
L06-0510	75.3	82.7	77.9	-4.7	81.1	-1.6
L06-0520	77.5	82.8	78.9	-3.9	81.5	-1.3
L07-0040	74.4	78.7	75.2	-3.5	76.8	-1.9
L07-0041	74.4	81.4	75.2	-6.2	76.8	-4.6
L07-0042	73.7	80.2	74.2	-5.9	76.8	-3.4
L07-0043	72.9	80.2	74.1	-6.1	76.8	-3.4
L07-0050	76.2	80.0	76.5	-3.4	76.9	-3.1
L07-0060	74.8	79.6	80.6	1.0	81.9	2.3
L07-0061	75.5	78.3	79.2	0.9	79.3	1.0
L07-0062	76.3	79.6	80.6	1.0	81.9	2.3
L07-0064	76.4	79.1	79.5	0.4	80.4	1.3
L07-0068	78.9	79.8	79.2	-0.6	79.3	-0.5
L07-0070	76.9	80.0	79.5	-0.5	80.4	0.4
L07-0080	77.3	80.1	80.3	0.3	81.4	1.4
L07-0100	75.0	81.0	79.8	-1.1	81.3	0.4
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1
L08-0010	60.5	70.7	64.9	-5.8	67.2	-3.5
L08-0012	60.5	70.8	64.9	-5.8	67.2	-3.5
L08-0020	60.9	71.2	64.9	-6.3	67.2	-3.9
L08-0030	61.0	71.2	64.9	-6.3	67.2	-4.0
L08-0040	61.4	71.7	64.9	-6.8	67.3	-4.5
L08-0050	61.6	71.8	64.9	-6.9	67.3	-4.5
L08-0060	62.5	72.8	65.6	-7.2	67.4	-5.3
L09-0010	69.4	75.5	73.0	-2.5	75.5	0.1
L09-0040	73.1	77.3	75.2	-2.1	75.9	-1.4
L09-0050	72.9	77.3	75.4	-2.0	76.1	-1.2
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.6
L09-0070	77.3	82.1	83.9	1.8	85.4	3.3
L11-0020	79.6	85.6	81.1	-4.6	84.5	-1.1
L11-0030	79.6	85.6	87.1	1.4	88.6	3.0
L13-0010	76.0	80.3	78.4	-1.9	80.8	0.5
L13-0020	77.6	79.9	80.4	0.5	81.1	1.3
L15-0010	71.9	77.2	73.4	-3.7	75.8	-1.4
L15-0050	72.7	77.1	79.4	2.3	80.7	3.6
MC0010	50.7	59.9	56.3	-3.6	59.9	0.0
MC0020	50.7	59.9	56.3	-3.6	59.9	0.0
MC0030	51.1	60.3	56.6	-3.7	60.1	-0.2
MC0040	51.4	59.7	56.7	-3.0	60.5	0.8
MC0050	51.5	60.1	56.9	-3.3	60.6	0.5
MC0060	51.5	60.1	56.9	-3.3	60.7	0.5
MC0070	52.2	64.1	57.1	-7.0	60.8	-3.3
MC0080	52.4	61.1	57.1	-4.1	60.8	-0.3
MC0090	53.3	63.2	58.3	-4.8	61.7	-1.5
MC0100	53.2	62.2	58.4	-3.9	61.7	-0.5
MC0110	54.3	63.6	59.9	-3.7	63.1	-0.6
MC0120	54.4	66.8	60.0	-6.8	63.1	-3.6
MC0130	54.2	64.0	60.3	-3.7	63.4	-0.6
MC0140	53.9	64.1	60.3	-3.8	63.4	-0.7
MC0150	57.2	68.6	62.5	-6.1	65.3	-3.3
MC0160	57.2	68.7	62.6	-6.2	65.3	-3.4
MC0170	57.9	69.2	63.0	-6.1	65.7	-3.4
MC0172	58.1	69.3	63.2	-6.1	65.9	-3.5
MC0174	58.2	69.3	63.2	-6.1	65.9	-3.5
MC0176	58.2	69.4	63.2	-6.1	65.9	-3.5
MC0178	58.2	69.4	63.2	-6.1	65.9	-3.5
MC0180	58.8	69.7	63.6	-6.1	66.2	-3.5
MC0190	58.8	69.7	63.6	-6.1	66.2	-3.5

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
MC0200	59.3	70.8	64.2	-6.6	66.7	-4.2
MC0210	58.5	70.2	64.3	-5.9	66.7	-3.5
MC0220	60.1	70.4	64.9	-5.5	67.2	-3.2
MC0230	61.4	70.9	66.8	-4.1	68.8	-2.1
MC0240	61.5	70.9	66.8	-4.1	68.9	-2.0
MC0250	62.0	71.1	67.7	-3.4	69.7	-1.4
MC0260	62.9	71.5	68.8	-2.6	70.8	-0.7
MC0270	62.2	70.5	68.9	-1.6	70.9	0.5
MC0280	65.4	71.4	69.6	-1.9	71.4	0.0
MC0282	65.5	71.5	69.7	-1.8	71.5	0.0
MC0290	65.6	71.5	70.4	-1.1	73.5	2.0
MC0292	67.1	71.9	71.3	-0.6	73.9	2.0
MC0296	65.8	71.6	71.6	0.0	74.1	2.5
MC0298	65.4	71.6	71.6	0.0	74.1	2.5
MC0300	63.3	73.3	71.6	-1.6	74.1	0.8
MC0310	63.3	72.5	71.7	-0.8	74.3	1.8
MC0320	65.4	74.7	71.7	-3.0	74.3	-0.5
MC0330	65.2	71.6	72.0	0.4	75.0	3.4
MC0340	65.3	72.5	72.1	-0.4	75.0	2.6
MC0350	65.3	72.8	72.1	-0.7	75.1	2.3
MC0360	65.5	75.5	72.2	-3.2	75.2	-0.2
MC0370	64.9	75.5	72.2	-3.3	75.2	-0.3
MC0380	65.8	74.7	72.3	-2.4	75.3	0.6
MC0390	67.1	73.5	72.4	-1.1	75.3	1.8
MC0400	67.1	74.8	72.4	-2.4	75.3	0.5
MC0410	68.1	78.7	72.9	-5.8	75.5	-3.2
MC0420	69.2	77.2	73.0	-4.2	75.5	-1.7
MC0422	69.2	77.2	73.1	-4.2	75.6	-1.7
MC0430	69.4	77.2	73.4	-3.8	75.7	-1.5
MC0430	69.4	77.2	73.4	-3.8	75.7	-1.5
MC0431	70.1	80.0	80.7	0.7	81.4	1.5
MC0440	69.0	76.0	73.4	-2.6	75.8	-0.2
MC0450	70.4	78.1	73.7	-4.3	76.0	-2.1
MC0451	69.7	77.4	73.6	-3.8	75.9	-1.5
MC0460	71.7	77.3	74.1	-3.3	76.7	-0.6
MC0461	70.4	77.6	74.2	-3.4	76.7	-0.9
MC0462	71.1	77.4	74.2	-3.2	76.7	-0.7
MC0463	71.3	76.7	74.2	-2.5	76.7	0.0
MC0464	71.7	78.6	74.2	-4.4	76.8	-1.8
MC0464	71.7	78.6	74.2	-4.4	76.8	-1.8
MC0470	72.2	78.7	74.5	-4.2	76.8	-1.9
MC0480	71.8	77.5	74.7	-2.8	77.3	-0.2
MC0490	72.3	78.3	75.6	-2.7	77.7	-0.6
MC0500	72.4	78.4	75.8	-2.7	78.2	-0.2
MC0510	73.4	80.2	76.8	-3.5	78.7	-1.5
MC0520	73.0	81.1	77.1	-4.0	79.9	-1.1
MC0530	73.3	81.3	77.1	-4.2	79.9	-1.4
MC0540	73.3	81.4	77.3	-4.1	80.7	-0.7
MC0545	73.6	81.7	77.6	-4.1	80.8	-0.9
MC0550	74.0	81.9	77.9	-4.0	80.9	-1.0
MC0560	74.1	82.0	78.1	-3.9	81.4	-0.5
MC0570	74.5	82.1	78.3	-3.8	81.5	-0.6
MC0580	74.5	82.1	78.5	-3.7	81.9	-0.2
MC0590	75.6	82.9	79.3	-3.6	82.2	-0.8
MC0600	75.6	83.0	79.5	-3.4	82.7	-0.3
MC0610	76.0	83.2	79.7	-3.5	82.7	-0.5
MC0620	76.0	83.9	79.9	-4.0	83.3	-0.6
MC0630	75.1	83.2	80.0	-3.1	83.3	0.2
MC0640	75.3	83.3	80.1	-3.2	83.4	0.1
MC0642	76.2	83.8	80.1	-3.7	83.4	-0.4
MC0644	76.3	83.9	80.8	-3.1	84.5	0.6
MC0650	77.1	84.3	80.9	-3.4	84.5	0.2
MC0660	76.2	83.7	80.1	-3.6	83.3	-0.4
MC0662	76.3	83.8	80.6	-3.2	84.7	0.9
MC0670	78.0	84.8	80.9	-3.9	84.7	-0.1
WIC0005	50.5	56.7	57.0	0.4	59.7	3.0
WIC0010	50.9	60.3	58.7	-1.6	61.2	0.9
WIC0020	50.9	58.9	58.8	-0.1	61.3	2.5
WIC0030	51.8	59.4	59.4	0.0	61.9	2.5
WIC0032	52.5	60.1	59.9	-0.2	62.4	2.3
WIC0034	54.1	61.4	60.9	-0.5	63.3	1.9
WIC0040	54.9	62.1	61.3	-0.9	63.6	1.5
L01-0006	Node turned off in model					
L01-0008	Node turned off in model					
L01-0009	Node turned off in model					
L01-0010	Node turned off in model					
L01-0130	Node turned off in model					
L01-0140	Node turned off in model					
L01-0150	Node turned off in model					

Table 4-6. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L01-0160	Node turned off in model					
L02-0311	Node turned off in model					
L02-0312	Node turned off in model					
L02-0313	Node turned off in model					
L02-0315	Node turned off in model					
L02-0316	Node turned off in model					
L02-0320	Node turned off in model					
L02-0330	Node turned off in model					
L02-0340	Node turned off in model					
L02-0360	Node turned off in model					
L02-0508	Node turned off in model					
L02-0509	Node turned off in model					
WIC0050	Node turned off in model					
WIC0060	Node turned off in model					
	Node turned off in model					

For some laterals, survey data were not available from the above-mentioned sources and, therefore, elevations were obtained from the original design drawings (1939) or from USGS topographic mapping. In either case, the elevation was converted to NAVD 1988 datum as accurately as possible. These laterals include the western portion of Lateral 2 that extends from L02-0060 to L02-0180 and the entirety of Lateral 3 and Lateral 8. Modeling of these laterals should be refined if additional surveys are performed in the future.

Some portions of the laterals were originally included in the model, but survey data was not available, so the nodes/links representing these laterals were made inactive in the model. However, the subshed data was applied at the junction of the inactive lateral with a modeled channel so that the total watershed area was included in the active model. These laterals include a small portion of Lateral 1, including node L01-0130 through L01-0150, another small portion of Lateral 1 including L01-0010 and L01-0009 through L01-0006, a small part of Lateral 2 that includes node L02-0360, another portion of Lateral 2 including L02-0340 through L02-0311, and a small portion of the WIC including node WIC0060 and WIC0050. If additional surveys of these facilities are conducted, the modeling of these laterals should be made active and refined.

Link Data

Links are used to represent linear facilities such as pipes and open channel segments. Pump stations are also represented as links in the model. The existing conditions model includes 417 links. A single link represents each of the pump stations within the City. The link data is presented in Table 4-7. The location of a link is determined by locating the link's upstream and downstream nodes on Figure 4-1.

Pipe materials observed in the system included reinforced concrete pipes (RCP), corrugated metal pipes (CMP), and corrugated plastic pipes (CPP). The Manning's "n" values for these material types are listed in Table 4-8. In some cases, the pipes were nearly or completely plugged with sediment. For these pipes, depending on the extent of sediment in the culvert, a Manning's "n" value of 0.03 to 0.2 was used to represent the restricted flow capacity of the pipe, and these pipes are shaded in red in Table 4-7.

The open channels in the area ranged from completely open with just minor weeds to very densely overgrown with blackberry bushes and aquatic weeds. The range of Manning's "n" values representing these conditions was from 0.03 to 0.08, and was based on field observations of the channel segments.

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
L1	EIC0075	EIC0070	Trapezoidal	47.16	46.62	0.070	1,485	0	35.00	1.45	2.18
L10	EIC0130	EIC0120	Trapezoidal	49.97	50.25	0.060	57	0	14.94	0.85	0.91
L11	EIC0120	EIC0100	Trapezoidal	50.25	50.10	0.070	1,142	0	14.68	0.87	1.02
L12	EIC0100	EIC0110	Trapezoidal	50.10	50.15	0.060	51	0	16.41	1.56	1.08
L13	EIC0110	EIC0090	Trapezoidal	50.15	48.20	0.080	2,871	0	8.95	1.24	1.43
L14	EIC0090	EIC0080	Trapezoidal	48.20	48.10	0.030	59	0	25.00	1.45	2.18
L15	EIC0080	EIC0075	Trapezoidal	48.10	47.16	0.060	1,804	0	25.00	1.45	2.18
L16	WIC0030	WIC0020	Trapezoidal	51.77	50.85	0.050	1,555	0	8.75	1.40	1.42
L17	WIC0020	WIC0010	Rectangular	50.85	50.90	0.015	64	8	7.00	0.00	0.00
L18	WIC0010	WIC0005	Trapezoidal	50.90	50.49	0.065	2,592	0	8.15	1.25	2.32
L19	WIC0005	EIC0075	Trapezoidal	50.49	47.16	0.065	2,543	0	8.15	1.25	2.32
L2	EIC0070	EIC0060	Trapezoidal	46.62	46.59	0.060	83	0	35.00	1.45	2.18
L25	WIC0040	WIC0034	Trapezoidal	54.90	54.07	0.040	1,226	0	11.30	1.16	1.29
L26	WIC0034	WIC0032	Trapezoidal	54.07	52.52	0.045	2,286	0	10.00	1.00	1.00
L27	WIC0032	WIC0030	Trapezoidal	52.52	51.77	0.050	1,102	0	7.30	1.37	1.49
L28	L02-0010	WIC0040	Trapezoidal	55.39	54.90	0.040	2,619	0	10.00	1.43	1.00
L29	WIC0060	WIC0050	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
L3	EIC0060	EIC0050	Trapezoidal	46.59	44.95	0.060	4,518	0	35.00	1.60	2.15
L30	WIC0050	WIC0040	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
L31	L02-0042	L02-0040	Trapezoidal	57.04	56.84	0.070	899	0	10.00	1.00	1.00
L32	L02-0040	L02-0032	Trapezoidal	56.84	55.87	0.070	2,421	0	10.13	0.75	1.16
L33	L02-0032	L02-0030	Trapezoidal	55.87	55.10	0.065	1,931	0	8.36	1.05	1.19
L34	L02-0030	L02-0020	Rectangular	55.10	55.50	0.015	71	7	7.00	0.00	0.00
L35	L02-0020	L02-0010	Trapezoidal	55.50	55.39	0.065	623	0	14.76	0.74	1.03
L4	EIC0050	EIC0040	Trapezoidal	44.95	44.91	0.040	84	0	35.00	1.60	2.15
L5	EIC0040	EIC0030	Trapezoidal	44.91	44.77	0.035	1,208	0	35.00	1.60	2.15
L6	EIC0030	EIC0020	Trapezoidal	44.77	44.44	0.035	94	0	40.00	1.81	2.11
L7	EIC0020	EIC0010	Trapezoidal	44.44	43.90	0.035	1,486	0	40.00	1.81	2.11
L8	EIC0140	EIC0150	Trapezoidal	50.02	49.79	0.060	78	0	18.58	0.83	1.64
L9	EIC0150	EIC0130	Trapezoidal	49.79	49.97	0.070	963	0	15.57	0.94	0.94
Link100	MC0200	MC0190	Trapezoidal	59.34	58.78	0.050	1,426	0	10.00	1.00	1.00
Link101	MC0190	MC0180	Special	58.78	58.76	0.024	57	8.75	0.00	0.00	0.00
Link102	MC0180	MC0178	Trapezoidal	58.76	58.21	0.040	1,419	0	10.00	1.00	1.00
Link108	L08-0060	L08-0050	Trapezoidal	62.48	61.56	0.080	1,072	0	3.00	1.00	1.00
Link109	L08-0050	L08-0040	Circular	61.56	61.44	0.024	143	3	0.00	0.00	0.00
Link110	L08-0040	L08-0030	Trapezoidal	61.44	60.97	0.080	542	0	3.00	1.00	1.00
Link111	L08-0030	L08-0020	Circular	60.97	60.91	0.015	69	3	0.00	0.00	0.00
Link112	L08-0020	L08-0012	Trapezoidal	60.91	60.50	0.080	478	0	3.00	1.00	1.00
Link113	L08-0012	L08-0010	Circular	60.50	60.45	0.024	60	3	0.00	0.00	0.00
Link114	L08-0010	MC0220	Trapezoidal	60.45	60.11	0.070	401	0	3.00	1.00	1.00
Link116	MC0220	MC0210	Trapezoidal	60.11	58.52	0.060	1,149	0	10.00	1.00	1.00
Link127	MC0270	MC0260	Special	62.20	62.90	0.024	93	7	0.00	0.00	0.00
Link128	MC0260	MC0250	Trapezoidal	62.90	62.04	0.080	1,375	0	8.00	1.00	1.00
Link129	MC0250	MC0240	Trapezoidal	62.04	61.46	0.080	939	0	8.00	1.00	1.00
Link130	MC0240	MC0230	Special	61.46	61.40	0.024	98	7	0.00	0.00	0.00
Link131	MC0230	MC0220	Trapezoidal	61.40	60.11	0.080	2,066	0	10.00	1.00	1.00
Link134	L03-0094	L03-0092	Circular	67.90	67.84	0.024	147	1.5	0.00	0.00	0.00
Link135	L03-0092	L03-0090	Circular	67.84	67.81	0.015	77	3.5	0.00	0.00	0.00
Link136	L03-0090	L03-0080	Trapezoidal	67.81	66.11	0.060	1,135	0	2.00	1.00	1.00
Link137	L03-0080	L03-0070	Circular	66.11	65.93	0.024	120	2	0.00	0.00	0.00
Link138	L03-0070	L03-0062	Trapezoidal	65.93	64.74	0.050	796	0	2.00	1.00	1.00
Link139	L03-0062	L03-0060	Circular	64.74	64.64	0.015	65	2.5	0.00	0.00	0.00
Link140	L03-0060	L03-0050	Trapezoidal	64.64	64.02	0.050	414	0	3.00	1.00	1.00
Link141	L03-0050	L03-0040	Trapezoidal	64.02	63.52	0.075	1,245	0	3.00	1.00	1.00
Link142	L03-0040	L03-0030	Circular	63.52	63.47	0.024	132	3	0.00	0.00	0.00
Link143	L03-0030	L03-0020	Trapezoidal	63.47	63.06	0.080	1,031	0	4.00	1.00	1.00
Link144	L03-0020	L03-0010	Circular	63.06	63.00	0.024	129	3	0.00	0.00	0.00
Link145	L03-0010	MC0260	Trapezoidal	63.00	62.90	0.080	260	0	4.00	1.00	1.00
Link146	L02-0100	L02-0095	Circular	62.70	62.66	0.015	100	3.5	0.00	0.00	0.00
Link147	L02-0090	L02-0088	Trapezoidal	62.52	59.44	0.040	135	0	9.00	1.45	1.25
Link148	L02-0088	L02-0086	Circular	59.44	59.16	0.030	51	4	0.00	0.00	0.00
Link148	L02-0088	L02-0086	Circular	59.44	59.16	0.030	51	4	0.00	0.00	0.00
Link149	L02-0086	L02-0080	Trapezoidal	59.16	59.30	0.040	2,568	0	10.70	1.47	1.29
Link150	L02-0080	L02-0070	Circular	59.30	58.86	0.015	56	2.5	0.00	0.00	0.00
Link151	L02-0070	L02-0064	Trapezoidal	58.86	60.30	0.040	780	0	8.46	1.01	1.05
Link152	L02-0064	L02-0060	Circular	60.30	60.19	0.015	128	2.5	0.00	0.00	0.00
Link153	L02-0060	L02-0050	Circular	60.19	59.68	0.015	160	2.5	7.46	0.56	0.75
Link157	L02-0180	L02-0170	Circular	68.29	67.99	0.060	52	1	0.00	0.00	0.00
Link158	L02-0170	L02-0160	Trapezoidal	67.99	65.97	0.050	1,199	0	12.23	1.94	1.66
Link159	L02-0160	L02-0150	Circular	65.97	66.48	0.030	43	2	0.00	0.00	0.00
Link160	L02-0150	L02-0140	Trapezoidal	66.48	66.11	0.040	1,311	0	4.18	1.57	1.27
Link161	L02-0140	L02-0130	Circular	66.11	66.23	0.024	60	2.5	0.00	0.00	0.00
Link162	L02-0130	L02-0120	Trapezoidal	66.23	64.39	0.045	1,315	0	6.05	1.64	2.45
Link163	L02-0120	L02-0110	Circular	64.39	64.87	0.015	62	2.5	0.00	0.00	0.00
Link164	L02-0110	L02-0108	Trapezoidal	64.87	64.11	0.035	899	0	5.68	1.40	2.05
Link165	L02-0108	L02-0106	Circular	64.11	64.02	0.024	53	2.5	0.00	0.00	0.00
Link166	L02-0106	L02-0104	Trapezoidal	64.02	64.20	0.040	1,584	0	7.68	1.36	1.08
Link167	L02-0104	L02-0102	Circular	64.20	64.16	0.015	82	2.5	0.00	0.00	0.00
Link168	L02-0102	L02-0100	Trapezoidal	64.16	62.70	0.065	1,226	0	8.14	1.42	1.21
Link169	L01-0240	L01-0230	Trapezoidal	63.89	62.44	0.050	2,459	0	11.80	1.13	1.26
Link170	L01-0230	L01-0220	Circular	62.44	62.40	0.015	68	3	0.00	0.00	0.00
Link171	L01-0220	L01-0210	Trapezoidal	62.40	61.30	0.070	2,688	0	15.07	1.03	1.42

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
Link173	L02-0200	L01-0240	Trapezoidal	66.50	63.89	0.040	1,216	0	3.33	2.63	2.85
Link174	L02-0190	L02-0130	Trapezoidal	66.86	66.23	0.040	1,124	0	2.09	0.52	0.02
Link175	L02-0253	L02-0252	Trapezoidal	66.14	65.72	0.040	532	0	4.00	1.00	1.00
Link176	L02-0252	L02-0250	Trapezoidal	65.72	64.14	0.080	2,003	0	6.53	0.75	0.95
Link177	L02-0250	L02-0240	Trapezoidal	64.14	62.95	0.030	1,511	0	6.00	1.22	1.00
Link178	L02-0240	L02-0230	Circular	62.95	62.88	0.024	100	6.5	0.00	0.00	0.00
Link179	L02-0230	L02-0220	Trapezoidal	62.88	63.72	0.040	729	0	9.22	1.61	1.23
Link180	L02-0220	L02-0210	Trapezoidal	63.72	63.98	0.030	162	0	8.53	1.22	1.10
Link181	L02-0210	L01-0240	Trapezoidal	63.98	63.89	0.015	155	0	9.22	1.61	1.23
Link182	L01-0340	L01-0330	Trapezoidal	69.85	66.97	0.050	647	0	2.87	1.22	1.35
Link183	L01-0330	L01-0320	Circular	66.97	66.88	0.015	81	2	0.00	0.00	0.00
Link184	L01-0320	L01-0310	Trapezoidal	66.88	67.25	0.050	498	0	4.86	1.42	0.99
Link185	L01-0310	L01-0300	Trapezoidal	67.25	67.89	0.050	855	0	4.86	1.42	0.99
Link186	L01-0300	L01-0290	Circular	67.89	67.59	0.015	70	2	0.00	0.00	0.00
Link187	L01-0290	L01-0280	Trapezoidal	67.59	65.51	0.050	972	0	4.86	1.42	0.99
Link188	L01-0280	L01-0270	Circular	65.51	65.29	0.015	103	2.5	0.00	0.00	0.00
Link189	L01-0270	L01-0260	Trapezoidal	65.29	65.15	0.040	64	0	4.86	1.42	0.99
Link190	L01-0260	L01-0250	Circular	65.15	65.02	0.015	66	1.5	0.00	0.00	0.00
Link191	L01-0250	L02-0230	Trapezoidal	65.02	62.88	0.050	1,000	0	5.00	1.00	1.00
Link192	MC0422	MC0420	Trapezoidal	69.20	69.20	0.050	83	0	6.00	1.00	1.00
Link193	MC0420	L09-0010	Trapezoidal	69.20	69.38	0.050	164	0	6.00	1.00	1.00
Link194	L09-0010	MC0410	Trapezoidal	69.38	68.10	0.035	327	0	6.00	1.00	1.00
Link195	MC0410	MC0400	Trapezoidal	68.10	67.10	0.035	1,490	0	7.00	1.00	1.00
Link196	MC0400	MC0390	Trapezoidal	67.10	67.10	0.040	78	0	8.50	1.00	1.00
Link197	MC0390	MC0380	Trapezoidal	67.10	65.82	0.040	2,112	0	10.00	7.23	0.64
Link198	MC0380	MC0370	Trapezoidal	65.82	64.87	0.060	1,560	0	11.66	3.14	1.10
Link199	MC0370	MC0360	Special	64.87	65.54	0.024	88	8	0.00	0.00	0.00
Link200	MC0360	MC0350	Trapezoidal	65.54	65.33	0.080	1,092	0	15.25	1.34	1.97
Link201	MC0350	MC0340	Rectangular	65.33	65.31	0.025	153	6	10.00	0.00	0.00
Link202	MC0340	MC0330	Trapezoidal	65.31	65.24	0.060	368	0	8.00	1.00	1.00
Link203	MC0330	MC0320	Circular	65.24	65.35	0.024	73	4	0.00	0.00	0.00
Link204	MC0320	MC0310	Trapezoidal	65.35	63.26	0.050	1,184	0	15.20	2.02	1.60
Link205	MC0310	MC0300	Special	63.26	63.33	0.015	98	5.5	0.00	0.00	0.00
Link206	MC0300	MC0298	Trapezoidal	63.33	65.39	0.060	458	0	8.00	1.00	1.00
Link207	MC0298	MC0296	Trapezoidal	65.39	65.80	0.040	92	0	8.00	1.00	1.00
Link208	MC0296	MC0292	Trapezoidal	65.80	67.08	0.065	1,292	0	14.14	1.67	1.22
Link209	MC0292	MC0290	Trapezoidal	67.08	65.63	0.080	1,163	0	11.29	1.26	1.44
Link210	MC0290	MC0282	Rectangular	65.63	65.51	0.070	99	3	7.50	0.00	0.00
Link211	MC0282	MC0280	Trapezoidal	65.51	65.43	0.060	68	0	8.00	1.00	1.00
Link212	MC0280	MC0270	Trapezoidal	65.43	62.20	0.060	2,595	0	13.29	2.29	1.53
Link214	L04-0100	L04-0094	Trapezoidal	69.57	69.52	0.050	135	0	2.00	4.31	2.11
Link215	L04-0094	L04-0092	Circular	69.52	69.47	0.024	91	3	0.00	0.00	0.00
Link216	L04-0092	L04-0090	Trapezoidal	69.47	69.36	0.070	242	0	4.00	2.00	2.00
Link217	L04-0090	L04-0088	Circular	69.36	68.51	0.015	94	3	0.00	0.00	0.00
Link218	L04-0088	L04-0080	Circular	68.51	68.10	0.015	66	3	0.00	0.00	0.00
Link219	L04-0080	L04-0070	Trapezoidal	68.10	67.97	0.080	769	0	6.63	1.63	1.36
Link220	L04-0070	L04-0068	Trapezoidal	67.97	67.77	0.040	1,204	0	5.45	1.31	1.19
Link221	L04-0068	L04-0066	Circular	67.77	67.96	0.015	118	3	0.00	0.00	0.00
Link222	L04-0066	L04-0064	Trapezoidal	67.96	68.43	0.035	99	0	5.30	1.57	1.42
Link223	L04-0064	L04-0062	Circular	68.43	68.19	0.015	119	3	0.00	0.00	0.00
Link224	L04-0062	L04-0060	Trapezoidal	68.19	68.30	0.035	315	0	5.30	1.57	1.42
Link225	L04-0060	L04-0050	Rectangular	68.30	67.81	0.015	105	2.5	8.00	0.00	0.00
Link226	L04-0050	L04-0040	Trapezoidal	67.81	67.04	0.060	527	0	5.17	1.83	1.65
Link227	L04-0040	L04-0030	Trapezoidal	67.04	66.86	0.080	400	0	5.17	1.83	1.65
Link228	L04-0030	MC0292	Circular	66.86	67.08	0.015	76	3	0.00	0.00	0.00
Link236	L05-0110	L05-0100	Trapezoidal	69.81	69.68	0.080	626	0	5.63	1.74	1.11
Link237	L05-0100	L05-0090	Trapezoidal	69.68	69.55	0.080	610	0	5.63	1.74	1.11
Link238	L05-0090	L05-0080	Trapezoidal	69.55	69.42	0.080	615	0	6.00	1.45	1.10
Link239	L05-0080	L05-0070	Trapezoidal	69.42	69.40	0.080	88	0	6.00	1.45	1.10
Link240	L05-0070	L05-0060	Trapezoidal	69.40	69.31	0.080	457	0	6.00	1.45	1.10
Link241	L05-0060	L05-0050	Trapezoidal	69.31	69.21	0.080	456	0	6.00	1.45	1.10
Link242	L05-0050	L05-0040	Special	69.21	69.21	0.024	117	2.3	0.00	0.00	0.00
Link243	L05-0040	L05-0020	Trapezoidal	69.21	69.05	0.060	130	0	6.00	1.00	1.00
Link244	L05-0020	L05-0014	Trapezoidal	69.05	69.18	0.080	411	0	6.00	1.00	1.00
Link245	L05-0014	L05-0012	Trapezoidal	69.18	67.90	0.035	332	0	6.00	1.00	1.00
Link246	L05-0012	L05-0010	Circular	67.90	67.24	0.015	159	3	0.00	0.00	0.00
Link247	L05-0010	MC0330	Trapezoidal	67.24	65.24	0.080	1,417	0	6.59	1.15	1.10
Link254.1	L02-0480.1	L02-0470	Circular	67.65	67.00	0.015	133	4.5	0.00	0.00	0.00
Link255.1	L02-0470	L02-0460	Trapezoidal	67.00	66.32	0.040	910	0	6.61	0.93	0.95
Link256	L02-0460	L02-0450	Trapezoidal	66.67	66.35	0.060	1,118	0	6.61	0.93	0.95
Link257	L02-0450	L02-0440	Trapezoidal	66.35	66.60	0.050	1,004	0	5.39	0.88	1.46
Link258	L02-0440	L02-0430	Trapezoidal	66.60	66.86	0.050	801	0	5.39	0.88	1.46
Link259	L02-0430	L02-0253	Trapezoidal	66.86	66.14	0.035	1,862	0	6.94	0.72	1.12
Link260	L02-0310	L02-0304	Trapezoidal	73.80	73.20	0.035	280	0	3.14	1.11	1.14
Link261	L02-0304	L02-0302	Circular	73.20	73.10	0.015	22	2	0.00	0.00	0.00
Link262	L02-0302	L02-0300	Circular	73.70	70.81	0.024	78	2.5	0.00	0.00	0.00
Link263	L02-0300	L02-0292	Trapezoidal	70.81	68.97	0.035	462	0	6.22	1.47	1.27
Link264	L02-0291	L02-0290	Circular	68.93	68.70	0.015	512	4	0.00	0.00	0.00
Link265	L02-0290	L02-0284	Circular	68.70	68.26	0.015	1,115	4	0.00	0.00	0.00
Link266	L02-0282	L02-0279	Circular	68.44	68.33	0.015	200	4.5	0.00	0.00	0.00
Link267	L02-0273	L02-0272	Trapezoidal	67.70	66.56	0.035	880	0	10.00	2.00	2.00
Link268	L02-0270	L02-0260	Trapezoidal	66.95	67.18	0.035	238	0	12.27	1.70	1.96

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
Link269	L02-0260	L02-0255	Circular	67.21	67.14	0.015	48	3	0.00	0.00	0.00
Link269	L02-0260	L02-0255	Circular	67.21	67.14	0.015	48	3	0.00	0.00	0.00
Link270	L02-0255	L02-0254	Trapezoidal	66.53	68.01	0.035	2,420	0	6.00	1.20	1.20
Link271	L02-0530	L02-0522	Trapezoidal	76.37	74.61	0.035	1,940	0	0.50	1.50	2.32
Link272	L02-0520	L02-0518	Trapezoidal	74.57	74.35	0.035	1,270	0	3.04	1.52	1.93
Link273	MC0670	MC0662	Trapezoidal	78.00	76.30	0.080	416	0	5.00	1.00	1.00
Link274	MC0662	MC0660	Circular	76.30	76.20	0.015	67	2	0.00	0.00	0.00
Link275	MC0660	MC0630	Trapezoidal	76.20	75.13	0.080	216	0	5.00	1.00	1.00
Link276	MC0640	MC0630	Circular	75.30	75.13	0.015	46	3	0.00	0.00	0.00
Link277	MC0630	MC0620	Trapezoidal	75.13	76.02	0.080	626	0	6.93	0.88	1.10
Link278	MC0620	MC0610	Circular	76.02	76.00	0.015	85	3	0.00	0.00	0.00
Link279	MC0610	MC0600	Trapezoidal	76.00	75.64	0.080	670	0	7.02	0.96	1.38
Link280	MC0600	MC0590	Circular	75.64	75.60	0.015	84	3	0.00	0.00	0.00
Link281	MC0590	MC0580	Trapezoidal	75.60	74.52	0.080	2,015	0	5.00	1.00	1.00
Link282	MC0580	MC0570	Circular	74.52	74.48	0.015	66	3	0.00	0.00	0.00
Link283	MC0570	MC0560	Trapezoidal	74.48	74.07	0.080	759	0	5.00	1.00	1.00
Link284	MC0560	MC0550	Circular	74.07	74.01	0.015	104	3	0.00	0.00	0.00
Link285	MC0550	MC0545	Trapezoidal	74.01	73.62	0.080	721	0	5.00	1.00	1.00
Link286	MC0545	MC0540	Trapezoidal	73.62	73.33	0.080	535	0	5.00	1.00	1.00
Link287	MC0540	MC0530	Circular	73.33	73.29	0.015	69	3	0.00	0.00	0.00
Link288	MC0530	MC0520	Trapezoidal	73.29	72.99	0.050	569	0	12.13	1.12	0.83
Link289	MC0520	MC0510	Circular	72.99	73.35	0.015	136	3	0.00	0.00	0.00
Link290	MC0510	MC0500	Trapezoidal	73.35	72.36	0.060	1,764	0	3.61	0.98	1.77
Link291	MC0500	MC0490	Circular	72.36	72.30	0.015	114	3.5	0.00	0.00	0.00
Link292	MC0490	MC0480	Trapezoidal	72.30	71.84	0.080	812	0	5.00	1.00	1.00
Link293	MC0480	MC0470	Circular	71.84	72.22	0.015	96	3.5	0.00	0.00	0.00
Link294	MC0470	MC0461	Trapezoidal	72.22	71.87	0.040	643	0	5.68	2.10	1.47
Link295	MC0460	MC0450	Circular	71.65	70.43	0.024	114	4	0.00	0.00	0.00
Link296	MC0450	MC0451	Trapezoidal	70.43	69.71	0.040	690	0	5.00	1.00	1.00
Link297	MC0440	MC0430	Special	68.97	69.36	0.024	107	4.8	0.00	0.00	0.00
Link298	MC0430	MC0422	Trapezoidal	69.36	69.20	0.050	3,165	0	9.75	1.25	1.29
Link299	MC0650	MC0644	Trapezoidal	77.06	76.30	0.080	554	0	5.00	1.00	1.00
Link300	MC0644	MC0642	Circular	76.30	76.20	0.015	68	1.667	0.00	0.00	0.00
Link301	MC0642	MC0640	Trapezoidal	76.20	75.30	0.080	951	0	5.00	1.00	1.00
Link305	L09-0050	L09-0040	Circular	72.85	73.05	0.015	164	2	0.00	0.00	0.00
Link311	L06-0040	L06-0020	Trapezoidal	68.45	69.00	0.050	662	0	7.95	1.22	1.56
Link314	L06-0020	MC0410	Trapezoidal	69.00	68.10	0.050	2,255	0	7.95	1.22	1.56
Link329	L07-0080	L07-0070	Circular	77.30	76.93	0.050	149	1.25	0.00	0.00	0.00
Link330	L07-0070	L07-0064	Trapezoidal	76.93	76.36	0.080	659	0	1.75	5.63	1.85
Link331	L07-0064	L07-0062	Circular	76.36	76.28	0.200	88	1.25	0.00	0.00	0.00
Link332	L07-0062	L07-0060	Trapezoidal	76.28	74.76	0.050	214	0	3.00	2.07	1.57
Link333	L07-0060	L07-0050	Circular	74.76	76.20	0.200	120	1.75	0.00	0.00	0.00
Link334	L07-0050	L07-0040	Trapezoidal	76.20	74.35	0.035	388	0	3.00	2.07	1.57
Link336	L07-0140	L07-0150	Circular	66.86	66.96	0.024	109	3	0.00	0.00	0.00
Link337	L07-0130	L07-0140	Trapezoidal	72.56	66.86	0.040	389	0	6.45	3.00	2.44
Link338	L02-0540	L02-0538	Circular	70.20	68.55	0.015	1,502	3.5	0.00	0.00	0.00
Link342.1	L02-0500	L02-0490	Circular	66.05	66.27	0.015	947	4.5	0.00	0.00	0.00
Link343	L06-0240	L06-0230	Trapezoidal	77.21	75.05	0.040	525	0	3.10	1.40	1.60
Link344	L06-0230	L06-0220	Circular	75.05	74.54	0.015	1,366	2.5	0.00	0.00	0.00
Link345	L06-0220	L06-0200	Circular	74.42	72.98	0.015	1,060	2.5	0.00	0.00	0.00
Link346	L06-0200	L06-0150	Circular	73.00	71.57	0.015	1,035	2.5	0.00	0.00	0.00
Link347	L06-0150	L06-0151	Circular	71.57	69.86	0.015	987	4	0.00	0.00	0.00
Link348	L06-0141	L06-0040	Rectangular	69.44	69.40	0.015	85	6	6.00	0.00	0.00
Link349	L06-0432	L06-0430	Special	73.28	73.22	0.024	104	5	0.00	0.00	0.00
Link350	L06-0430	L06-0435	Trapezoidal	73.22	72.03	0.040	1,289	0	10.50	1.23	0.96
Link351	L06-0400	L06-0390	Circular	73.76	73.03	0.024	170	4	0.00	0.00	0.00
Link352	L06-0390	L06-0380	Trapezoidal	73.03	70.89	0.035	174	0	8.10	1.40	1.43
Link353	L06-0380	L06-0360	Circular	70.89	70.03	0.014	965	4	0.00	0.00	0.00
Link354	L06-0360	L06-0350	Circular	70.03	69.10	0.015	280	5	0.00	0.00	0.00
Link355	L06-0350	L06-0340	Circular	69.10	68.27	0.015	990	5	0.00	0.00	0.00
Link356	L06-0340	L06-0040	Circular	68.76	68.45	0.015	1,100	5	0.00	0.00	0.00
Link357	L06-0270	L06-0260	Circular	77.46	77.46	0.024	62	2	0.00	0.00	0.00
Link358	L06-0260	L06-0250	Trapezoidal	77.46	77.20	0.040	192	0	3.10	1.40	1.60
Link359	L06-0250	L06-0245	Circular	77.20	76.81	0.024	106	1.8	0.00	0.00	0.00
Link360	L06-0245	L06-0242	Trapezoidal	76.81	77.24	0.040	796	0	3.10	1.40	1.60
Link361	L06-0502	L06-0500	Circular	74.64	74.44	0.022	20	2	0.00	0.00	0.00
Link362	L06-0500	L06-0492	Trapezoidal	74.44	72.80	0.035	1,141	0	7.70	1.30	1.40
Link363	L06-0492	L06-0490	Circular	72.80	72.70	0.024	30	2	0.00	0.00	0.00
Link364	L06-0490	L06-0480	Trapezoidal	72.70	71.88	0.035	656	0	7.70	1.30	1.40
Link365	L06-0480	L06-0460	Rectangular	71.88	71.78	0.015	177	6	5.00	0.00	0.00
Link366	L06-0460	L06-0432	Trapezoidal	71.78	73.28	0.035	2,308	0	8.10	1.50	1.50
Link367	L06-0310	L06-0300	Circular	78.73	77.97	0.200	190	1.8	0.00	0.00	0.00
Link368	L06-0300	L06-0294	Trapezoidal	77.97	78.44	0.040	488	0	3.00	1.40	1.30
Link369	L06-0294	L06-0292	Circular	78.44	77.95	0.024	43	1.5	0.00	0.00	0.00
Link370	L06-0292	L06-0290	Trapezoidal	77.95	77.59	0.040	610	0	3.00	1.40	1.30
Link371	L06-0290	L06-0280	Circular	77.59	77.08	0.024	40	1.5	0.00	0.00	0.00
Link372	L06-0280	L06-0270	Trapezoidal	77.08	77.46	0.040	623	0	3.00	1.40	1.30
Link374	L06-0520	L06-0510	Circular	77.50	75.52	0.022	40	2.5	0.00	0.00	0.00
Link375	L06-0510	L06-0502	Trapezoidal	75.52	74.64	0.035	1,556	0	7.80	1.20	1.20
Link376	L11-0030	L11-0020	Circular	79.60	79.60	0.200	80	2.5	0.00	0.00	0.00
Link377	L11-0020	MC0650	Trapezoidal	79.60	77.06	0.060	832	0	6.10	1.62	1.55
Link378	L13-0020	L13-0010	Trapezoidal	77.60	75.95	0.080	968	0	2.00	1.00	1.00

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
Link379	L13-0010	MC0545	Trapezoidal	75.95	73.62	0.080	1,368	0	3.00	1.00	1.00
Link384	L02-0044	L02-0042	Trapezoidal	57.12	57.04	0.070	366	0	12.21	1.06	1.13
Link385	L02-0275	L02-0260	Circular	70.00	69.82	0.015	65	3.5	0.00	0.00	0.00
Link386	L09-0070	L09-0060	Circular	77.26	76.60	0.024	57	1	0.00	0.00	0.00
Link387	L09-0060	L09-0050	Trapezoidal	76.60	72.85	0.080	785	0	5.00	1.56	1.61
Link388	L09-0040	L09-0010	Trapezoidal	73.05	69.38	0.080	2,169	0	5.17	1.56	1.61
Link390	L07-0100	L07-0130	Circular	74.98	72.56	0.015	765	3	0.50	1.60	1.69
Link391	L07-0100	L07-0080	Trapezoidal	78.80	79.00	0.080	2,932	0	0.50	9.19	2.13
Link392	L06-0242	L06-0240	Circular	77.24	77.21	0.024	30	1.8	0.00	0.00	0.00
Link393	L06-0150	L06-0361	Circular	71.57	70.03	0.015	616	4	0.00	0.00	0.00
Link394	L02-0522	L02-0520	Circular	74.61	74.54	0.024	20	2	0.00	0.00	0.00
Link395	L02-0518	L02-0310	Circular	74.35	73.80	0.024	40	2	0.00	0.00	0.00
Link396	L02-0272	L02-0270	Trapezoidal	66.56	66.95	0.035	350	0	7.31	2.05	1.99
Link397	L02-0254	L02-0253	Circular	68.10	68.05	0.024	25	4	0.00	0.00	0.00
Link398	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Link400	L02-0490	L02-0470	Trapezoidal	76.35	74.82	0.014	200	0.5	50.00	10.00	10.00
Link400	L02-0490	L02-0470	Trapezoidal	76.35	74.82	0.014	200	0.5	50.00	10.00	10.00
Link401	L02-0050	L02-0044	Trapezoidal	59.68	57.12	0.070	1,460	0	12.21	1.06	1.13
Link402	L15-0050	L15-0010	Circular	72.74	71.94	0.050	1,823	1.25	0.00	0.00	0.00
Link403	L15-0010	MC0430	Circular	71.94	69.36	0.050	20	1.25	0.00	0.00	0.00
Link404	L02-0200	L02-0190	Circular	66.50	66.86	0.045	50	1.5	0.00	0.00	0.00
Link406	L02-0095	L02-0090	Circular	62.66	62.52	0.015	103	4	0.00	0.00	0.00
Link407	L02-0292	L02-0291	Circular	68.97	68.93	0.014	148	4	0.00	0.00	0.00
Link408	L02-0293	L02-0291	Circular	69.94	68.93	0.014	512	2	0.00	0.00	0.00
Link409	L02-0284	L02-0280	Circular	68.26	67.88	0.014	960	4	0.00	0.00	0.00
Link410	L02-0277	L02-0278	Circular	69.44	69.28	0.014	171	2	0.00	0.00	0.00
Link411	L02-0278	L02-0279	Circular	69.28	68.33	0.014	690	2.5	0.00	0.00	0.00
Link412	L02-0279	L02-0247	Circular	68.33	67.98	0.014	875	4.5	0.00	0.00	0.00
Link413	L02-0247	L02-0246	Circular	67.98	67.84	0.014	350	4.5	0.00	0.00	0.00
Link414	L02-0281	L02-0282	Circular	69.00	68.44	0.014	700	3	0.00	0.00	0.00
Link416	L02-0239	L02-0238	Circular	67.66	67.37	0.014	280	2.5	0.00	0.00	0.00
Link417	L02-0238	L02-0237	Circular	67.37	67.05	0.014	160	4	0.00	0.00	0.00
Link419	L02-0244	L02-0243	Circular	68.87	68.27	0.014	530	3	0.00	0.00	0.00
Link420	L02-0243	L02-0238	Circular	68.27	67.37	0.014	900	4	0.00	0.00	0.00
Link421	L02-0262	L02-0261	Circular	67.05	66.85	0.014	169	4	0.00	0.00	0.00
Link422	L02-0261	L02-0255	Circular	66.88	66.85	0.014	54	2.5	0.00	0.00	0.00
Link423	L02-0237	L02-0262	Trapezoidal	67.05	67.05	0.035	160	0	10.00	2.00	2.00
Link424	L02-0280	L02-0273	Trapezoidal	67.88	67.70	0.035	270	0	10.00	2.00	2.00
Link425	L02-0246	L02-0273	Trapezoidal	67.84	67.70	0.014	260	0	10.00	2.00	2.00
Link426	L02-0287	L02-0286	Circular	71.00	69.38	0.014	587	2	0.00	0.00	0.00
Link427	L02-0286	L02-0283	Circular	69.38	68.89	0.014	794	3	0.00	0.00	0.00
Link428	L02-0283	L02-0282	Circular	68.89	68.44	0.014	866	4	0.00	0.00	0.00
Link429	L02-0262	L02-0275	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link430	L02-0481	L02-0470	Circular	68.55	68.16	0.014	542	2.5	0.00	0.00	0.00
Link431	L02-0514	L02-0500	Circular	68.52	66.69	0.014	329	3	0.00	0.00	0.00
Link433	L02-0538	L02-0510	Circular	68.60	68.80	0.014	619	4	0.00	0.00	0.00
Link434	L02-0512	L02-0500	Circular	68.15	66.05	0.014	322	4.5	0.00	0.00	0.00
Link436	L02-0509	L02-0508	Natural	74.41	75.44	0.014	304	1.25	0.00	0.00	0.00
Link437	L02-0508	L02-0507	Circular	75.44	75.57	0.014	73	1.5	0.00	0.00	0.00
Link438	L02-0507	L02-0506	Natural	75.57	73.70	0.014	308	1.5	0.00	0.00	0.00
Link439	L02-0506	L02-0505	Circular	73.69	73.44	0.014	120	1.5	0.00	0.00	0.00
Link441	L02-0504	L02-0503	Circular	72.37	72.37	0.014	33	1.2	0.00	0.00	0.00
Link442	L02-0503	L02-0502	Natural	72.38	72.52	0.014	33	0	0.00	0.00	0.00
Link443	L02-0502	L02-0500	Circular	72.52	68.24	0.014	91	3	0.00	0.00	0.00
Link444	L02-0505	L02-0504	Natural	73.44	72.37	0.014	500	0	0.00	0.00	0.00
Link445	L02-0544	L02-0543	Circular	72.00	71.48	0.014	520	2	0.00	0.00	0.00
Link446	L02-0543	L02-0542	Circular	71.48	71.22	0.014	260	2.5	0.00	0.00	0.00
Link447	L02-0542	L02-0541	Circular	71.22	70.71	0.014	510	3	0.00	0.00	0.00
Link448	L02-0541	L02-0540	Circular	70.71	70.20	0.014	724	3	0.00	0.00	0.00
Link450	L02-0472	L02-0471	Circular	71.17	70.93	0.014	245	2	0.00	0.00	0.00
Link451	L02-0471	L02-0467	Circular	70.93	69.05	0.014	480	2.5	0.00	0.00	0.00
Link452	L02-0468	L02-0467	Circular	69.60	69.05	0.014	250	3.25	0.00	0.00	0.00
Link453	L02-0465	L02-0468	Circular	69.85	69.60	0.014	250	3.25	0.00	0.00	0.00
Link454	L02-0463	L02-0465	Circular	70.08	69.85	0.014	230	3	0.00	0.00	0.00
Link455	L02-0462	L02-0463	Circular	70.53	70.08	0.014	558	2	0.00	0.00	0.00
Link456	L02-0461	L02-0464	Circular	70.73	70.73	0.014	55	3	0.00	0.00	0.00
Link457	L02-0464	L02-0463	Circular	70.73	70.08	0.014	433	3	0.00	0.00	0.00
Link458	L02-0467	L02-0460	Circular	69.05	68.32	0.014	728	4	0.00	0.00	0.00
Link459	L02-0422	L02-0425	Circular	70.72	69.54	0.014	894	2	0.00	0.00	0.00
Link460	L02-0427	L02-0421	Circular	70.09	69.54	0.014	759	2	0.00	0.00	0.00
Link461	L02-0424	L02-0427	Circular	70.53	70.09	0.014	545	2	0.00	0.00	0.00
Link462	L02-0421	L02-0426	Circular	69.40	69.30	0.014	30	3	0.00	0.00	0.00
Link463	L02-0426	L02-0428	Circular	72.05	72.05	0.005	10	2	0.00	0.00	0.00
Link464	L02-0425	L02-0421	Circular	69.45	69.40	0.014	58	2.5	0.00	0.00	0.00
Link465	L06-0436	L06-0434	Circular	73.27	72.16	0.014	900	2	0.00	0.00	0.00
Link466	L06-0434	L06-0433	Circular	72.16	71.44	0.014	213	2.5	0.00	0.00	0.00
Link467	L06-0433	L06-0435	Circular	72.16	72.03	0.014	118	2.5	0.00	0.00	0.00
Link469	L06-0435	L06-0400	Trapezoidal	72.03	73.76	0.040	961	0	10.50	1.23	0.96
Link470	L06-0221	L06-0220	Circular	77.00	75.55	0.014	591	1	0.00	0.00	0.00
Link470	L06-0221	L06-0220	Circular	77.00	75.55	0.014	591	1	0.00	0.00	0.00
Link472	MC0464	MC0462	Circular	71.66	71.13	0.014	525	3	0.00	0.00	0.00
Link473	MC0462	MC0461	Circular	71.13	70.41	0.014	609	3	0.00	0.00	0.00

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
Link475	MC0461	MC0460	Trapezoidal	71.87	71.65	0.040	389	0	5.68	2.10	1.47
Link476	MC0463	MC0462	Circular	71.32	71.13	0.014	215	2.25	0.00	0.00	0.00
Link478	L07-0040	L07-0041	Circular	74.50	74.43	0.014	25	1.5	0.00	0.00	0.00
Link479	L07-0041	L07-0042	Circular	74.43	73.73	0.014	315	2.5	0.00	0.00	0.00
Link480	L07-0042	L07-0043	Circular	73.73	72.94	0.014	22	1.5	0.00	0.00	0.00
Link481	L07-0043	MC0460	Circular	72.94	71.65	0.014	323	1.5	0.00	0.00	0.00
Link483	L06-0140	L06-0141	Circular	69.60	69.44	0.014	105	6	0.00	0.00	0.00
Link484	L06-0151	L06-0142	Circular	69.86	69.65	0.014	1,000	4	0.00	0.00	0.00
Link485	L02-0482	L02-0481	Circular	68.98	68.56	0.014	216	1.75	0.00	0.00	0.00
Link486	L02-0485	L02-0484	Circular	70.06	69.61	0.014	253	1.75	0.00	0.00	0.00
Link487	L02-0484	L02-0483	Circular	69.61	69.32	0.014	319	2	0.00	0.00	0.00
Link488	L02-0483	L02-0481	Circular	69.06	68.55	0.014	635	2.25	0.00	0.00	0.00
Link489	L02-0513	L02-0511	Circular	72.20	71.61	0.014	393	2	0.00	0.00	0.00
Link490	L02-0511	L02-0510	Circular	71.61	69.64	0.014	481	2	0.00	0.00	0.00
Link491	L02-0516	L02-0514	Circular	69.44	68.52	0.014	360	2	0.00	0.00	0.00
Link492	L06-0143	L06-0142	Circular	71.33	70.86	0.014	465	2	0.00	0.00	0.00
Link493	L06-0142	L06-0140	Circular	69.65	69.60	0.014	550	4	0.00	0.00	0.00
Link494	L06-0152	L06-0150	Circular	74.04	73.15	0.014	438	1	0.00	0.00	0.00
Link495	L06-0144	L06-0145	Circular	72.57	72.28	0.014	356	1.25	0.00	0.00	0.00
Link496	L06-0145	L06-0148	Circular	72.28	71.84	0.014	366	1.25	0.00	0.00	0.00
Link497	L06-0149	L06-0140	Circular	71.53	71.51	0.014	224	2	0.00	0.00	0.00
Link498	L06-0146	L06-0145	Circular	72.80	72.28	0.014	231	1	0.00	0.00	0.00
Link499	L07-0061	L07-0060	Circular	75.73	75.59	0.014	560	1.5	0.00	0.00	0.00
Link50	MC0100	MC0090	Rectangular	53.22	53.25	0.015	75	9	8.00	0.00	0.00
Link500	MC0451	MC0440	Trapezoidal	69.71	68.97	0.040	760	0	5.00	1.00	1.00
Link501	L07-0068	L07-0061	Natural	78.92	77.50	0.025	718	0	0.00	0.00	0.00
Link502	L07-0068	MC0451	Trapezoidal	78.92	76.53	0.035	620	0	20.00	8.00	8.00
Link504	L06-0438	L06-0434	Circular	73.69	72.16	0.014	300	1.5	0.00	0.00	0.00
Link505	L02-0288	L02-0281	Circular	70.38	69.00	0.014	925	2	0.00	0.00	0.00
Link506	L06-0147	L06-0146	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link506	L06-0147	L06-0146	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link507	L06-0148	L06-0149	Circular	71.84	71.53	0.014	56	1.5	0.00	0.00	0.00
Link508	L06-0222	L06-0221	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link509	L06-0361	L06-0360	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link51	MC0090	MC0080	Trapezoidal	53.25	52.40	0.080	1,414	0	8.23	1.64	1.50
Link510	L02-0515	L02-0512	Circular	68.58	68.45	0.014	510	4.5	0.00	0.00	0.00
Link513	L02-0517	L02-0515	Circular	71.15	70.82	0.014	204	2	0.00	0.00	0.00
Link514	L02-0510	L02-0515	Circular	68.76	68.58	0.014	360	4.5	0.00	0.00	0.00
Link515	L02-0506	L02-0517	Trapezoidal	76.67	76.38	0.025	195	1	4.00	20.00	20.00
Link516	L02-0504	L02-0512	Trapezoidal	74.40	74.04	0.025	180	1	4.00	20.00	20.00
Link517	MC0431	MC0430	Circular	70.06	70.00	0.014	590	1.25	0.00	0.00	0.00
Link52	MC0080	MC0070	Special	52.40	52.20	0.015	81	9.2	0.00	0.00	0.00
Link53	MC0070	MC0060	Trapezoidal	52.20	51.50	0.080	446	0	15.31	1.42	1.16
Link54	MC0060	MC0050	Trapezoidal	51.50	51.50	0.060	74	0	15.31	1.42	1.16
Link55	MC0050	MC0040	Trapezoidal	51.50	51.40	0.080	621	0	15.31	1.42	1.16
Link56	MC0040	MC0030	Special	51.40	51.10	0.024	78	6.7	0.00	0.00	0.00
Link57	MC0030	MC0020	Trapezoidal	51.10	50.71	0.080	1,219	0	8.80	5.34	0.99
Link58	MC0020	MC0010	Trapezoidal	50.71	50.68	0.060	69	0	8.80	5.34	0.99
Link59	MC0010	EIC0140	Trapezoidal	50.68	50.02	0.070	2,059	0	18.58	0.83	1.64
Link74	L02-0360	L02-0040	Circular	0.05	0.00	0.014	10	0.05	0.00	0.00	0.00
Link75	L01-0210	L01-0200	Circular	61.30	61.40	0.024	110	7	0.00	0.00	0.00
Link76	L01-0200	L01-0190	Trapezoidal	61.40	60.19	0.065	1,168	0	13.66	1.64	1.12
Link77	L01-0190	L01-0180	Trapezoidal	60.19	58.73	0.065	1,405	0	8.00	1.00	1.00
Link78	L01-0180	L01-0170	Circular	58.73	58.86	0.015	55	4	0.00	0.00	0.00
Link79	L01-0170	L01-0120	Trapezoidal	58.86	59.90	0.070	122	0	8.00	1.00	1.00
Link80	L01-0120	L01-0110	Rectangular	59.90	60.10	0.015	50	6	6.00	0.00	0.00
Link81	L01-0110	L01-0100	Trapezoidal	60.10	59.23	0.060	1,064	0	8.00	1.00	1.00
Link82	L01-0100	L01-0090	Trapezoidal	59.23	59.46	0.050	565	0	14.24	0.94	0.92
Link83	L01-0090	L02-0050	Trapezoidal	59.46	59.68	0.050	1,444	0	14.24	0.94	0.92
Link84	MC0178	MC0176	Trapezoidal	58.21	58.19	0.040	53	0	10.00	1.00	1.00
Link85	MC0176	MC0174	Trapezoidal	58.19	58.16	0.040	78	0	10.00	1.00	1.00
Link86	MC0174	MC0172	Trapezoidal	58.16	58.13	0.040	69	0	10.00	1.00	1.00
Link87	MC0172	MC0170	Trapezoidal	58.13	57.87	0.040	673	0	10.00	1.00	1.00
Link88	MC0170	MC0160	Trapezoidal	57.87	57.15	0.045	1,836	0	10.00	1.00	1.00
Link89	MC0160	MC0150	Trapezoidal	57.15	57.20	0.050	61	0	10.00	1.00	1.00
Link90	MC0150	MC0140	Trapezoidal	57.20	53.91	0.060	4,637	0	7.86	1.07	1.33
Link91	MC0140	MC0130	Trapezoidal	53.91	54.20	0.070	109	0	10.00	1.00	1.00
Link92	MC0130	MC0120	Trapezoidal	54.20	54.40	0.080	583	0	10.00	1.00	1.00
Link93	MC0120	MC0110	Trapezoidal	54.40	54.30	0.080	60	0	6.79	0.68	1.44
Link94	MC0110	MC0100	Trapezoidal	54.30	53.22	0.070	1,652	0	6.79	0.68	1.44
Link99	MC0210	MC0200	Rectangular	58.52	59.34	0.015	81	9	9.00	0.00	0.00
L20	L01-0010	WIC0030	Link turned off in model								
L21	L01-0009	L01-0008	Link turned off in model								
L22	L01-0008	L01-0006	Link turned off in model								
L23	L01-0006	WIC0020	Link turned off in model								
L42	L02-0340	L02-0330	Link turned off in model								
L43	L02-0330	L02-0320	Link turned off in model								
L44	L02-0320	L02-0316	Link turned off in model								
L45	L02-0316	L02-0315	Link turned off in model								
L46	L02-0315	L02-0313	Link turned off in model								
L47	L02-0313	L02-0312	Link turned off in model								
L48	L02-0312	L02-0311	Link turned off in model								

Table 4-7. Link Data

Link	US Node	DS Node	Type	US Invert Elevation, ft NAVD	DS Invert Elevation, ft NAVD	Roughness	Length, ft	Diameter or Height, ft	Bottom Width, ft	RSS	LSS
L49	L02-0311	L02-0020	Link turned off in model								
Link380	L01-0130	L01-0140	Link turned off in model								
Link381	L01-0140	L01-0150	Link turned off in model								
Link382	L01-0150	L01-0160	Link turned off in model								
Link383	L01-0160	MC0230	Link turned off in model								
Link405	L06-0240AA	L06-0240	Link turned off in model								
Link405	L06-0240AA	L06-0240	Link turned off in model								

Table 4-8. Manning's "n" Values

Material	Manning's "n" Value
Concrete	0.015
Corrugated Metal	0.024
Corrugated Plastic (with smooth interior)	0.013
Earthen Open Channels Clear with few weeds Densely overgrown with berry bushes and/or aquatic weeds	 0.030 to 0.080

Tailwater Boundary Condition Data

Data for two tailwater boundary conditions were needed for the model, including:

- East Intercepting Canal at the Wadsworth Canal – At this location, the following data were used in the model to define the downstream boundary condition.
  - At hour 0 (start of the 4-day storm), the water level starts at elevation 45 feet (1.1 feet deep)
  - At hour 72, the water level reaches its peak at elevation 54.8 feet, which is 0.5 foot below the top of the channel bank. This peak was assumed to occur a day after the peak of the rainfall because the tail water level is controlled by flooding in the Sutter Bypass, which should peak later than the flow from the RD 777 watershed.
  - At hour 144, the water level recedes to elevation 48 feet.
- Feather River at Lateral 7 – At this location, the following data was used in the model to define the Feather River boundary condition.
  - At hour 0 (start of the 4-day storm), the water level starts at elevation 67 feet, which would represent a free flowing outfall at the downstream end (eastern most end) of the modeled system, which is on the river side of the levee.
  - At hour 72, the water level reaches its peak at elevation 86.7 feet, which is 5 feet below the top of the Feather River Levee at this location. This peak was assumed to occur a day after the peak of the rainfall because the tail water level is controlled by flooding in the Feather River, which should peak later than the flow from the RD 777 watershed.
  - At hour 144, the water level recedes to elevation 70 feet.

Most of the channels in the drainage system are constructed, trapezoidal channels, but since the original construction, many have changed due to scour, sedimentation, and additional construction activities. For this modeling, the channels were all characterized as trapezoidal channels based on the surveyed channel cross-sections (see Chapter 3).

MODEL RESULTS

The hydrologic model mathematically transforms rainfall into runoff and produces runoff hydrographs that are used as input data in the hydraulic model. Table 4-9 presents the peak runoff and unit runoff (cfs/acre) for each subshed for the 10-year and 100-year design storms. For the 10-year storm, the unit runoff rates range from 0.02 cfs/acre for agricultural land to 1.66 cfs/acre for residential land. As shown, the 100-year unit runoff rates range from 0.02 for agricultural land to 2.64 cfs/acre for residential land. Figures 4-5 and 4-6 show runoff hydrographs for different locations in RD 777. Figure 4-5 shows the runoff in the Main Canal upstream and downstream of the City of Live Oak. The runoff increases considerably downstream of the City. Figure 4-6 shows the flow in reaches near the downstream end of the system.

Figures 4-7A, 4-7B, 4-8A and 4-8B show the model calibration curves for the 10-year and 100-year design storms, along with plotted subshed data. As shown in the figures, subshed runoff rate varied from the calibration curves due to the variation in infiltration rates, slope and impervious cover, compared to the value of these parameters used to create the calibration curves.

The model tracks the flow rates in the channels and culverts and determines the resulting water surface elevations. A summary of the resulting water surface elevations at each node is provided in Table 4-6 for the 10-year, and the 100-year storms.

Channel Profiles for the 10-Year Storm

Based on model results shown in Table 4-6, profiles for the 10-year storm are provided in Appendix 4A for the following channel segments:

- Profile 4A-1 – Main Canal from Metteer Road and Riviera Road to Clark Road.
- Profile 4A-2 – Main Canal from Clark Road to the confluence with the East Intercepting Canal.
- Profile 4A-3 – Lateral No. 6A from just south of Brubaker Road to its confluence with Lateral 6 (adjacent to the railroad and just north of Apricot Street).
- Profile 4A-4 – Lateral No. 6 from Riviera Road to its confluence with the Main Canal.
- Profile 4A-5 – Lateral No. 1 from Luther Road to the confluence with Lateral 2-A (just south of the Sutter Butte Canal).
- Profile 4A-6 – Lateral No. 2 from Epperson Way to its confluence with Lateral No. 1.
- Profile 4A-7 – Lateral No. 2-A-1, Lateral 2-A, and Western Intercepting Canal from north of Paseo Road to it confluence with the East Intercepting Canal.

As shown, the 10-year storm model results indicate minor flooding occurs and is usually associated with an undersized culvert or piped storm drain system. It appears that the existing system is generally capable of conveying a 10-year storm. Several culverts are filled or partially filled with sediment (see Table 4-7) and for these culverts a higher n-value was used (0.03 to 0.20). Use of a high n-value results in large increases in the hydraulic grade line across the culverts.

Table 4-9. Peak Runoff and Unit Runoff

Subshed/ Tributary Node	Subcatchment No.	Subshed Area, ac	Impervious Area %	10-Year Storm		100-Year Storm	
				Maximum Flow, cfs	Unit Runoff, cfs/ac	Maximum Flow, cfs	Unit Runoff, cfs/ac
EIC0075	1	113.7	1	17.12	0.15	25.48	0.22
EIC0090	1	145.2	5.7	34.11	0.23	57.48	0.40
EIC0100	1	283.2	1	31.68	0.11	51.28	0.18
EIC0140	1	163.1	1	23.72	0.15	35.40	0.22
L01-0008	1	209.8	1	Redirected to WIC0020, see Note 1			
L01-0010	1	402.3	3.8	Redirected to WIC0030, see Note 1			
L01-0120	1	77.4	1	18.26	0.24	24.28	0.31
L01-0150	1	43.8	1	Redirected to MCO230, see Note 1			
L01-0160	1	24.7	1	3.10	0.13	5.29	0.21
L01-0180	1	194.8	1	42.38	0.22	55.50	0.28
L01-0210	1	216.5	1	51.80	0.24	65.95	0.30
L01-0230	1	208.4	1	24.27	0.12	39.19	0.19
L01-0290	1	294.6	1	61.14	0.21	79.20	0.27
L02-0020	1	193.6	5.2	79.96	0.41	113.84	0.59
L02-0030	1	223.9	1	56.08	0.25	70.51	0.31
L02-0040	1	145.8	1	35.10	0.24	45.48	0.31
L02-0042	1	110.6	1	28.07	0.25	36.21	0.33
L02-0070	1	137.4	1	35.96	0.26	45.69	0.33
L02-0080	1	127.8	1	33.65	0.26	42.80	0.33
L02-0088	1	138.7	1	31.13	0.22	41.03	0.30
L02-0100	1	108.9	1	30.73	0.28	38.36	0.35
L02-0108	1	37.1	1	10.77	0.29	13.74	0.37
L02-0120	1	185.2	1	49.51	0.27	61.83	0.33
L02-0140	1	35.1	1	10.28	0.29	13.10	0.37
L02-0160	1	74.7	1	20.80	0.28	26.37	0.35
L02-0180	1	56.8	1	16.38	0.29	20.66	0.36
L02-0220	1	52.3	1	16.11	0.31	19.87	0.38
L02-0239	1	15.56	60	16.81	1.08	26.32	1.69
L02-0240	1	37.3	1	14.22	0.38	16.45	0.44
L02-0243	1	8.04	60	8.68	1.08	13.60	1.69
L02-0244	1	11.18	60	12.08	1.08	18.91	1.69
L02-0247	1	10.88	60	11.75	1.08	18.41	1.69
L02-0250	1	173.5	1	38.16	0.22	50.10	0.29
L02-0252	1	44.7	1	8.82	0.20	12.54	0.28
L02-0253	1	129.8	1	19.29	0.15	28.73	0.22
L02-0255	1	36.1	59.3	34.73	0.96	55.37	1.53
L02-0260	1	7.35	1	0.86	0.12	1.51	0.20
L02-0270	1	163.2	1	36.10	0.22	47.45	0.29
L02-0275	1	21.03	5	5.04	0.24	9.21	0.44
L02-0277	1	6.89	60	7.44	1.08	11.66	1.69
L02-0279	1	8.44	60	9.12	1.08	14.28	1.69
L02-0280	1	5.8	60	6.27	1.08	9.81	1.69
L02-0281	1	8.46	40	9.36	1.11	11.89	1.41
L02-0282	1	14.55	5	3.51	0.24	6.37	0.44
L02-0283	1	15.19	60	16.59	1.09	26.35	1.73
L02-0284	1	7.63	60	8.24	1.08	12.91	1.69
L02-0286	1	9.24	60	10.09	1.09	16.03	1.73
L02-0287	1	6.03	60	6.59	1.09	10.46	1.73
L02-0288	1	5.07	40	5.61	1.11	7.13	1.41
L02-0290	1	5.8	60	6.27	1.08	9.81	1.69
L02-0292	1	7.4	5	1.79	0.24	3.24	0.44
L02-0293	1	2.64	60	2.85	1.08	4.47	1.69
L02-0304	1	40.5	1	4.66	0.12	7.94	0.20
L02-0310	1	49.6	7.7	13.99	0.28	24.87	0.50
L02-0320	1	103.3	1	10.63	0.10	18.21	0.18
L02-0330	1	110.2	1.1	Redirected to L02-0020, see Note 1			
L02-0340	1	199.9	1	Redirected to L02-0020, see Note 1			
L02-0360	1	304.2	1	Redirected to L02-0040, see Note 1			
L02-0421	1	28.38	40	19.64	0.69	31.41	1.11
L02-0422	1	7.18	40	5.32	0.74	8.43	1.17
L02-0424	1	13.46	40	13.79	1.02	22.23	1.65
L02-0430	1	55.1	1	13.43	0.24	17.95	0.33
L02-0440	1	62.27	1	14.77	0.24	19.78	0.32
L02-0450	1	62.5	25.7	49.61	0.79	65.24	1.04
L02-0460	1	7.18	40	5.49	0.76	8.94	1.24
L02-0461	1	10.13	5	5.42	0.54	6.62	0.65
L02-0462	1	5.12	60	5.72	1.12	9.22	1.80
L02-0463	1	9.2	60	10.29	1.12	16.56	1.80
L02-0464	1	1.17	40	0.89	0.76	1.46	1.24
L02-0465	1	5.89	40	4.50	0.76	7.33	1.24
L02-0467	1	15.51	40	11.86	0.76	19.30	1.24
L02-0468	1	4.1	40	3.13	0.76	5.10	1.24
L02-0470	1	9.73	40	14.33	0.74	17.52	0.91
L02-0470	2	9.62	40	--	--	--	--
L02-0471	1	4.44	40	3.39	0.76	5.52	1.24
L02-0472	1	16.47	20	10.90	0.66	14.83	0.90
L02-0481	1	5.04	40	3.73	0.74	5.92	1.17
L02-0482	1	26.88	20	15.81	0.59	21.24	0.79
L02-0485	1	7.42	40	5.50	0.74	10.22	1.38
L02-0490	1	16.19	40	11.99	0.74	19.01	1.17

Table 4-9. Peak Runoff and Unit Runoff

Subshed/ Tributary Node	Subcatchment No.	Subshed Area, ac	Impervious Area %	10-Year Storm		100-Year Storm	
				Maximum Flow, cfs	Unit Runoff, cfs/ac	Maximum Flow, cfs	Unit Runoff, cfs/ac
L02-0502	1	14.3	40	10.59	0.74	16.79	1.17
L02-0507	1	10.3	40	7.63	0.74	12.10	1.17
L02-0510	1	14.19	40	10.51	0.74	16.66	1.17
L02-0513	1	19.19	40	14.21	0.74	22.54	1.17
L02-0514	1	13.57	40	10.05	0.74	15.94	1.17
L02-0516	1	25.25	40	17.85	0.71	28.46	1.13
L02-0522	1	103.3	1	10.45	0.10	17.99	0.17
L02-0530	1	249.8	1	23.31	0.09	40.30	0.16
L02-0538	1	31.51	40	21.32	0.68	33.91	1.08
L02-0540	1	19.18	40	14.14	0.74	22.22	1.16
L02-0541	1	10.4	40	7.67	0.74	12.05	1.16
L02-0542	1	4.46	40	3.29	0.74	5.17	1.16
L02-0543	1	11.13	40	8.21	0.74	12.89	1.16
L02-0544	1	17.66	20	10.46	0.59	14.16	0.80
L03-0020	1	23.5	1	2.97	0.13	5.09	0.22
L03-0040	1	68.8	1	7.40	0.11	12.58	0.18
L03-0050	1	157.4	1	15.51	0.10	26.70	0.17
L03-0080	1	45.1	1	7.49	0.17	11.25	0.25
L03-0094	1	196.9	1	42.79	0.22	56.02	0.28
L04-0070	1	173.8	1	25.10	0.14	37.49	0.22
L04-0100	1	186.4	1	26.73	0.14	39.94	0.21
L05-0010	1	20	66.4	30.96	1.55	52.45	2.62
L05-0050	1	122	1.4	12.56	0.10	21.39	0.18
L05-0080	1	145	1	14.41	0.10	24.79	0.17
L05-0110	1	169.2	1	16.55	0.10	28.51	0.17
L06-0140	1	4.68	40	3.45	0.74	5.42	1.16
L06-0142	1	12.97	40	9.56	0.74	15.03	1.16
L06-0143	1	5.15	40	3.80	0.74	5.97	1.16
L06-0144	1	6.65	40	4.90	0.74	7.70	1.16
L06-0145	1	6.45	40	4.76	0.74	7.47	1.16
L06-0147	1	4.22	65	5.20	1.23	8.30	1.97
L06-0150	1	14.63	40	10.79	0.74	16.95	1.16
L06-0151	1	17.29	40	12.75	0.74	20.03	1.16
L06-0152	1	6.86	40	5.06	0.74	7.95	1.16
L06-0200	1	21.18	40	15.50	0.73	24.61	1.16
L06-0220	1	73.75	1	7.94	0.11	13.43	0.18
L06-0222	1	4.94	65	3.82	0.77	5.81	1.18
L06-0230	1	47.3	1.1	5.35	0.11	9.09	0.19
L06-0240	1	77.1	1	8.19	0.11	13.95	0.18
L06-0240AA	1	16.4	60	18.45	1.13	28.75	1.75
L06-0290	1	50.8	1	5.67	0.11	9.64	0.19
L06-0310	1	68.6	1	7.38	0.11	12.54	0.18
L06-0350	1	7.88	65	11.02	1.40	15.51	1.97
L06-0360	1	28.15	40	23.30	0.83	30.80	1.09
L06-0430	1	42	1	4.81	0.11	8.20	0.20
L06-0432	1	48.28	40	30.01	0.62	48.28	1.00
L06-0435	1	12.28	40	9.10	0.74	14.42	1.17
L06-0436	1	11.11	40	8.23	0.74	13.05	1.17
L06-0438	1	32.7	40	22.07	0.67	35.45	1.08
L06-0460	1	102.1	1	12.80	0.13	20.51	0.20
L06-0480	1	245.8	1	28.04	0.11	45.34	0.18
L06-0520	1	251.7	1	28.64	0.11	46.31	0.18
L07-0041	1	4.24	40	3.13	0.74	4.91	1.16
L07-0042	1	1.55	5	0.34	0.22	0.59	0.38
L07-0060	1	101	3.4	11.40	0.11	18.74	0.19
L07-0061	1	10.92	40	8.05	0.74	12.65	1.16
L07-0062	1	14.83	5	3.22	0.22	7.63	0.51
L07-0080	1	54.1	1	7.27	0.13	11.66	0.22
L07-0100	1	266.6	1	24.65	0.09	42.65	0.16
L08-0010	1	159.7	1	15.72	0.10	27.06	0.17
L08-0060	1	160.2	1	15.76	0.10	27.14	0.17
L09-0040	1	127.5	3	13.86	0.11	22.99	0.18
L09-0070	1	139.7	1	13.94	0.10	23.97	0.17
L11-0030	1	110.3	1	11.28	0.10	19.33	0.18
L13-0020	1	114.2	1	14.16	0.12	22.72	0.20
L15-0050	1	102.4	2.7	11.26	0.11	18.73	0.18
MC0050	1	121.2	1	12.27	0.10	21.06	0.17
MC0100	1	95.4	1	9.90	0.10	16.93	0.18
MC0110	1	472.5	1	58.56	0.12	87.89	0.19
MC0160	1	58.7	1	9.45	0.16	14.15	0.24
MC0170	1	198	1	23.20	0.12	37.44	0.19
MC0172	1	119.4	1	17.89	0.15	26.63	0.22
MC0190	1	71.8	1	9.33	0.13	14.94	0.21
MC0210	1	88.4	1	9.24	0.10	15.79	0.18
MC0230	1	24.7	1	3.38	0.14	16.32	0.66
MC0270	1	153.2	1	22.42	0.15	33.44	0.22
MC0290	1	150	1	33.43	0.22	44.01	0.29
MC0310	1	54.4	1	8.83	0.16	13.23	0.24
MC0340	1	79.2	1.8	10.51	0.13	16.62	0.21
MC0370	1	47.6	1	9.32	0.20	13.25	0.28

Table 4-9. Peak Runoff and Unit Runoff

Subshed/ Tributary Node	Subcatchment No.	Subshed Area, ac	Impervious Area %	10-Year Storm		100-Year Storm	
				Maximum Flow, cfs	Unit Runoff, cfs/ac	Maximum Flow, cfs	Unit Runoff, cfs/ac
MC0400	1	85.74	1	9.10	0.11	13.41	0.16
MC0420	1	77	3.6	9.08	0.12	14.89	0.19
MC0430	1	5.7	40	34.81	0.56	46.03	0.75
MC0430	2	56	20	--	--	--	--
MC0431	1	16.09	40	11.86	0.74	18.64	1.16
MC0450	1	17.62	40	12.99	0.74	20.41	1.16
MC0451	1	16.12	20	9.55	0.59	12.92	0.80
MC0460	1	35.42	5	7.35	0.21	12.74	0.36
MC0461	1	7.27	20	4.31	0.59	5.83	0.80
MC0463	1	13.02	40	9.60	0.74	15.08	1.16
MC0464	1	6.35	40	5.36	0.32	7.76	0.47
MC0464	2	10.2	1	--	--	--	--
MC0510	1	95.3	1	9.89	0.10	16.92	0.18
MC0550	1	142.8	1	14.22	0.10	24.45	0.17
MC0630	1	115.7	1	11.77	0.10	20.19	0.17
MC0650	1	129.7	1	13.04	0.10	22.40	0.17
MC0670	1	244.3	1	22.86	0.09	39.52	0.16
WIC0005	1	291.2	2.4	39.74	0.14	69.68	0.24
WIC0020	1	101.1	1	11.59	0.11	19.09	0.19
WIC0030	1	162.2	1	105.07	0.65	164.87	1.02
WIC0032	1	124	1	16.87	0.14	26.03	0.21
WIC0034	1	154.1	1	41.88	0.27	52.48	0.34
WIC0040	1	296	1	75.32	0.25	92.85	0.31

Note 1:
Runoff that is redirected to another Node is combined with all runoff tributary to that node, resulting in artificially high unit runoff rates at the receiving node.

Figure 4-5. 100-Year Hydrographs for Main Canal Upstream and Downstream from Live Oak

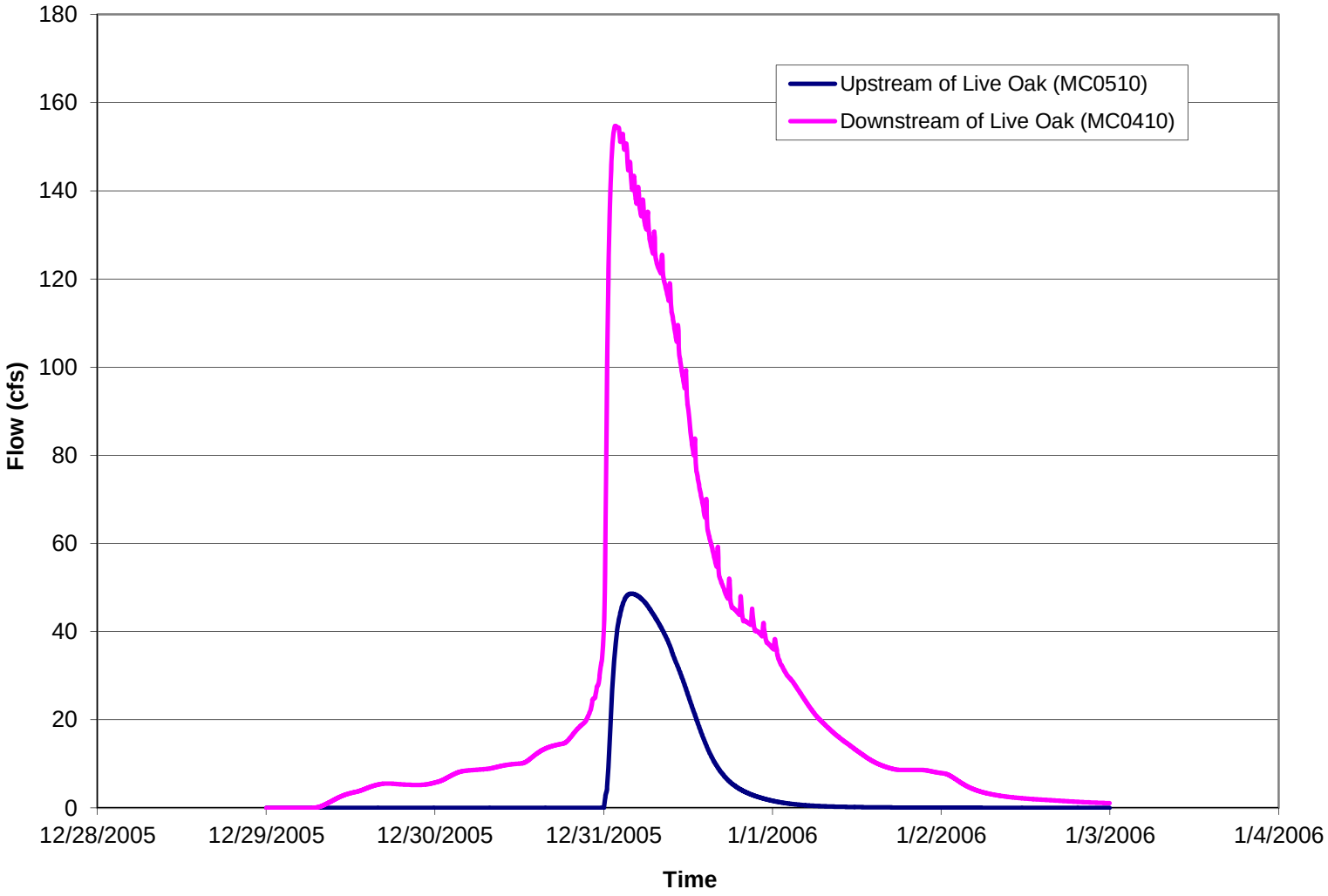


Figure 4-6. 100-Year Hydrographs for Downstream End of Main Canal and the East Intercepting Canal Downstream from RD 777 and the West Intercepting Canal

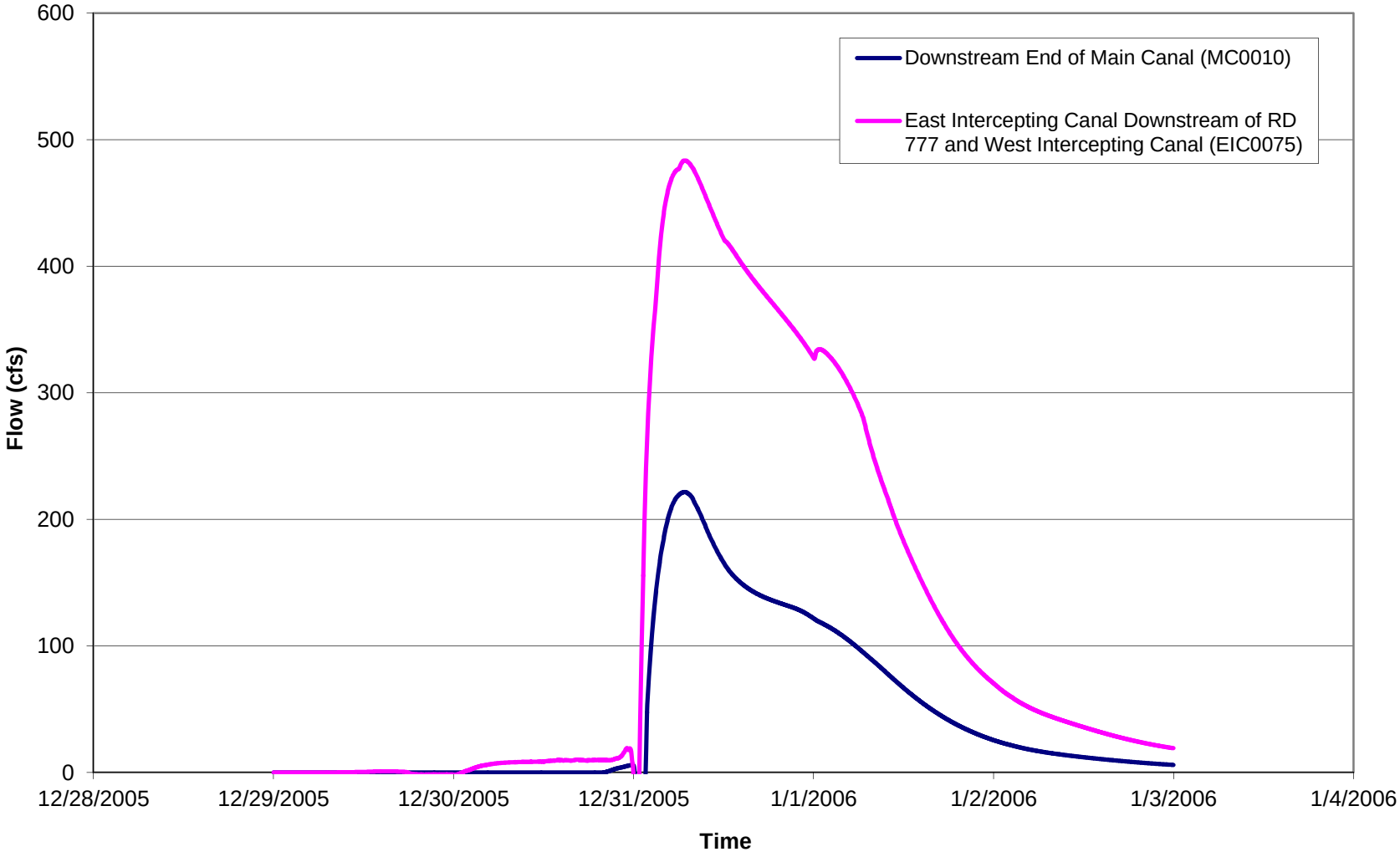


Figure 4-7A. Sutter County Runoff Calibration Curves for a 10-year Design Storm with Model Subshed Data

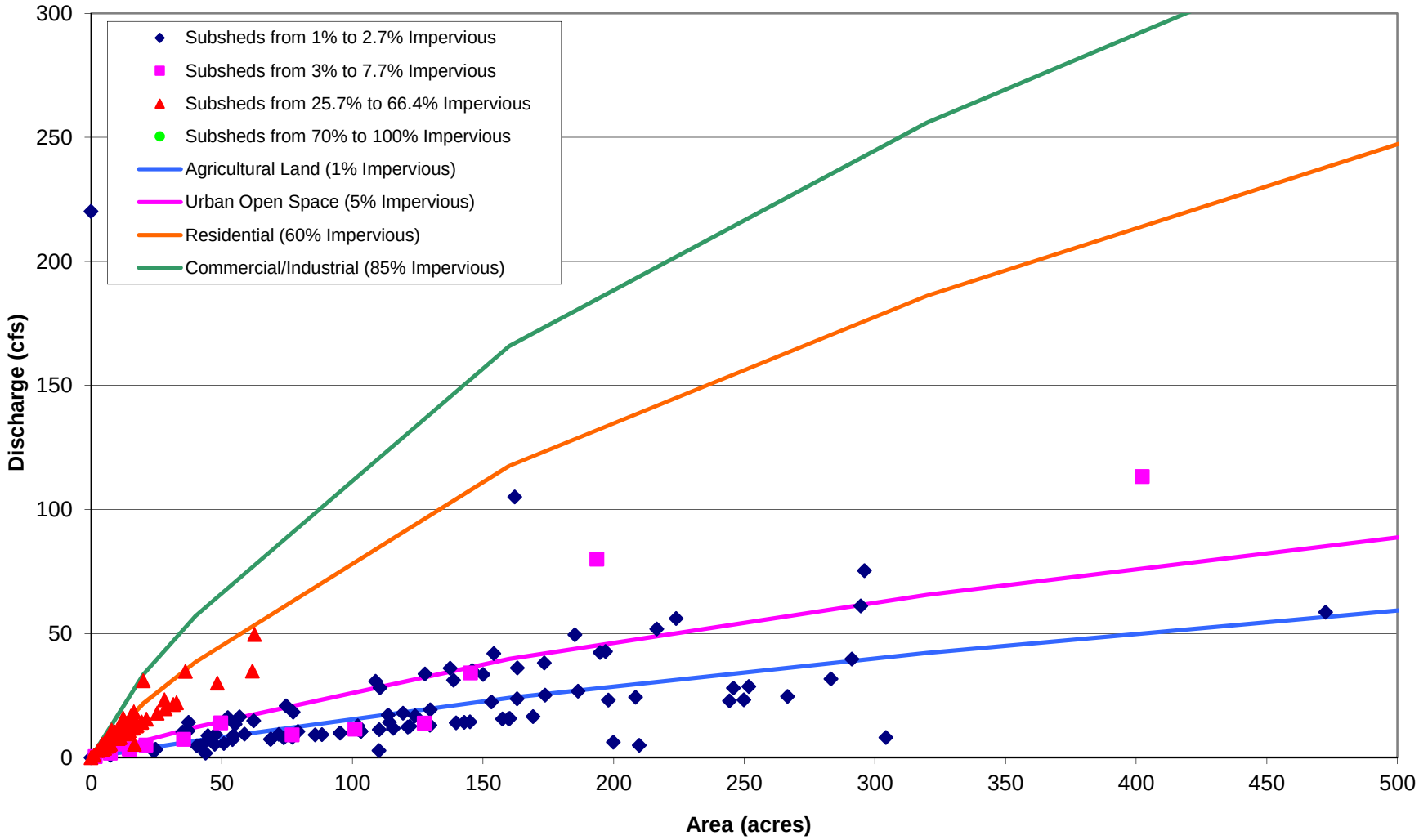


Figure 4-7B. Sutter County Runoff Calibration Curves for a 10-year Design Storm with Model Subshed Data

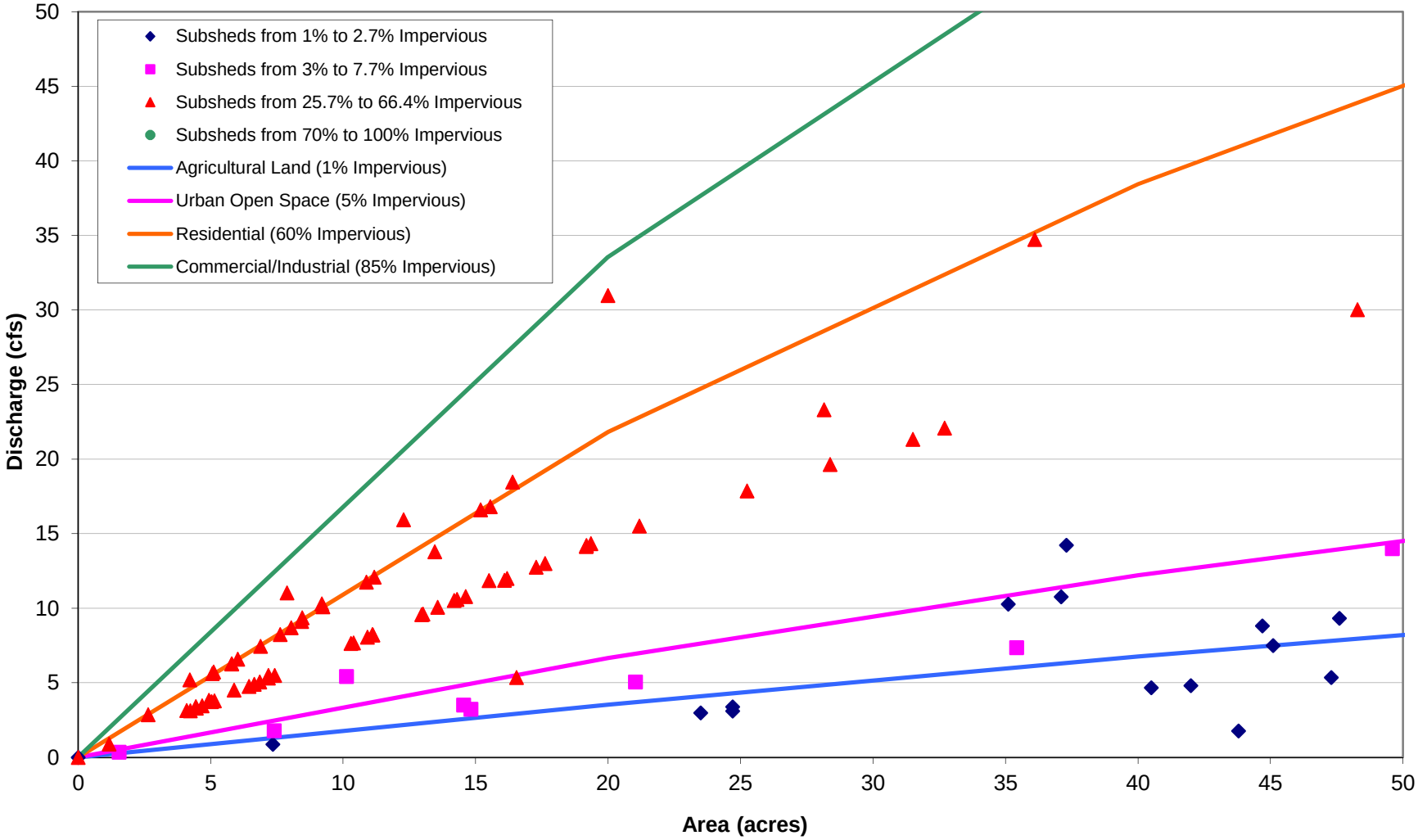


Figure 4-8A. Sutter County Runoff Calibration Curves for a 100-year Design Storm with Model Subshed Data

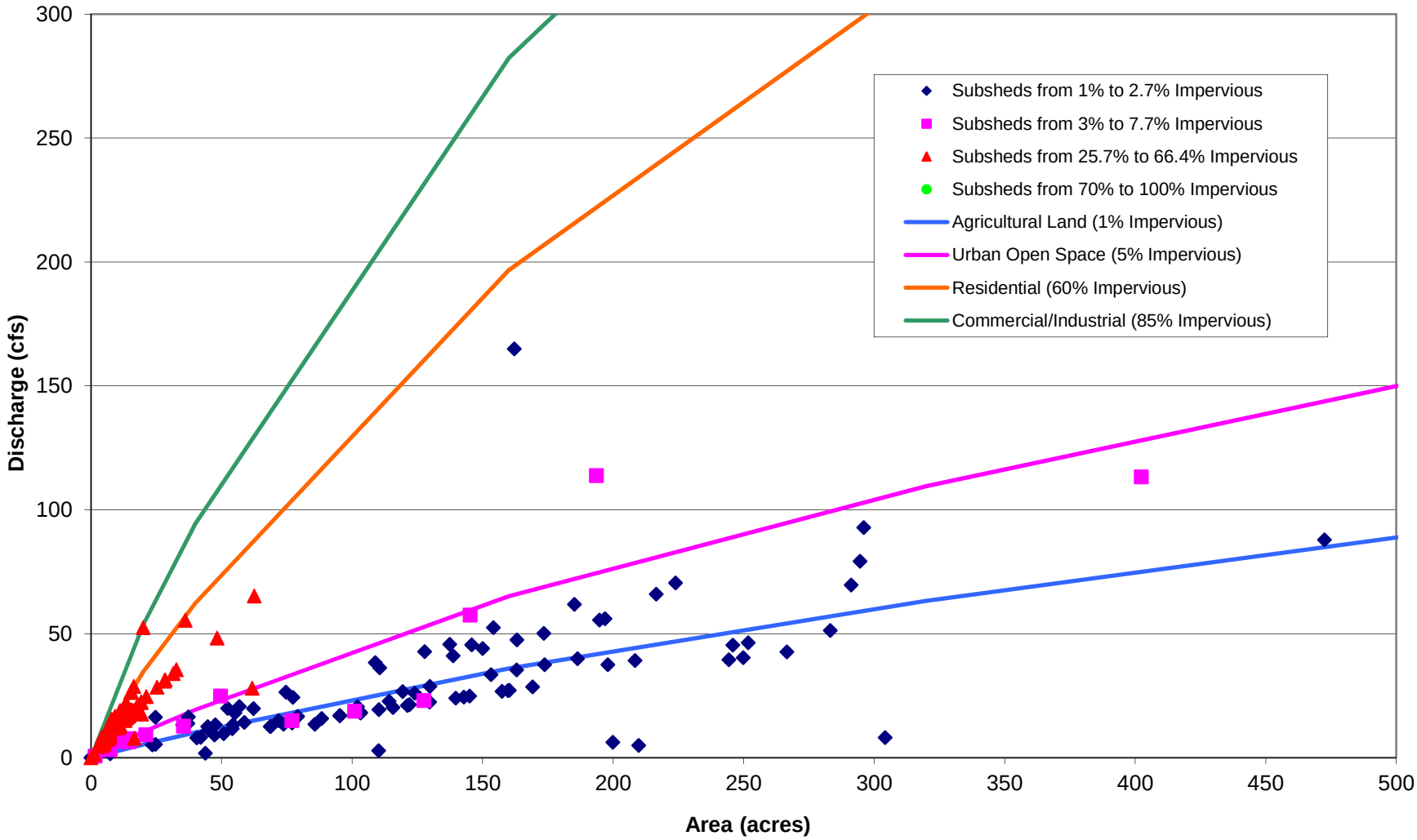
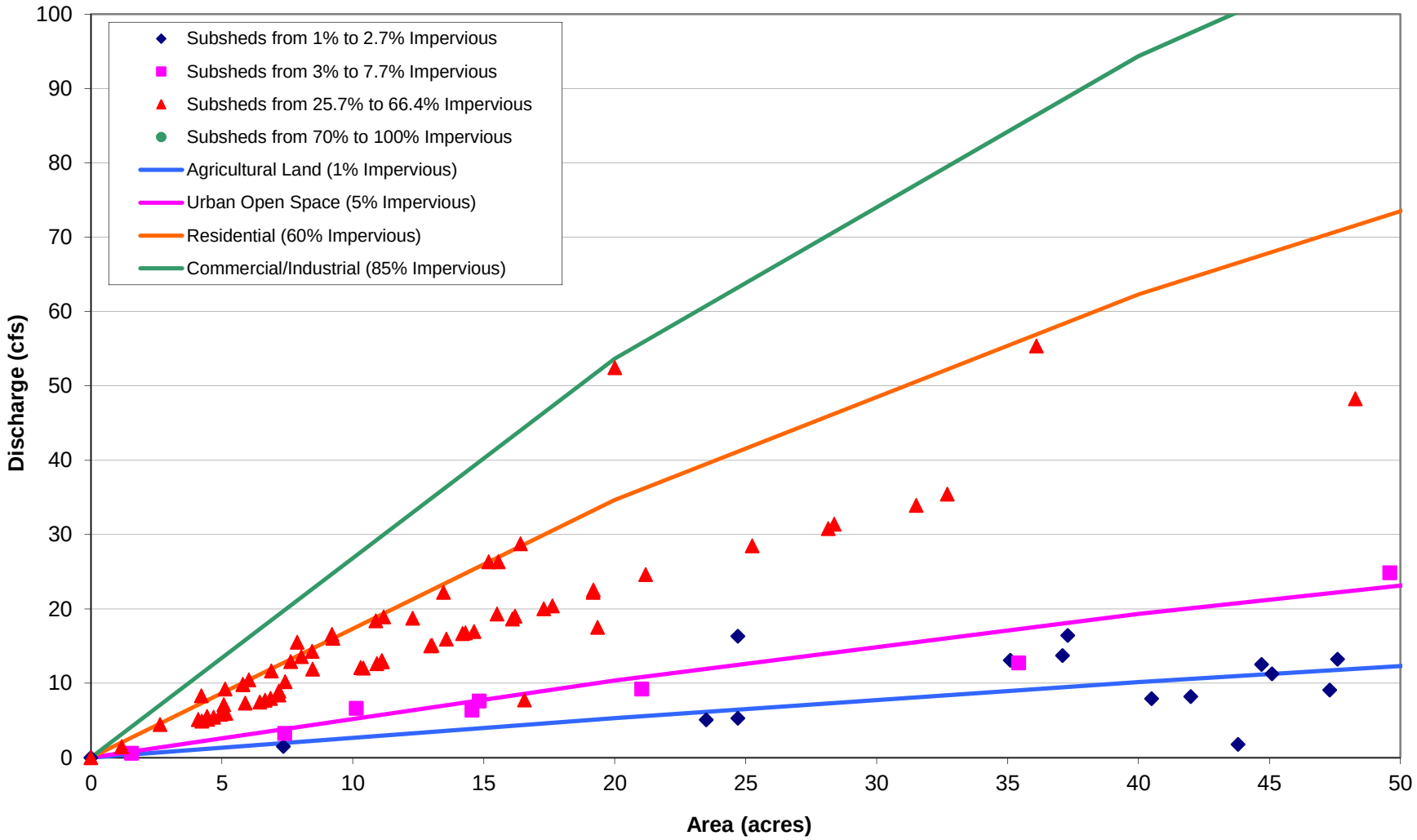


Figure 4-8B. Sutter County Runoff Calibration Curves for a 100-year Design Storm with Model Subshed Data



Channel Profiles for the 100-Year Storm

Based on model results shown in Table 4-6, profiles for the 100-year storm are provided in Appendix 4B for the following channel segments:

- Profile 4B-1 – Main Canal from Metteer Road to Clark Road.
- Profile 4B-2 – Main Canal from Clark Road to the confluence with the East Intercepting Canal.
- Profile 4B-3 – Lateral No. 6A from just south of Brubaker Road to its confluence with Lateral 6 (adjacent to the railroad and just north of Apricot Street).
- Profile 4B-4 – Lateral No. 6 from Riviera Road to its confluence with the Main Canal.
- Profile 4B-5 – Lateral No. 1 from Luther Road to the confluence with Lateral 2-A (just south of the Sutter Butte Canal).
- Profile 4B-6 – Lateral No. 2 from Epperson Way to its confluence with Lateral No. 1.
- Profile 4B-7 – Lateral No. 2-A-1, Lateral 2-A, and Western Intercepting Canal from north of Paseo Road to it confluence with the East Intercepting Canal.

As shown, the 100-year storm model results indicate flooding occurs throughout much of the District for this large storm. The flooding is so extensive that it would have overflowed the channels and spread/flowed from one lateral system to another. However, without one-foot contour mapping to define the ground surface, the extent of flooding and depths cannot be accurately simulated with the XP-SWMM Model. Several culverts are filled with sediment (see Table 4-7). Use of this high n-value results in large increases in the hydraulic grade line across the culverts.

LIMITATIONS OF MODELING RESULTS FOR SNAKE RIVER, MORRISON SLOUGH, AND SAND CREEK

The inclusion of neighboring watersheds was necessary in order to accurately characterize flow in the RD 777 system. Bordering watersheds include Snake River, Morrison Slough, and Sand Creek. The modeling of the Snake River/Morrison Slough and the Sand Creek watersheds was performed using single model watersheds tributary to nodes along the East Intercepting Canal. The hydrologic data was calibrated to reproduce the 100-year flow rates from the *Sutter County Master Drainage Plan* prepared by Psomas, dated March 2002, and adopted by Sutter County on June 11, 2002 (Appendix B). In particular:

- The runoff from the Snake River/Morrison Slough watershed of 32,000 acres was calibrated to produce a 100-year storm peak flow of 2,639 cfs and a 10-year storm peak flow of 998 cfs.
- The runoff from the Sand Creek watershed of 5,087 acres was calibrated to produce a 100-year storm peak flow of 564 cfs and a 10-year storm peak flow of 220 cfs.

These peak flow rates were obtained from the Sutter County Master Drainage Plan and have not been evaluated or verified by West Yost.

MODEL FILES

The existing conditions model files are provided on the CD provided at the back of this report. Development of computer models requires hundreds of field observations, many days of field surveying and survey data reduction, and data entry of thousands of values. Although these models have received a quality control check, West Yost does not guarantee that these model files are free of errors. These model files were developed specifically for the planning purposes of this MDS, and use of the files for other purposes is not recommended.

APPENDIX 4A

10-Year Storm Channel Profiles for Existing Conditions

Description of Profiles

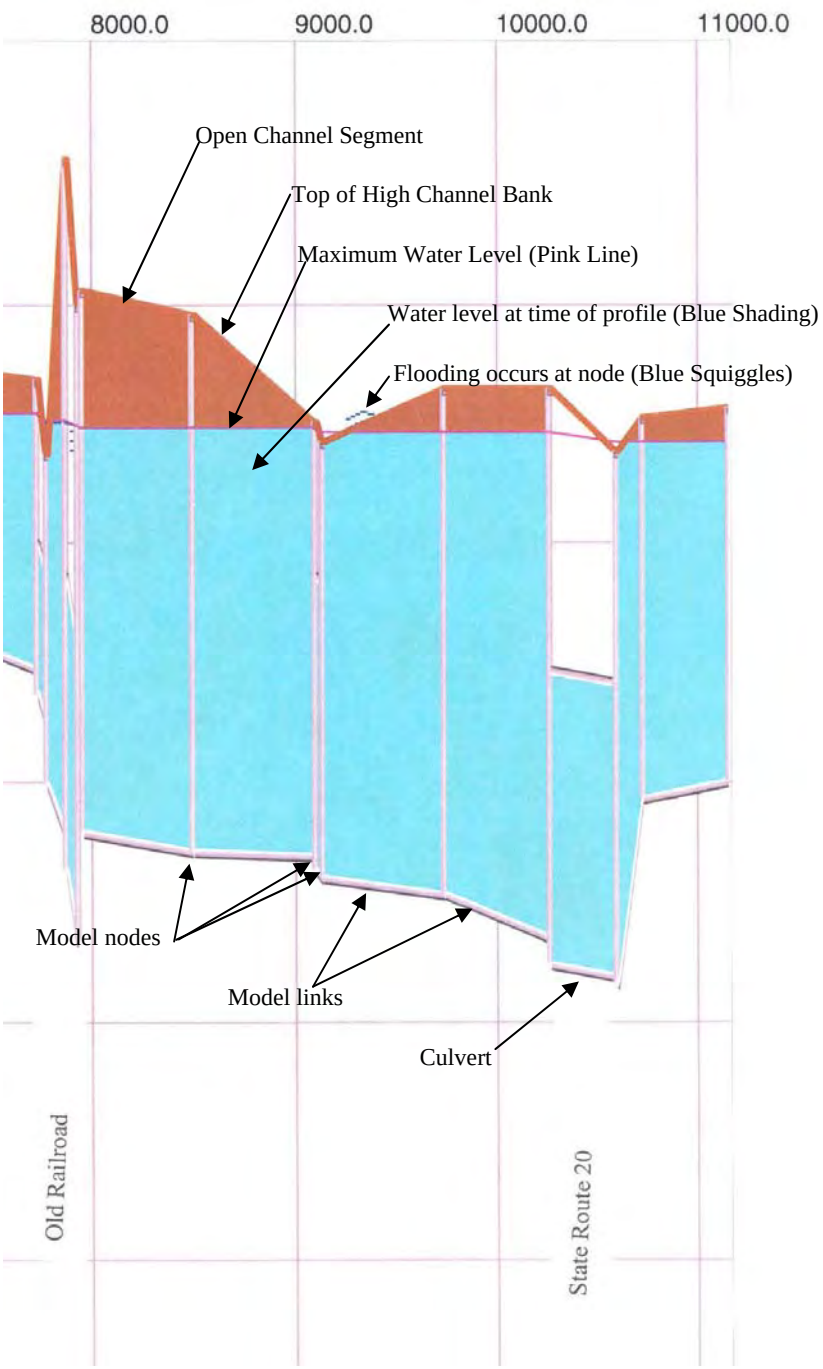


Figure 4A-1. Main Canal from Metteer Road to Clark Road (L11-0030 -- MC0250)

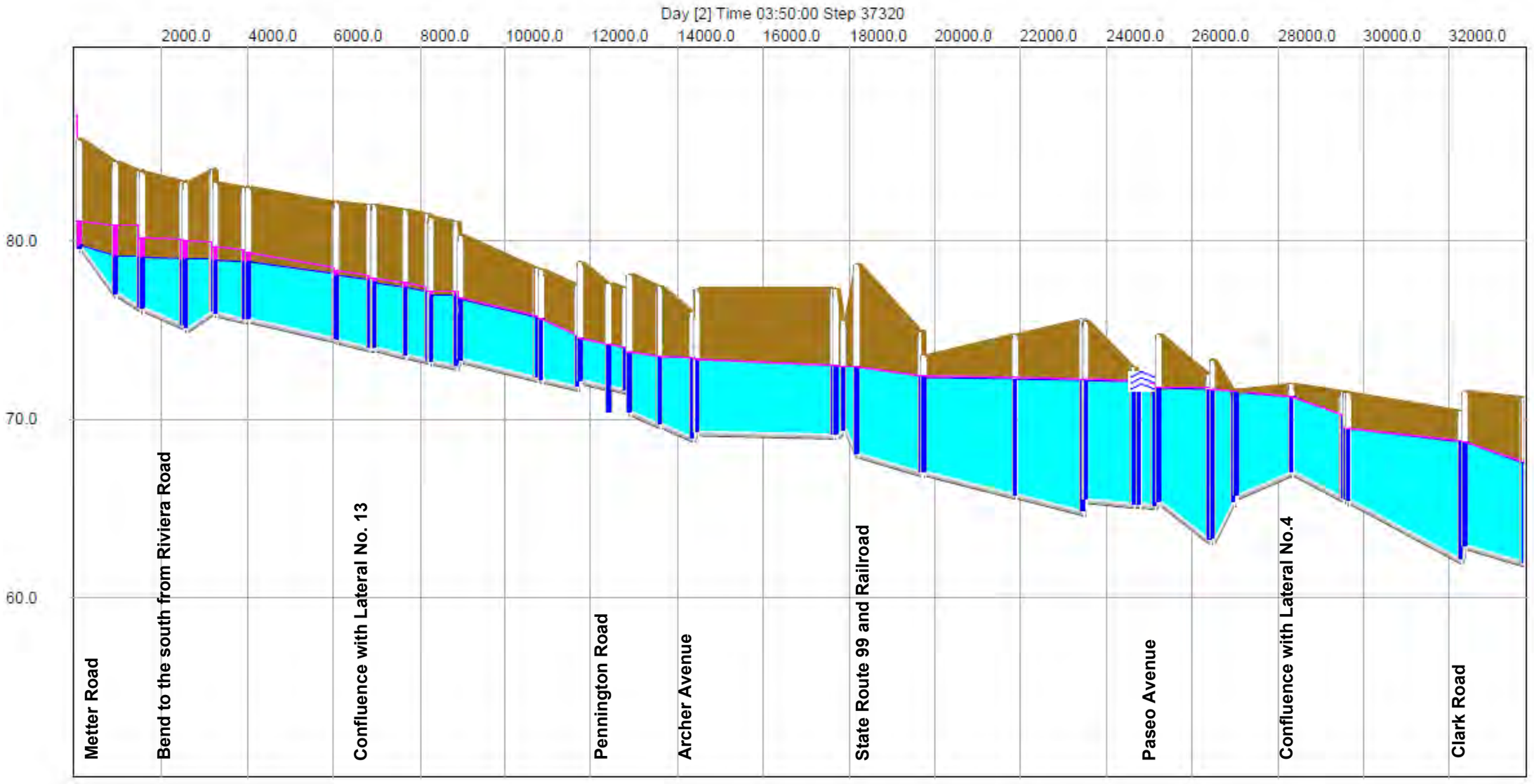


Figure 4A-2. Main Canal from Clark Road to the confluence with East Intercepting Canal (MC0270 -- EIC130)

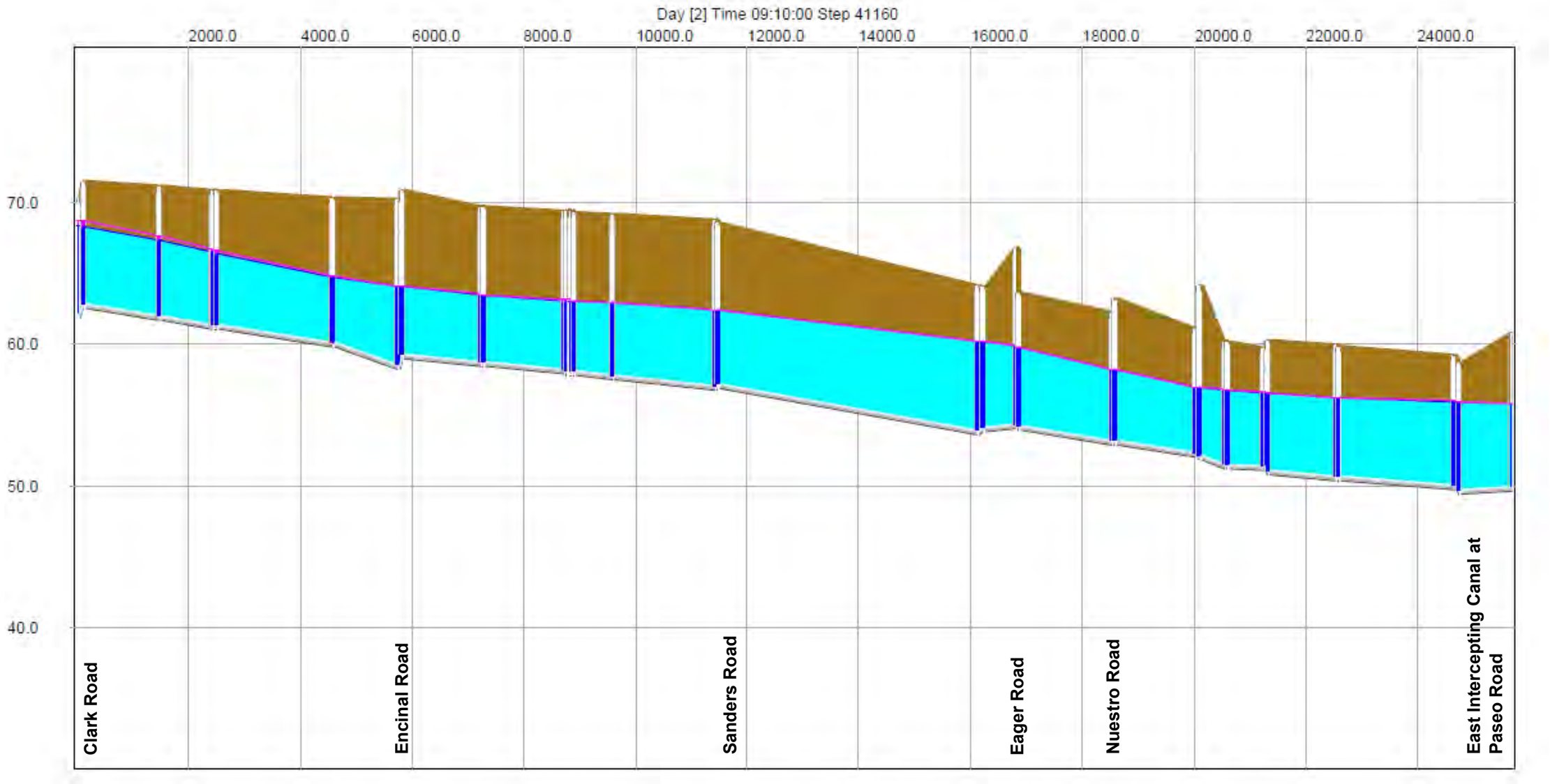


Figure 4A-3. Lateral No. 6A from just south of Brubaker Road to its confluence with Lateral No.6 (L06-0310 -- MC0410)

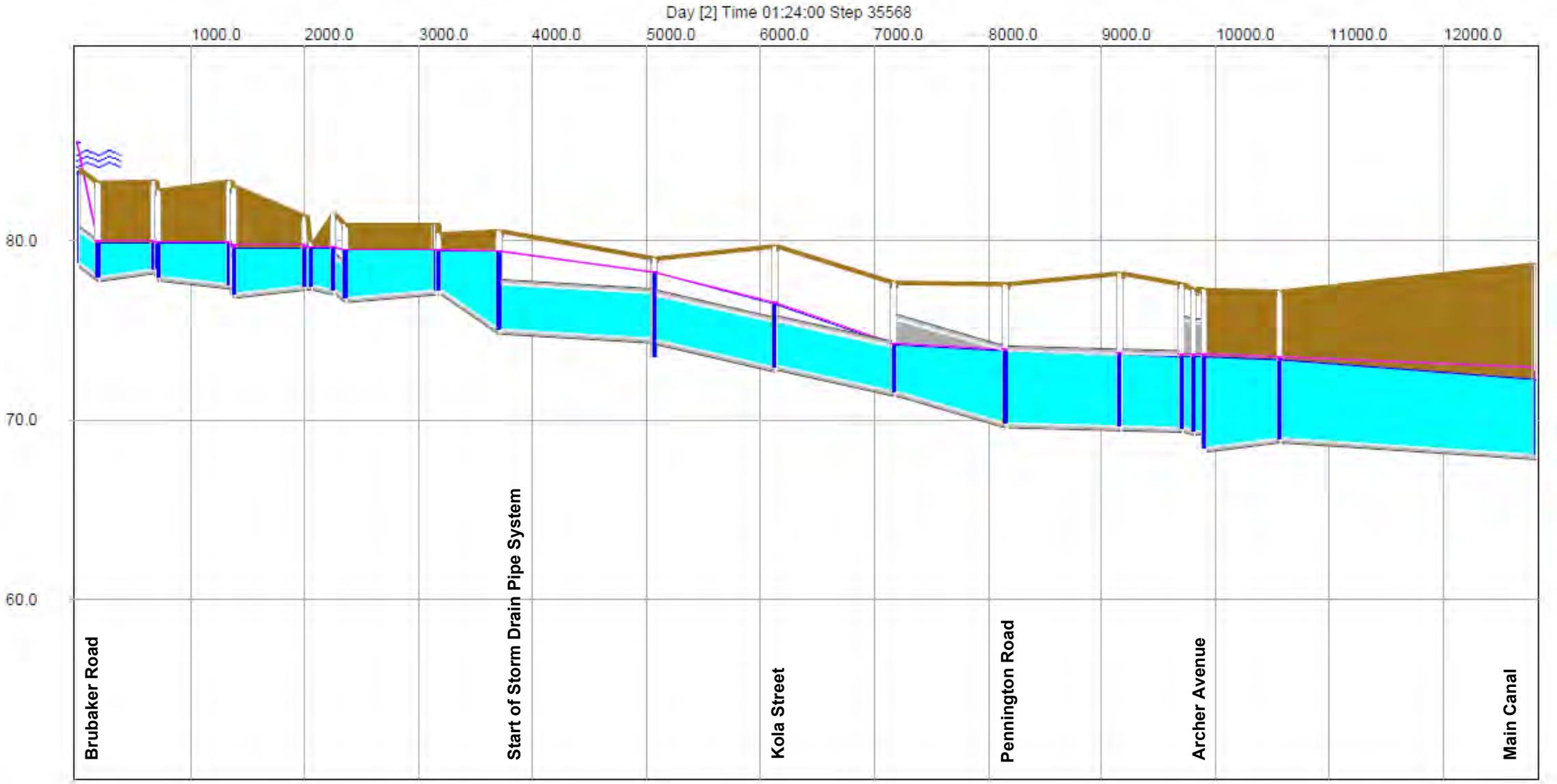


Figure 4A-4. Lateral No. 6A from Riviera Road to its confluence with the Main Canal (L06-0520 -- MC0400)

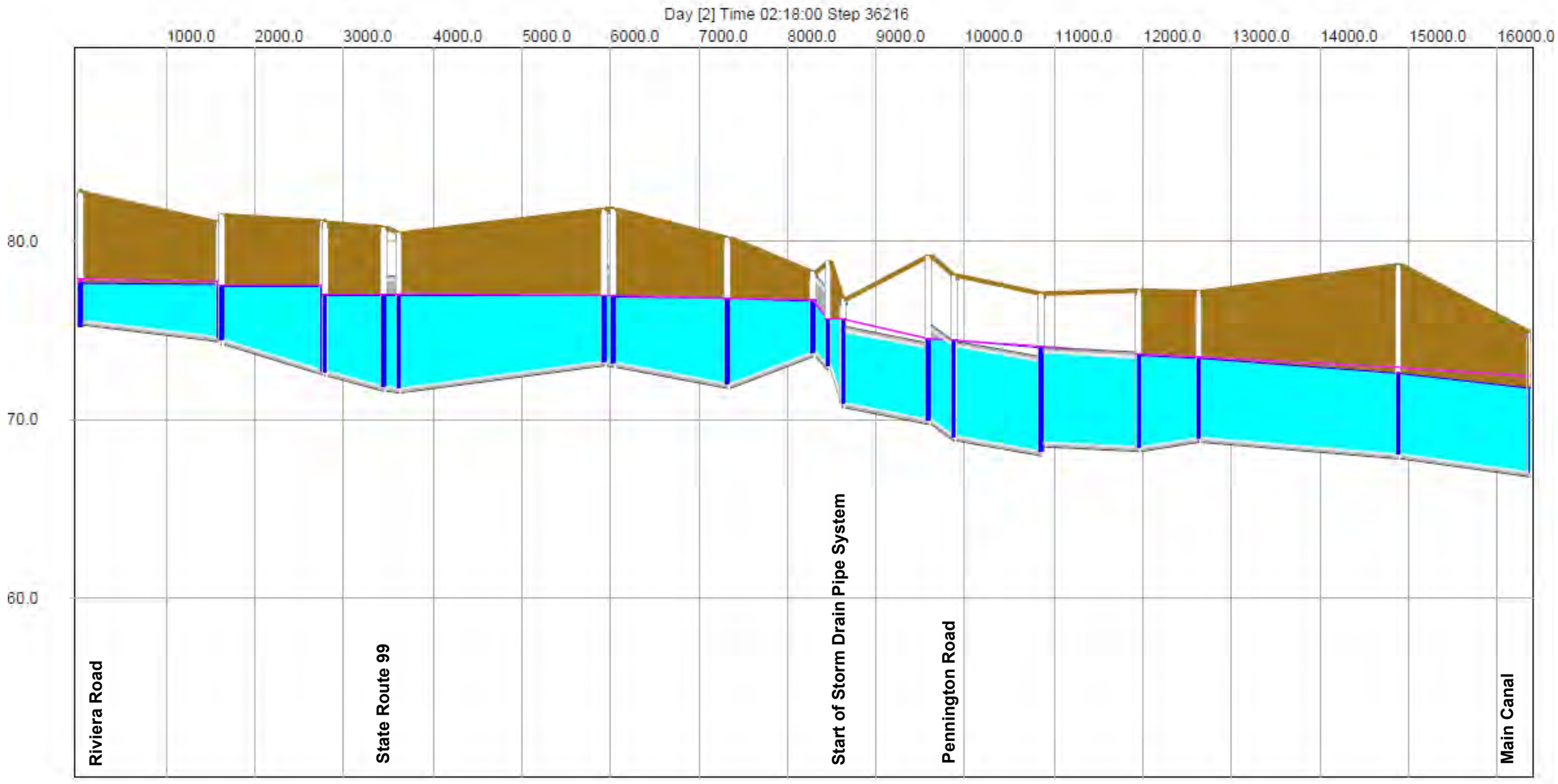


Figure 4A-5. Lateral No. 1 from Luther Road to the confluence with Lateral 2-A (L02-0530 -- L02-0050)

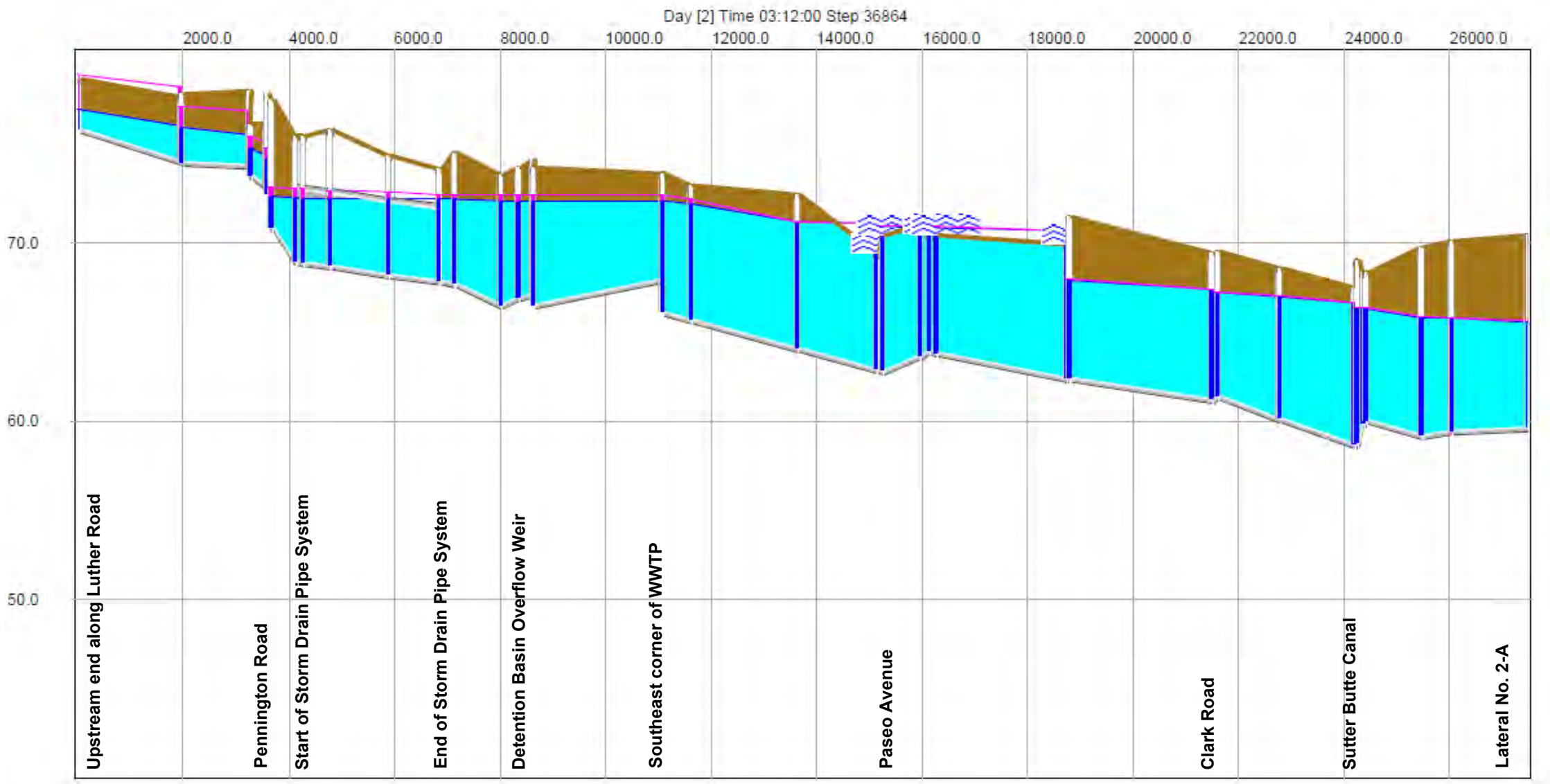


Figure 4A-6. Lateral No. 2 from Epperson Way to its confluence with Lateral No. 1 (L02-0544 -- L02-0252)

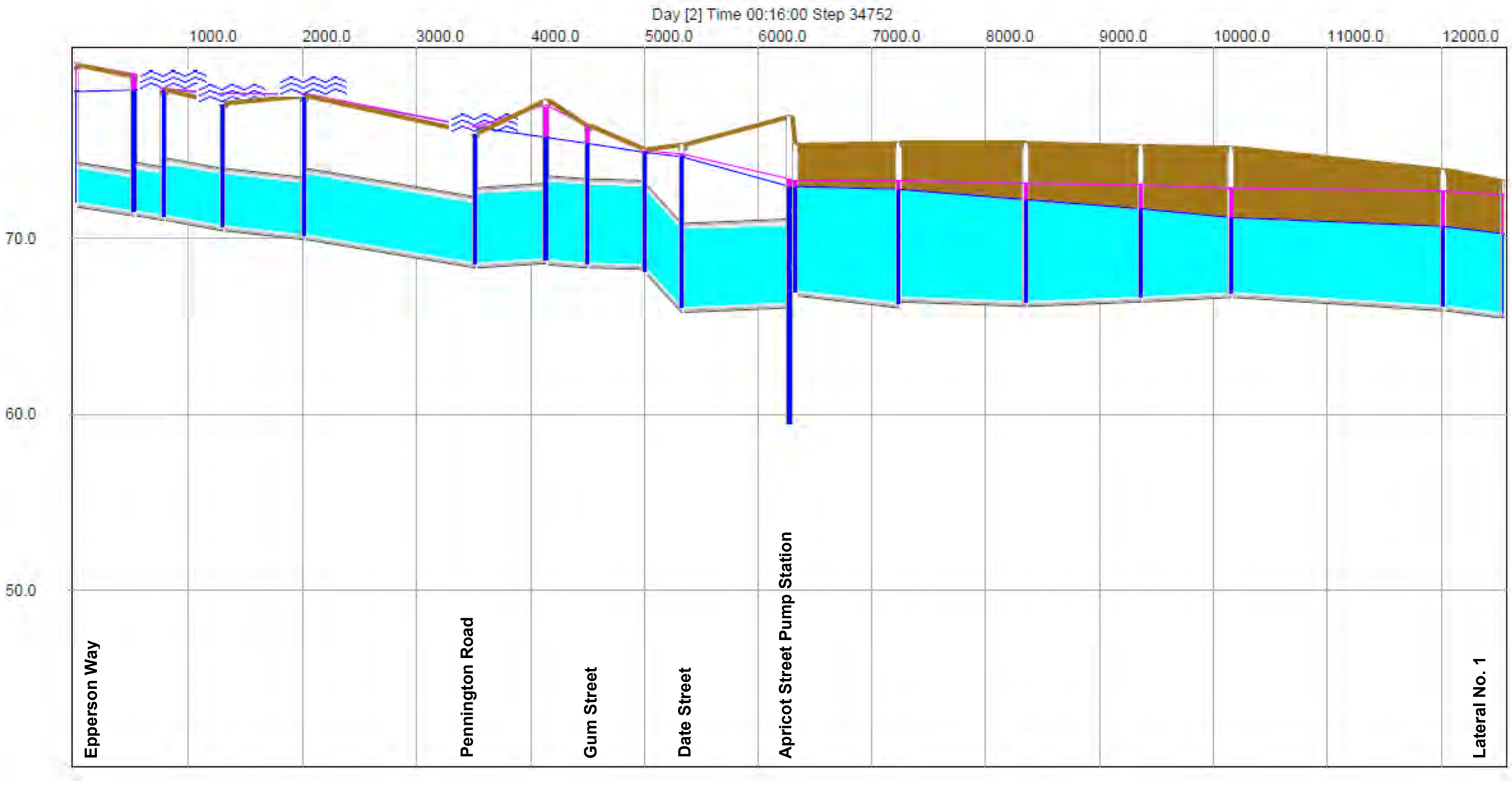
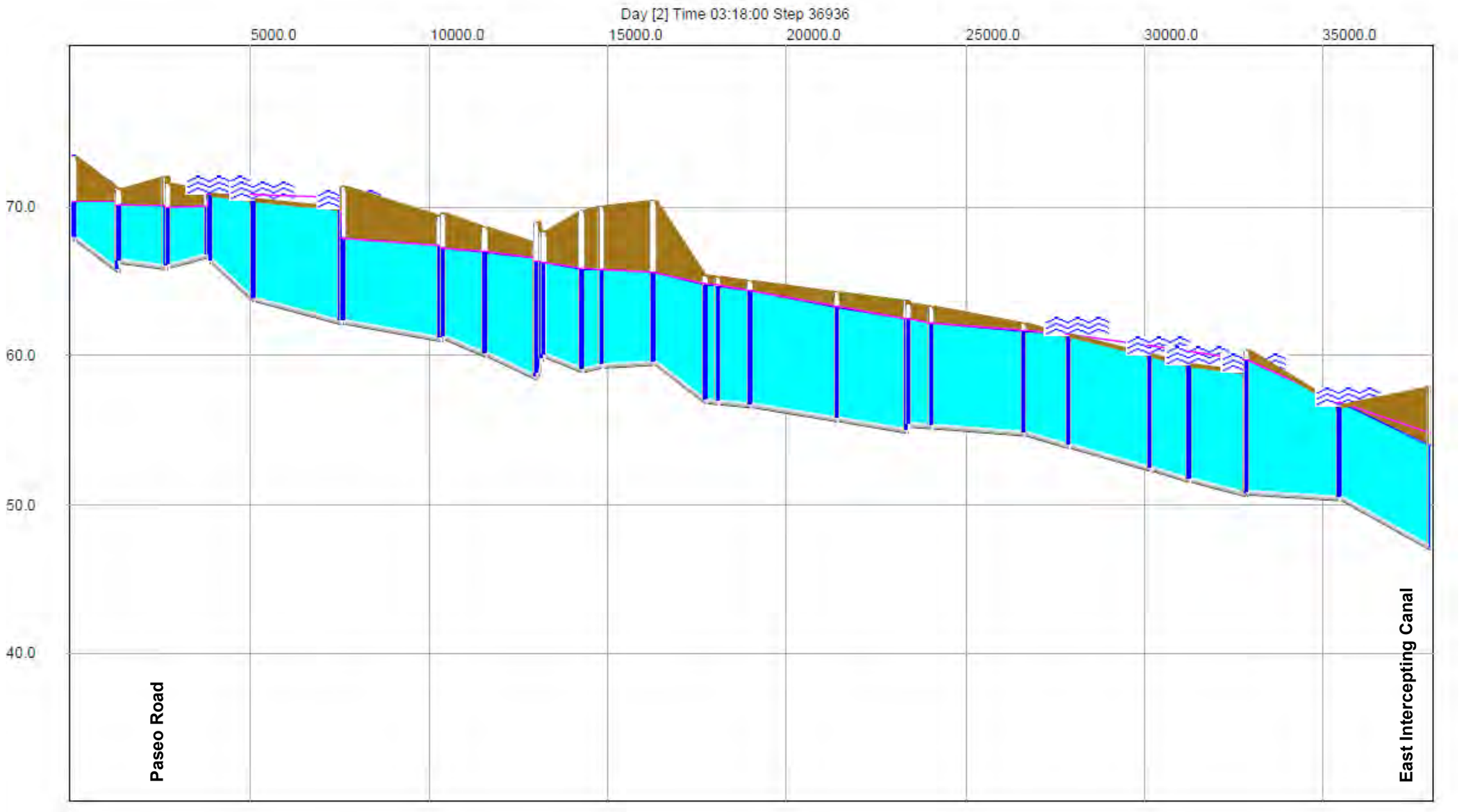


Figure 4A-7. Lateral No. 2-A-1, Lateral 2-A, and Western Intercepting Canal from north of Paseo Road to it confluence with the East Intercepting Canal (L02-0180 -- EIC0075)



APPENDIX 4B

100-Year Storm Channel Profiles for Existing Conditions

Description of Profiles

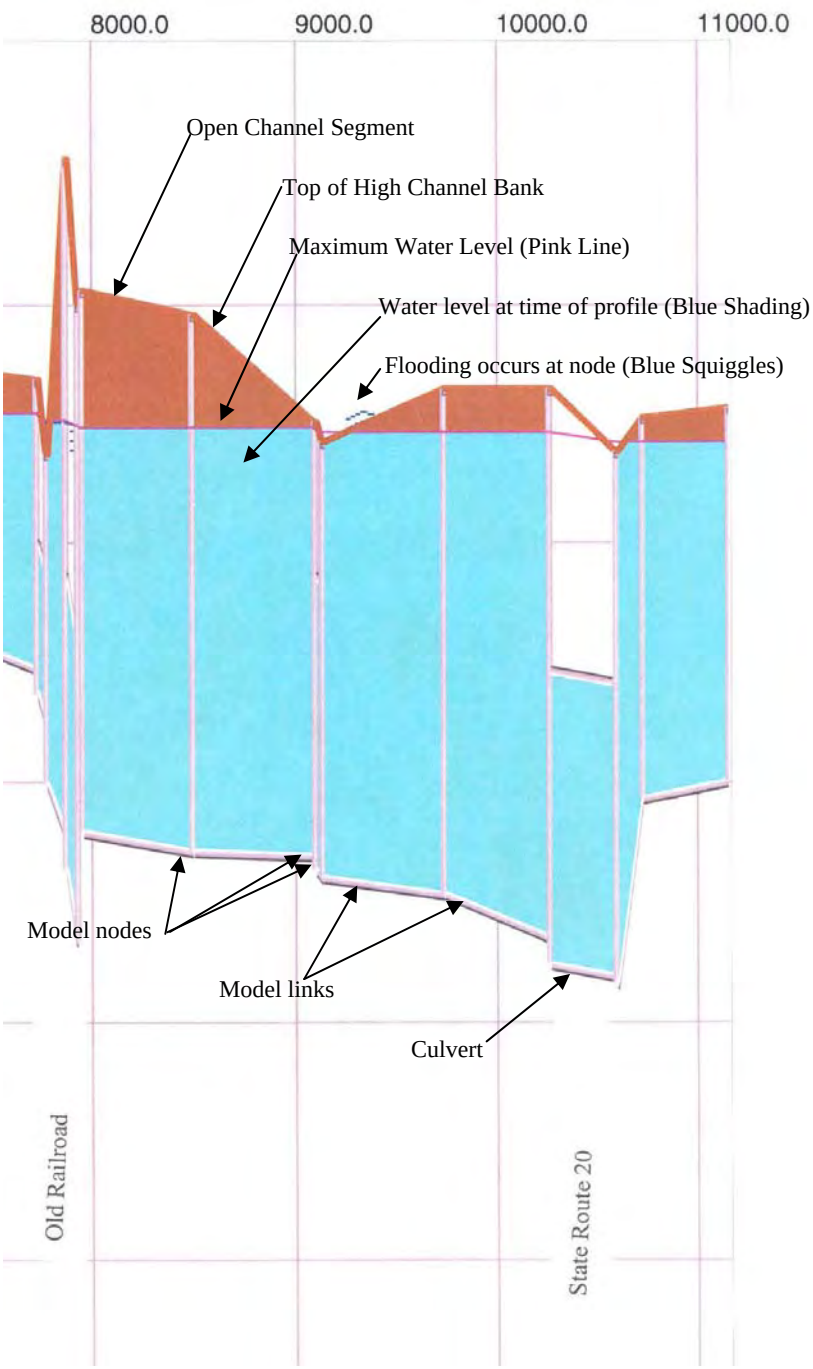


Figure 4B-1. Main Canal from Metteer Road to Clark Road (L11-0030 -- MC0250)

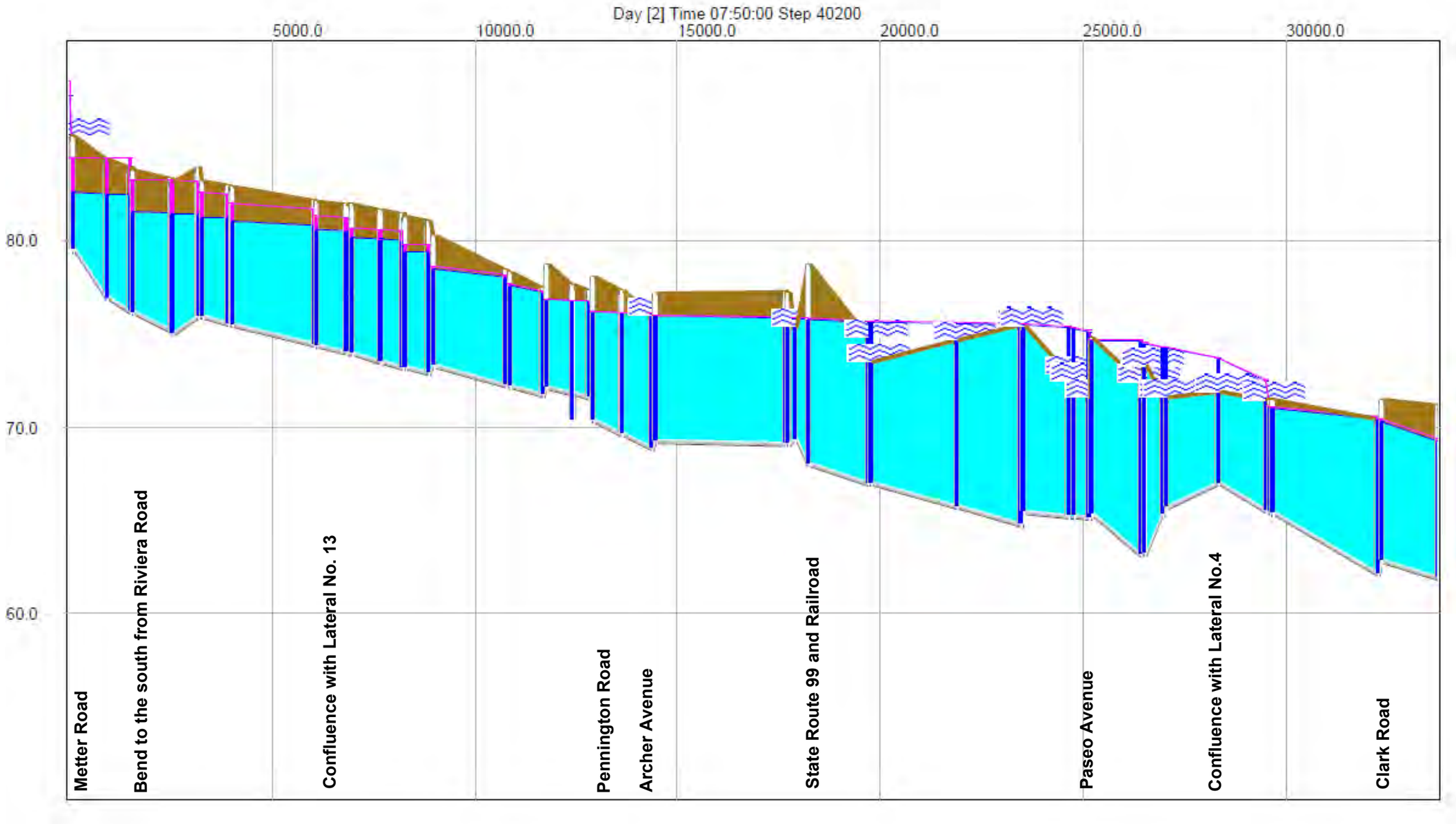


Figure 4B-2. Main Canal from Clark Road to the confluence with East Intercepting Canal (MC0270 -- EIC130)

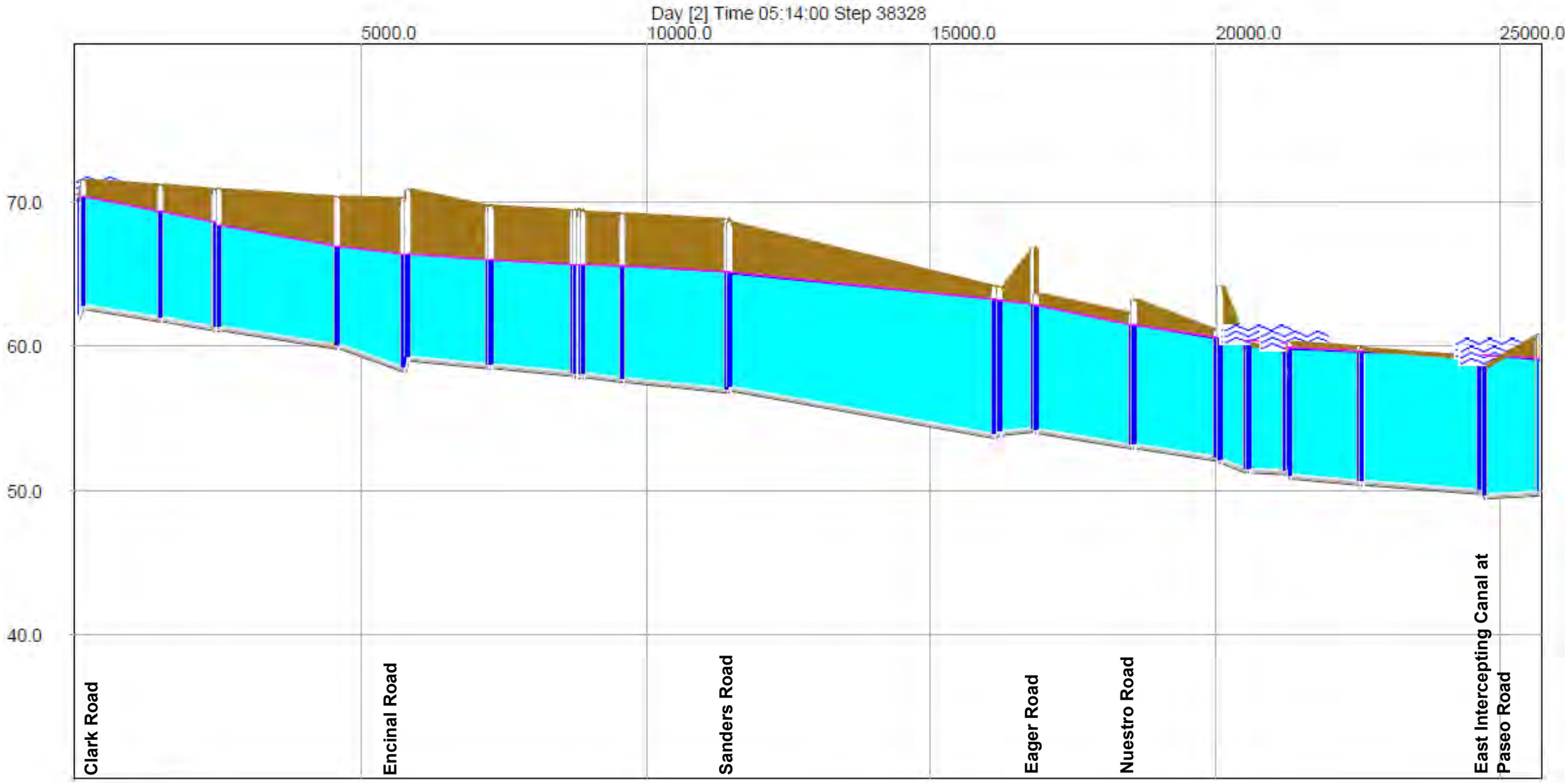


Figure 4B-3. Lateral No. 6A from just south of Brubaker Road to its confluence with Lateral No.6 (L06-0310 -- MC0410)

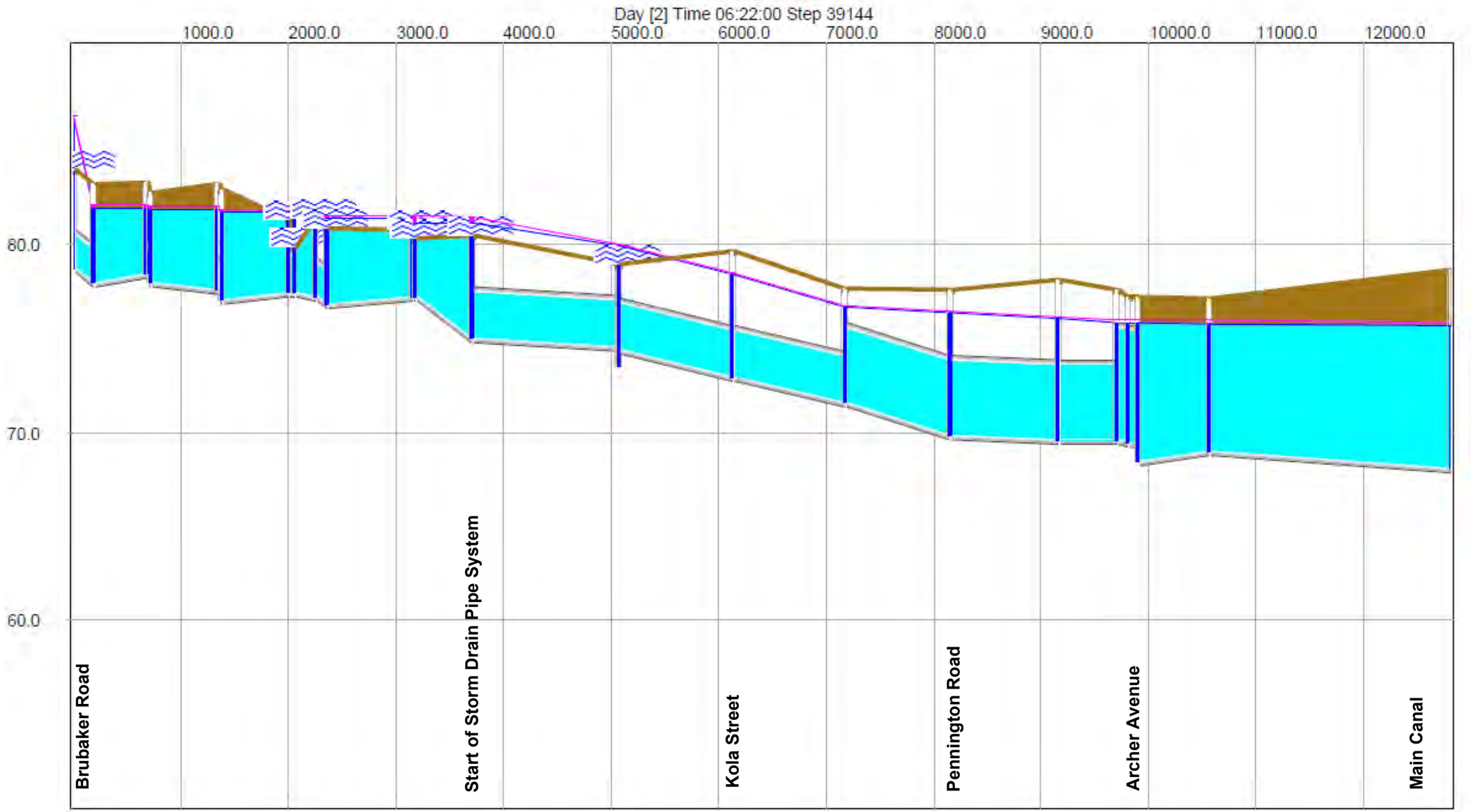


Figure 4B-4. Lateral No. 6A from Riviera Road to its confluence with the Main Canal (L06-0520 -- MC0400)

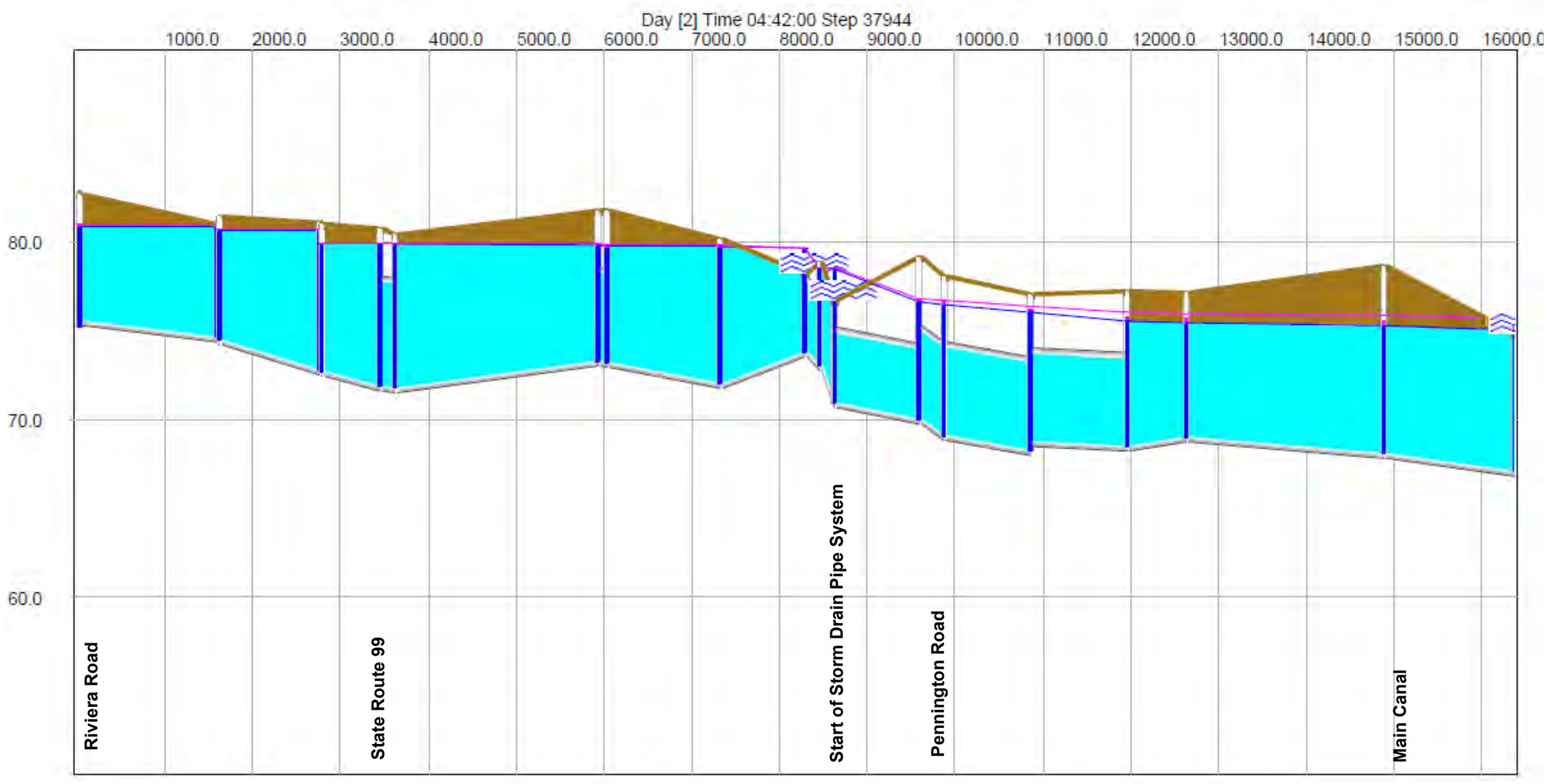


Figure 4B-5. Lateral No. 1 from Luther Road to the confluence with Lateral 2-A (L02-0530 -- L02-0050)

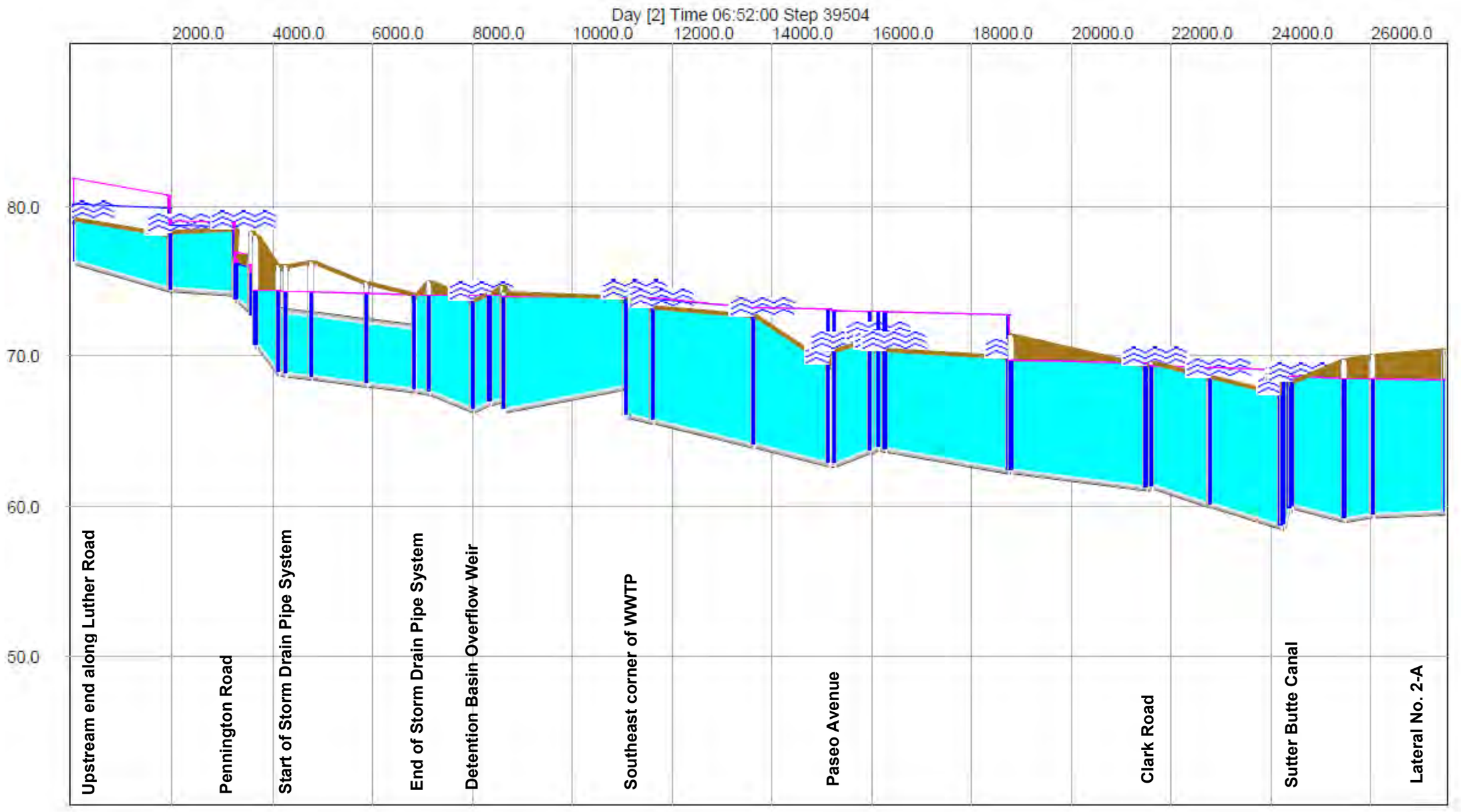


Figure 4B-6. Lateral No. 2 from Epperson Way to its confluence with Lateral No. 1 (L02-0544 -- L02-0252)

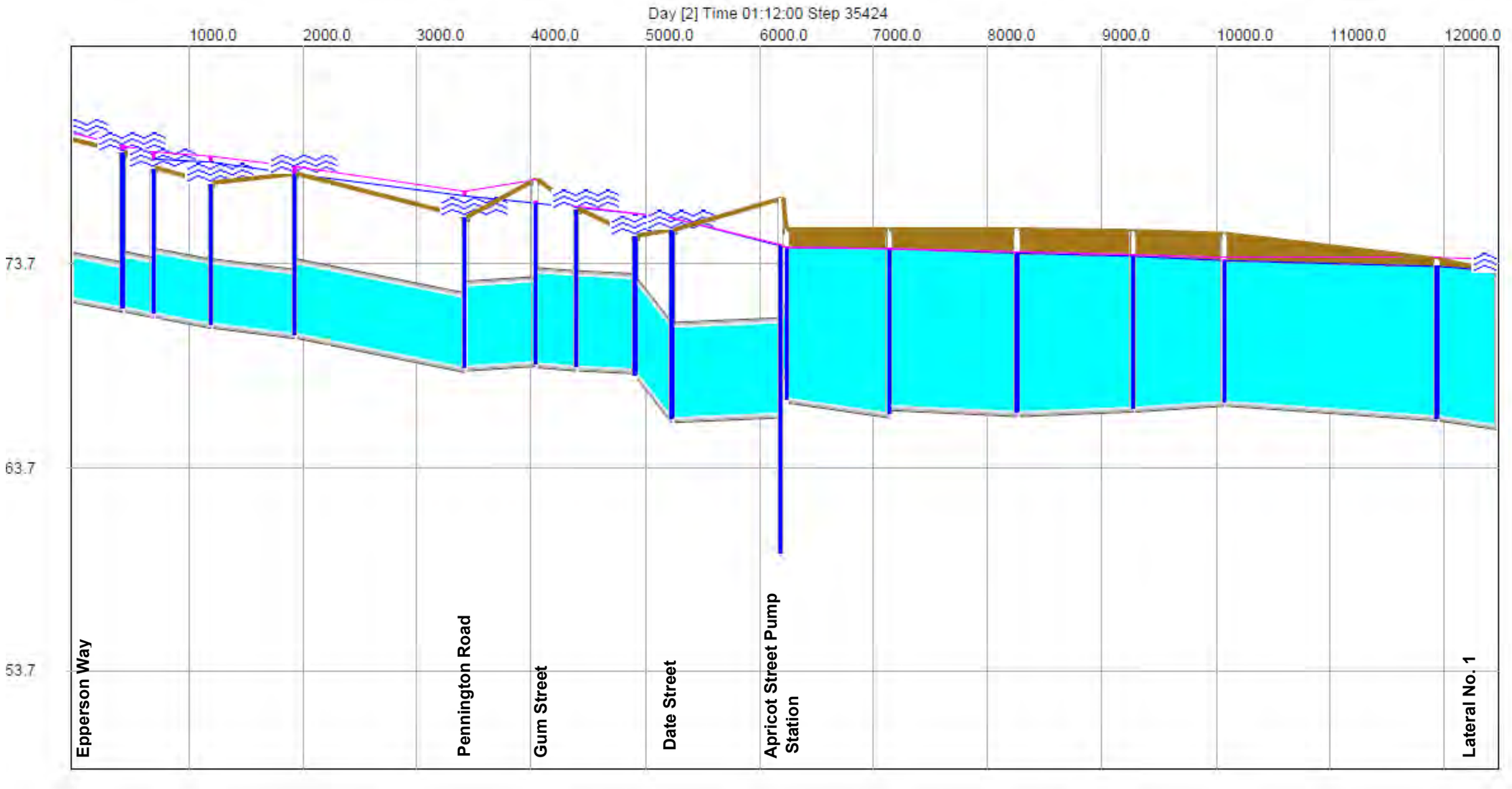
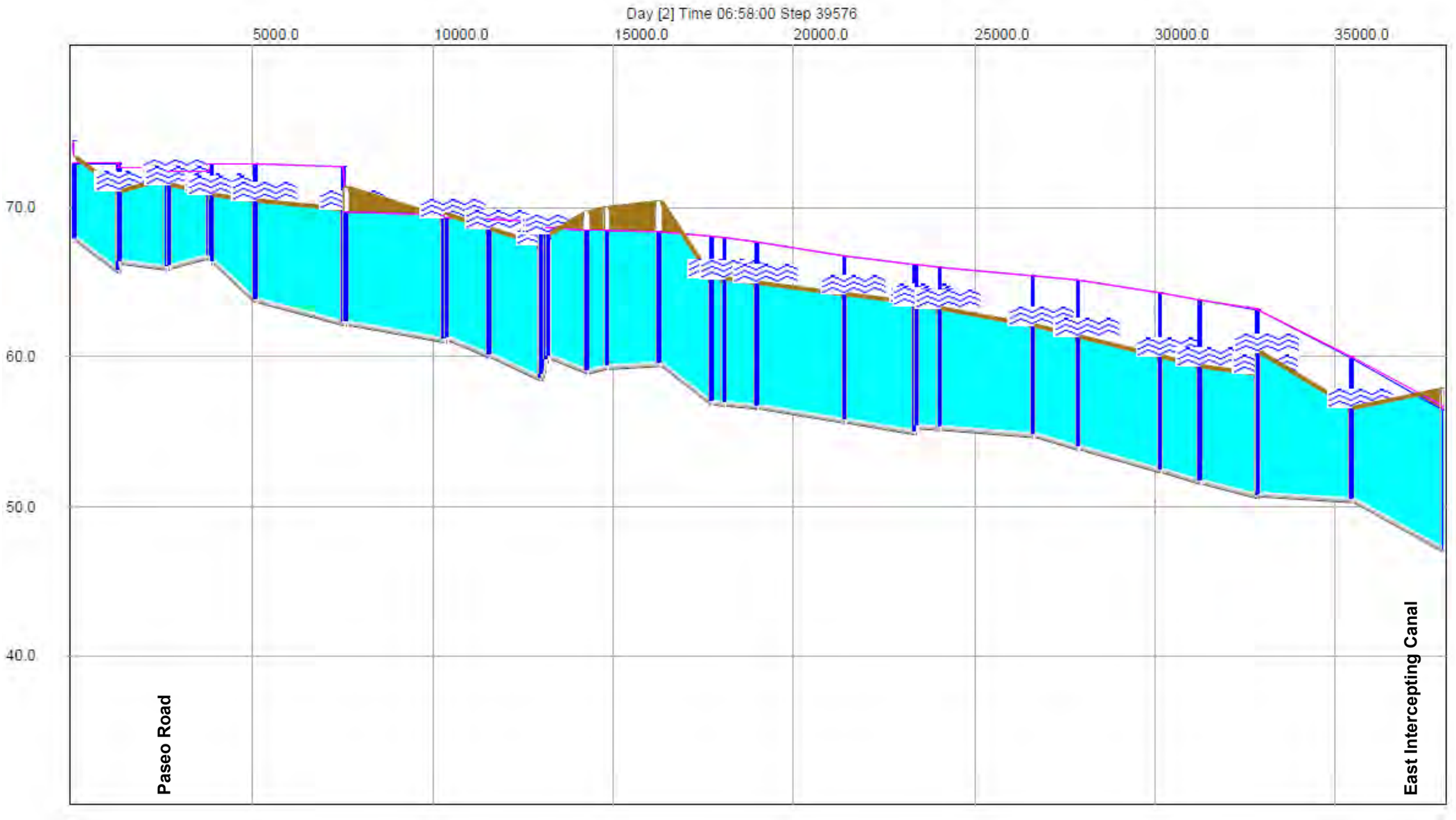


Figure 4B-7. Lateral No. 2-A-1, Lateral 2-A, and Western Intercepting Canal from north of Paseo Road to it confluence with the East Intercepting Canal (L02-0180 -- EIC0075)



CHAPTER 5. ANALYSIS OF EXISTING DRAINAGE INFRASTRUCTURE

This chapter provides an evaluation of the existing drainage infrastructure within the City of Live Oak. This evaluation is based on the recommended drainage criteria presented in Chapter 3. The drainage criteria used in this evaluation are the following:

- 10-Year Storm: Pipeline conveyance systems shall maintain the hydraulic grade line a minimum of 1-foot below the gutter line.
- 100-Year Storm; Flow shall be conveyed or detained in the street section while maintaining a water surface at least 1-foot below the adjacent building pad elevations.

Also, a comparison of the modeled flooding with the known flooding problem areas is presented in this chapter.

10-YEAR DESIGN STORM MODEL RESULTS

A comparison of the modeled 10-year storm water surface elevation, ground elevation, invert elevation, and freeboard for each model node is shown in Table 5-1. In this table:

- The nodes with over one-foot of freeboard are in compliance with the 10-year storm drain criteria and are not shaded any color.
- The nodes with less than one -foot of freeboard are shaded green.
- The nodes with up to one -foot of flooding are shaded orange.
- The nodes with one to two feet of flooding are shaded red.
- The nodes with over two feet of flooding depth are shaded purple.

Overland flood flow has not been modeled throughout most of the City and it is likely that as modeled flood water depths at a node approach or exceed 2 feet in depth, the water will actually flow to other adjacent nodes. Two dimensional evaluation of the surface flood flow could be incorporated into the XP-SWMM model using 1-foot contour mapping of the City. However, since this mapping is not available and since the goal of this MDS is to eliminate the flooding, implementation of surface flow modeling appears to be unwarranted.

A schematic of the 10-year flooding is shown in Figure 5-1, using the same color scheme as listed above for Table 5-1. The following flooding problems appear to occur during the 10-year storm:

- Apricot Street Pump Station and tributary storm drains: Model results indicate that in the 10-year storm much of this pump station-storm drain system would flood up to a depth of 1-foot.
- Larkin Street Pump Station and tributary storm drains: Model results indicate that in the 10-year storm much of this pump station-storm drain system would have less than 1-foot of freeboard with flooding at drain inlets.
- J Street and Fir Street: Model results indicate that in the 10-year storm flooding along J Street, Fir Street, and Sinnard Avenue will occur at depths of up to 1-foot.

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5
EIC0020	44.4	55.7	54.8	-0.9	55.0	-0.8
EIC0030	44.8	55.8	54.8	-0.9	55.0	-0.7
EIC0040	44.9	56.1	54.8	-1.3	56.4	0.3
EIC0050	45.0	56.1	54.8	-1.3	56.4	0.3
EIC0060	46.6	57.4	54.8	-2.6	57.1	-0.3
EIC0070	46.6	57.4	54.8	-2.6	57.1	-0.4
EIC0075	47.2	57.9	54.8	-3.0	57.4	-0.4
EIC0080	48.1	58.5	54.9	-3.6	57.5	-1.0
EIC0090	48.2	58.6	54.9	-3.7	57.5	-1.1
EIC0100	50.1	57.8	55.6	-2.3	59.1	1.3
EIC0110	50.2	59.2	55.6	-3.7	59.1	-0.1
EIC0120	50.3	63.1	55.9	-7.2	59.4	-3.6
EIC0130	50.0	60.8	55.9	-4.9	59.4	-1.3
EIC0140	50.0	59.2	56.0	-3.2	59.6	0.4
EIC0150	49.8	58.6	56.0	-2.6	59.6	1.0
L01-0090	59.5	70.1	65.7	-4.4	67.3	-2.7
L01-0100	59.2	69.7	65.8	-4.0	67.4	-2.3
L01-0110	60.1	68.3	66.3	-2.1	67.8	-0.5
L01-0120	59.9	68.3	66.3	-2.0	67.9	-0.4
L01-0170	58.9	69.0	66.3	-2.7	67.9	-1.1
L01-0180	58.7	67.5	66.6	-0.9	68.4	0.9
L01-0190	60.2	68.6	67.0	-1.6	68.7	0.1
L01-0200	61.4	69.5	67.2	-2.3	68.8	-0.7
L01-0210	61.3	69.4	67.4	-2.0	69.1	-0.3
L01-0220	62.4	71.4	67.9	-3.5	69.4	-2.0
L01-0230	62.4	69.9	70.7	0.8	72.9	3.0
L01-0240	63.9	70.5	70.9	0.4	72.9	2.5
L01-0250	65.0	71.3	70.9	-0.4	73.0	1.6
L01-0260	65.2	71.4	72.8	1.4	74.6	3.2
L01-0270	65.3	71.5	72.8	1.4	74.6	3.1
L01-0280	65.5	71.6	73.1	1.5	74.8	3.2
L01-0290	67.6	72.4	73.1	0.6	74.8	2.4
L01-0300	67.9	73.2	73.1	-0.1	74.8	1.6
L01-0310	67.3	73.4	73.1	-0.3	74.8	1.4
L01-0320	66.9	73.5	73.1	-0.4	74.8	1.3
L01-0330	67.0	74.1	73.1	-1.0	74.8	0.7
L01-0340	69.9	72.6	73.1	0.5	74.8	2.2
L02-0010	55.4	63.3	62.0	-1.3	64.2	0.9
L02-0020	55.5	63.5	62.2	-1.3	64.4	0.9
L02-0030	55.1	63.7	62.2	-1.4	64.5	0.8
L02-0032	55.9	64.3	63.1	-1.1	65.2	0.9
L02-0040	56.8	65.0	64.2	-0.8	66.2	1.2
L02-0042	57.0	65.3	64.6	-0.7	66.5	1.2
L02-0044	57.1	65.4	64.7	-0.7	66.5	1.2
L02-0050	59.7	70.4	65.5	-4.9	67.1	-3.2
L02-0060	60.2	66.9	66.7	-0.1	68.3	1.4
L02-0064	60.3	66.2	67.8	1.6	69.6	3.4
L02-0070	58.9	65.5	67.8	2.3	69.6	4.1
L02-0080	59.3	66.0	68.2	2.2	70.3	4.3
L02-0086	59.2	68.9	68.2	-0.7	70.3	1.3
L02-0088	59.4	68.9	68.3	-0.7	70.3	1.4
L02-0090	62.5	68.2	68.3	0.1	70.3	2.2
L02-0095	62.7	68.6	68.3	-0.3	70.4	1.8
L02-0100	62.7	69.6	68.4	-1.2	70.5	1.0
L02-0102	64.2	68.8	68.5	-0.3	70.6	1.8
L02-0104	64.2	69.0	68.9	-0.1	71.0	2.1
L02-0106	64.0	68.5	68.9	0.4	71.1	2.5
L02-0108	64.1	68.6	69.7	1.1	72.0	3.4
L02-0110	64.9	69.5	69.7	0.2	72.0	2.5
L02-0120	64.4	71.4	70.1	-1.3	72.5	1.1
L02-0130	66.2	71.5	70.1	-1.4	72.5	1.0
L02-0140	66.1	72.0	70.2	-1.8	72.6	0.6
L02-0150	66.5	71.2	70.2	-1.0	72.6	1.5
L02-0160	66.0	71.3	70.4	-0.8	73.0	1.7
L02-0170	68.0	73.3	70.4	-2.9	73.0	-0.3
L02-0180	68.3	70.7	73.5	2.8	74.5	3.8
L02-0190	66.9	71.1	70.2	-0.9	72.5	1.4
L02-0200	66.5	70.9	70.9	0.0	72.9	2.1
L02-0210	64.0	70.5	70.9	0.4	72.9	2.5
L02-0220	63.7	71.1	70.9	-0.2	72.9	1.9
L02-0230	62.9	70.4	70.9	0.5	73.0	2.5
L02-0237	67.1	75.2	72.7	-2.5	73.9	-1.3
L02-0238	67.4	75.0	72.7	-2.3	73.9	-1.1
L02-0239	67.7	75.4	72.7	-2.7	73.9	-1.5
L02-0240	63.0	69.5	71.1	1.6	73.2	3.7
L02-0243	68.3	75.4	72.7	-2.7	73.9	-1.5
L02-0244	68.9	75.5	72.7	-2.8	73.9	-1.6

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L02-0246	67.8	75.0	72.7	-2.3	73.9	-1.1
L02-0247	68.0	75.2	72.7	-2.5	73.9	-1.3
L02-0250	64.1	72.7	71.1	-1.6	73.2	0.5
L02-0252	65.7	73.2	72.5	-0.8	73.7	0.5
L02-0253	66.1	73.9	72.7	-1.2	73.8	-0.1
L02-0254	68.0	73.9	72.7	-1.2	73.8	-0.1
L02-0255	66.5	74.2	72.7	-1.5	73.9	-0.4
L02-0260	67.1	74.7	72.7	-1.9	73.9	-0.7
L02-0261	66.9	76.0	72.7	-3.3	73.9	-2.1
L02-0262	67.1	75.0	72.7	-2.3	73.9	-1.1
L02-0270	67.0	74.2	72.7	-1.5	73.9	-0.3
L02-0272	66.6	73.8	72.7	-1.1	73.9	0.1
L02-0273	67.7	75.0	72.7	-2.3	73.9	-1.1
L02-0275	70.0	75.0	70.8	-4.2	73.9	-1.1
L02-0277	69.4	76.0	72.8	-3.2	75.3	-0.7
L02-0278	69.3	74.6	72.8	-1.9	74.8	0.1
L02-0279	68.3	75.6	72.8	-2.8	75.6	0.0
L02-0280	67.9	74.1	72.7	-1.4	73.9	-0.2
L02-0281	69.0	77.0	72.8	-4.2	77.0	0.0
L02-0282	68.4	75.8	72.8	-3.0	75.8	0.0
L02-0283	68.9	75.2	72.8	-2.4	75.5	0.3
L02-0284	68.3	74.9	72.8	-2.1	74.0	-0.9
L02-0286	69.4	76.2	72.8	-3.4	76.4	0.2
L02-0287	71.0	78.6	72.8	-5.8	78.5	-0.1
L02-0288	70.4	77.5	72.8	-4.7	77.5	0.0
L02-0290	68.7	76.3	72.9	-3.4	74.1	-2.2
L02-0291	68.9	76.0	73.0	-3.0	74.2	-1.8
L02-0292	69.0	76.0	73.0	-3.0	74.2	-1.8
L02-0293	69.9	75.3	73.0	-2.3	74.2	-1.1
L02-0300	70.8	78.0	73.1	-4.9	74.3	-3.7
L02-0302	72.8	78.3	75.3	-3.1	76.2	-2.1
L02-0304	73.2	76.7	75.6	-1.1	76.9	0.2
L02-0310	73.8	76.7	75.9	-0.7	77.0	0.4
L02-0421	69.4	76.8	75.5	-1.3	76.5	-0.3
L02-0422	70.7	76.8	76.8	0.0	77.0	0.2
L02-0424	70.5	76.9	77.2	0.2	77.7	0.8
L02-0425	69.5	76.1	75.5	-0.6	76.5	0.4
L02-0426	62.0	76.9	75.4	-1.5	76.4	-0.5
L02-0427	70.1	76.5	76.4	-0.1	77.1	0.6
L02-0428	72.1	77.0	76.1	-0.9	77.1	0.1
L02-0430	66.9	75.1	72.9	-2.3	73.9	-1.3
L02-0440	66.6	75.2	73.0	-2.2	74.1	-1.2
L02-0450	66.4	75.4	73.1	-2.3	74.2	-1.1
L02-0460	66.3	75.3	73.2	-2.1	74.4	-1.0
L02-0461	70.7	76.0	72.9	-3.1	74.3	-1.7
L02-0462	70.5	75.4	73.0	-2.4	75.4	0.0
L02-0463	70.1	76.1	72.9	-3.1	74.3	-1.7
L02-0464	70.7	76.0	72.9	-3.2	74.3	-1.7
L02-0465	69.9	75.4	73.1	-2.3	74.3	-1.1
L02-0467	69.1	75.4	73.2	-2.2	74.4	-1.0
L02-0468	69.6	75.2	73.2	-2.0	74.3	-0.8
L02-0470	67.0	75.3	73.3	-2.0	74.5	-0.9
L02-0470	67.0	75.3	73.3	-2.0	74.5	-0.9
L02-0471	70.9	75.2	73.3	-1.9	74.9	-0.3
L02-0472	71.2	75.7	73.3	-2.4	75.7	0.0
L02-0480.1	67.7	76.9	74.8	-2.0	75.7	-1.2
L02-0481	68.6	76.3	74.1	-2.2	75.0	-1.3
L02-0482	69.0	77.7	76.4	-1.2	77.7	0.1
L02-0483	69.1	74.4	74.4	0.0	75.0	0.7
L02-0484	69.6	75.2	74.7	-0.5	75.2	0.0
L02-0485	70.1	75.2	75.0	-0.2	75.4	0.2
L02-0490	59.5	76.9	73.4	-3.5	74.5	-2.3
L02-0500	66.1	75.3	74.8	-0.5	75.9	0.6
L02-0502	72.5	77.0	74.8	-2.2	75.9	-1.1
L02-0503	72.4	75.6	74.8	-0.8	75.9	0.3
L02-0504	72.4	75.4	75.0	-0.4	76.1	0.7
L02-0505	73.4	76.5	75.0	-1.5	76.1	-0.4
L02-0506	73.7	77.7	75.1	-2.5	76.2	-1.4
L02-0507	75.6	77.1	76.5	-0.6	76.7	-0.3
L02-0510	68.8	77.8	75.9	-1.8	77.2	-0.6
L02-0511	71.6	76.9	77.0	0.0	77.5	0.6
L02-0512	68.2	75.0	75.0	-0.1	76.1	1.1
L02-0513	72.2	77.8	77.9	0.1	78.5	0.7
L02-0514	68.5	75.3	75.1	-0.2	76.0	0.7
L02-0515	68.6	76.4	76.4	0.0	76.4	0.1
L02-0516	69.4	75.9	76.1	0.1	77.0	1.0
L02-0517	71.2	77.4	76.4	-1.0	76.4	-0.9
L02-0518	74.4	78.5	77.4	-1.1	79.1	0.6

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L02-0520	74.5	78.4	77.6	-0.7	79.2	0.8
L02-0522	74.6	78.1	78.8	0.6	81.0	2.9
L02-0530	76.4	79.2	79.3	0.1	81.0	1.9
L02-0538	68.6	76.0	76.3	0.3	77.2	1.2
L02-0540	70.2	78.1	78.3	0.2	78.4	0.3
L02-0541	70.7	77.7	78.3	0.6	79.0	1.3
L02-0542	71.2	78.4	78.5	0.1	79.2	0.8
L02-0543	71.5	79.2	79.2	0.0	79.4	0.2
L02-0544	72.0	79.9	79.9	0.1	80.1	0.3
L03-0010	63.0	71.6	68.9	-2.7	70.8	-0.8
L03-0020	63.1	71.6	69.1	-2.6	71.6	0.0
L03-0030	63.5	72.1	69.1	-2.9	71.6	-0.4
L03-0040	63.5	72.1	69.4	-2.7	72.5	0.4
L03-0050	64.0	72.6	69.4	-3.2	72.5	-0.1
L03-0060	64.6	73.2	69.4	-3.8	72.5	-0.7
L03-0062	64.7	73.3	69.6	-3.8	72.7	-0.6
L03-0070	65.9	74.5	69.7	-4.8	72.7	-1.8
L03-0080	66.1	74.7	71.7	-3.0	74.7	0.0
L03-0090	67.8	76.4	71.9	-4.5	74.8	-1.6
L03-0092	67.8	76.4	71.9	-4.5	74.8	-1.6
L03-0094	67.9	76.5	79.8	3.3	80.9	4.4
L04-0030	66.9	71.9	71.3	-0.6	73.9	2.0
L04-0040	67.0	71.6	71.3	-0.3	73.9	2.3
L04-0050	67.8	72.1	71.3	-0.7	73.9	1.9
L04-0060	68.3	71.4	71.4	0.0	73.9	2.6
L04-0062	68.2	73.1	71.4	-1.7	73.9	0.9
L04-0064	68.4	73.3	71.6	-1.7	74.0	0.7
L04-0066	68.0	71.7	71.6	-0.1	74.0	2.3
L04-0068	67.8	72.0	72.0	0.1	74.2	2.3
L04-0070	68.0	74.4	72.2	-2.3	74.2	-0.2
L04-0080	68.1	76.0	72.2	-3.8	74.3	-1.7
L04-0088	68.5	75.0	72.4	-2.7	74.4	-0.6
L04-0090	69.4	73.0	72.5	-0.5	74.5	1.5
L04-0092	69.5	73.6	72.6	-1.1	74.5	0.9
L04-0094	69.5	73.7	73.0	-0.7	75.1	1.3
L04-0100	69.6	73.8	73.0	-0.8	75.1	1.2
L05-0010	67.2	73.8	72.0	-1.8	75.0	1.2
L05-0012	67.9	73.0	72.0	-0.9	75.0	2.0
L05-0014	69.2	74.2	72.0	-2.2	75.0	0.8
L05-0020	69.1	75.9	72.0	-3.8	75.0	-0.9
L05-0040	69.2	74.0	72.0	-2.0	75.0	1.0
L05-0050	69.2	74.0	72.7	-1.3	75.6	1.6
L05-0060	69.3	74.2	72.8	-1.4	75.6	1.4
L05-0070	69.4	74.5	72.9	-1.6	75.7	1.2
L05-0080	69.4	74.5	72.9	-1.6	75.7	1.1
L05-0090	69.6	74.8	73.0	-1.9	75.7	0.8
L05-0100	69.7	75.1	73.0	-2.1	75.7	0.5
L05-0110	69.8	75.5	73.1	-2.4	75.7	0.2
L06-0020	69.0	77.2	73.5	-3.6	75.7	-1.5
L06-0040	68.5	77.2	73.7	-3.5	75.7	-1.5
L06-0140	69.6	77.6	73.7	-3.9	75.8	-1.8
L06-0141	69.4	77.2	73.7	-3.5	75.7	-1.5
L06-0142	69.7	78.2	73.8	-4.4	76.0	-2.2
L06-0143	71.3	78.2	73.8	-4.4	76.0	-2.2
L06-0144	72.6	78.1	78.1	0.0	78.4	0.4
L06-0145	72.3	78.3	76.6	-1.7	77.6	-0.6
L06-0146	72.8	75.0	75.6	0.6	76.6	1.6
L06-0147	75.0	79.0	76.8	-2.2	77.0	-2.0
L06-0148	71.8	77.5	73.7	-3.8	75.8	-1.8
L06-0149	71.5	77.5	73.7	-3.8	75.8	-1.7
L06-0150	71.6	77.7	74.2	-3.4	76.7	-1.0
L06-0151	69.9	77.6	74.0	-3.6	76.3	-1.2
L06-0152	74.0	76.7	76.9	0.2	77.3	0.6
L06-0200	73.0	79.7	76.6	-3.1	78.5	-1.2
L06-0220	73.5	79.0	78.3	-0.8	80.0	1.0
L06-0221	77.0	79.5	78.1	-1.4	80.0	0.5
L06-0222	77.0	79.5	77.9	-1.6	78.8	-0.7
L06-0230	75.1	80.5	79.4	-1.1	81.5	1.0
L06-0240	77.2	80.3	79.5	-0.8	81.5	1.2
L06-0240AA	67.3	80.5	74.7	-5.9	75.8	-4.7
L06-0242	77.2	80.8	79.5	-1.3	81.6	0.8
L06-0245	76.8	80.9	79.5	-1.3	81.6	0.7
L06-0250	77.2	81.4	79.7	-1.7	81.7	0.3
L06-0260	77.5	79.9	79.7	-0.2	81.7	1.9
L06-0270	77.5	81.3	79.7	-1.6	81.8	0.5
L06-0280	77.1	82.9	79.8	-3.2	81.8	-1.1
L06-0290	77.6	83.3	79.9	-3.3	82.1	-1.2
L06-0292	78.0	82.8	79.9	-2.8	82.1	-0.7

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L06-0294	78.4	83.3	80.0	-3.3	82.1	-1.2
L06-0300	78.0	83.2	80.0	-3.2	82.1	-1.1
L06-0310	78.7	84.0	85.6	1.6	86.9	2.9
L06-0340	68.3	77.1	74.1	-3.0	76.2	-0.9
L06-0350	69.1	78.1	74.5	-3.6	76.6	-1.5
L06-0360	70.0	79.1	74.6	-4.6	76.7	-2.4
L06-0361	70.0	79.1	74.3	-4.9	76.6	-2.5
L06-0380	70.9	76.7	75.6	-1.1	78.6	1.8
L06-0390	73.0	78.8	75.7	-3.1	78.6	-0.2
L06-0400	73.8	78.2	76.7	-1.5	79.7	1.5
L06-0430	73.2	81.8	76.9	-4.8	79.8	-2.0
L06-0432	73.3	81.8	77.0	-4.8	79.9	-1.9
L06-0433	71.2	80.4	76.8	-3.6	79.8	-0.6
L06-0434	72.2	80.5	76.8	-3.7	79.8	-0.7
L06-0435	72.0	80.2	76.8	-3.4	79.8	-0.4
L06-0436	73.3	80.4	77.4	-3.0	80.2	-0.2
L06-0438	73.7	79.5	80.1	0.7	81.0	1.5
L06-0460	71.8	80.5	77.1	-3.4	79.9	-0.5
L06-0480	71.9	80.8	77.1	-3.7	79.9	-0.9
L06-0490	72.7	81.0	77.1	-3.9	79.9	-1.1
L06-0492	72.8	81.1	77.6	-3.6	80.8	-0.3
L06-0500	74.4	81.5	77.6	-3.9	80.8	-0.7
L06-0502	74.6	81.0	77.7	-3.2	81.0	0.1
L06-0510	75.3	82.7	77.9	-4.7	81.1	-1.6
L06-0520	77.5	82.8	78.9	-3.9	81.5	-1.3
L07-0040	74.4	78.7	75.2	-3.5	76.8	-1.9
L07-0041	74.4	81.4	75.2	-6.2	76.8	-4.6
L07-0042	73.7	80.2	74.2	-5.9	76.8	-3.4
L07-0043	72.9	80.2	74.1	-6.1	76.8	-3.4
L07-0050	76.2	80.0	76.5	-3.4	76.9	-3.1
L07-0060	74.8	79.6	80.6	1.0	81.9	2.3
L07-0061	75.5	78.3	79.2	0.9	79.3	1.0
L07-0062	76.3	79.6	80.6	1.0	81.9	2.3
L07-0064	76.4	79.1	79.5	0.4	80.4	1.3
L07-0068	78.9	79.8	79.2	-0.6	79.3	-0.5
L07-0070	76.9	80.0	79.5	-0.5	80.4	0.4
L07-0080	77.3	80.1	80.3	0.3	81.4	1.4
L07-0100	75.0	81.0	79.8	-1.1	81.3	0.4
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1
L08-0010	60.5	70.7	64.9	-5.8	67.2	-3.5
L08-0012	60.5	70.8	64.9	-5.8	67.2	-3.5
L08-0020	60.9	71.2	64.9	-6.3	67.2	-3.9
L08-0030	61.0	71.2	64.9	-6.3	67.2	-4.0
L08-0040	61.4	71.7	64.9	-6.8	67.3	-4.5
L08-0050	61.6	71.8	64.9	-6.9	67.3	-4.5
L08-0060	62.5	72.8	65.6	-7.2	67.4	-5.3
L09-0010	69.4	75.5	73.0	-2.5	75.5	0.1
L09-0040	73.1	77.3	75.2	-2.1	75.9	-1.4
L09-0050	72.9	77.3	75.4	-2.0	76.1	-1.2
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.6
L09-0070	77.3	82.1	83.9	1.8	85.4	3.3
L11-0020	79.6	85.6	81.1	-4.6	84.5	-1.1
L11-0030	79.6	85.6	87.1	1.4	88.6	3.0
L13-0010	76.0	80.3	78.4	-1.9	80.8	0.5
L13-0020	77.6	79.9	80.4	0.5	81.1	1.3
L15-0010	71.9	77.2	73.4	-3.7	75.8	-1.4
L15-0050	72.7	77.1	79.4	2.3	80.7	3.6
MC0010	50.7	59.9	56.3	-3.6	59.9	0.0
MC0020	50.7	59.9	56.3	-3.6	59.9	0.0
MC0030	51.1	60.3	56.6	-3.7	60.1	-0.2
MC0040	51.4	59.7	56.7	-3.0	60.5	0.8
MC0050	51.5	60.1	56.9	-3.3	60.6	0.5
MC0060	51.5	60.1	56.9	-3.3	60.7	0.5
MC0070	52.2	64.1	57.1	-7.0	60.8	-3.3
MC0080	52.4	61.1	57.1	-4.1	60.8	-0.3
MC0090	53.3	63.2	58.3	-4.8	61.7	-1.5
MC0100	53.2	62.2	58.4	-3.9	61.7	-0.5
MC0110	54.3	63.6	59.9	-3.7	63.1	-0.6
MC0120	54.4	66.8	60.0	-6.8	63.1	-3.6
MC0130	54.2	64.0	60.3	-3.7	63.4	-0.6
MC0140	53.9	64.1	60.3	-3.8	63.4	-0.7
MC0150	57.2	68.6	62.5	-6.1	65.3	-3.3
MC0160	57.2	68.7	62.6	-6.2	65.3	-3.4
MC0170	57.9	69.2	63.0	-6.1	65.7	-3.4
MC0172	58.1	69.3	63.2	-6.1	65.9	-3.5
MC0174	58.2	69.3	63.2	-6.1	65.9	-3.5

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
MC0176	58.2	69.4	63.2	-6.1	65.9	-3.5
MC0178	58.2	69.4	63.2	-6.1	65.9	-3.5
MC0180	58.8	69.7	63.6	-6.1	66.2	-3.5
MC0190	58.8	69.7	63.6	-6.1	66.2	-3.5
MC0200	59.3	70.8	64.2	-6.6	66.7	-4.2
MC0210	58.5	70.2	64.3	-5.9	66.7	-3.5
MC0220	60.1	70.4	64.9	-5.5	67.2	-3.2
MC0230	61.4	70.9	66.8	-4.1	68.8	-2.1
MC0240	61.5	70.9	66.8	-4.1	68.9	-2.0
MC0250	62.0	71.1	67.7	-3.4	69.7	-1.4
MC0260	62.9	71.5	68.8	-2.6	70.8	-0.7
MC0270	62.2	70.5	68.9	-1.6	70.9	0.5
MC0280	65.4	71.4	69.6	-1.9	71.4	0.0
MC0282	65.5	71.5	69.7	-1.8	71.5	0.0
MC0290	65.6	71.5	70.4	-1.1	73.5	2.0
MC0292	67.1	71.9	71.3	-0.6	73.9	2.0
MC0296	65.8	71.6	71.6	0.0	74.1	2.5
MC0298	65.4	71.6	71.6	0.0	74.1	2.5
MC0300	63.3	73.3	71.6	-1.6	74.1	0.8
MC0310	63.3	72.5	71.7	-0.8	74.3	1.8
MC0320	65.4	74.7	71.7	-3.0	74.3	-0.5
MC0330	65.2	71.6	72.0	0.4	75.0	3.4
MC0340	65.3	72.5	72.1	-0.4	75.0	2.6
MC0350	65.3	72.8	72.1	-0.7	75.1	2.3
MC0360	65.5	75.5	72.2	-3.2	75.2	-0.2
MC0370	64.9	75.5	72.2	-3.3	75.2	-0.3
MC0380	65.8	74.7	72.3	-2.4	75.3	0.6
MC0390	67.1	73.5	72.4	-1.1	75.3	1.8
MC0400	67.1	74.8	72.4	-2.4	75.3	0.5
MC0410	68.1	78.7	72.9	-5.8	75.5	-3.2
MC0420	69.2	77.2	73.0	-4.2	75.5	-1.7
MC0422	69.2	77.2	73.1	-4.2	75.6	-1.7
MC0430	69.4	77.2	73.4	-3.8	75.7	-1.5
MC0430	69.4	77.2	73.4	-3.8	75.7	-1.5
MC0431	70.1	80.0	80.7	0.7	81.4	1.5
MC0440	69.0	76.0	73.4	-2.6	75.8	-0.2
MC0450	70.4	78.1	73.7	-4.3	76.0	-2.1
MC0451	69.7	77.4	73.6	-3.8	75.9	-1.5
MC0460	71.7	77.3	74.1	-3.3	76.7	-0.6
MC0461	70.4	77.6	74.2	-3.4	76.7	-0.9
MC0462	71.1	77.4	74.2	-3.2	76.7	-0.7
MC0463	71.3	76.7	74.2	-2.5	76.7	0.0
MC0464	71.7	78.6	74.2	-4.4	76.8	-1.8
MC0464	71.7	78.6	74.2	-4.4	76.8	-1.8
MC0470	72.2	78.7	74.5	-4.2	76.8	-1.9
MC0480	71.8	77.5	74.7	-2.8	77.3	-0.2
MC0490	72.3	78.3	75.6	-2.7	77.7	-0.6
MC0500	72.4	78.4	75.8	-2.7	78.2	-0.2
MC0510	73.4	80.2	76.8	-3.5	78.7	-1.5
MC0520	73.0	81.1	77.1	-4.0	79.9	-1.1
MC0530	73.3	81.3	77.1	-4.2	79.9	-1.4
MC0540	73.3	81.4	77.3	-4.1	80.7	-0.7
MC0545	73.6	81.7	77.6	-4.1	80.8	-0.9
MC0550	74.0	81.9	77.9	-4.0	80.9	-1.0
MC0560	74.1	82.0	78.1	-3.9	81.4	-0.5
MC0570	74.5	82.1	78.3	-3.8	81.5	-0.6
MC0580	74.5	82.1	78.5	-3.7	81.9	-0.2
MC0590	75.6	82.9	79.3	-3.6	82.2	-0.8
MC0600	75.6	83.0	79.5	-3.4	82.7	-0.3
MC0610	76.0	83.2	79.7	-3.5	82.7	-0.5
MC0620	76.0	83.9	79.9	-4.0	83.3	-0.6
MC0630	75.1	83.2	80.0	-3.1	83.3	0.2
MC0640	75.3	83.3	80.1	-3.2	83.4	0.1
MC0642	76.2	83.8	80.1	-3.7	83.4	-0.4
MC0644	76.3	83.9	80.8	-3.1	84.5	0.6
MC0650	77.1	84.3	80.9	-3.4	84.5	0.2
MC0660	76.2	83.7	80.1	-3.6	83.3	-0.4
MC0662	76.3	83.8	80.6	-3.2	84.7	0.9
MC0670	78.0	84.8	80.9	-3.9	84.7	-0.1
WIC0005	50.5	56.7	57.0	0.4	59.7	3.0
WIC0010	50.9	60.3	58.7	-1.6	61.2	0.9
WIC0020	50.9	58.9	58.8	-0.1	61.3	2.5
WIC0030	51.8	59.4	59.4	0.0	61.9	2.5
WIC0032	52.5	60.1	59.9	-0.2	62.4	2.3
WIC0034	54.1	61.4	60.9	-0.5	63.3	1.9
WIC0040	54.9	62.1	61.3	-0.9	63.6	1.5
L01-0006	Node turned off in model					
L01-0008	Node turned off in model					

Table 5-1. Node Data and Model Results

Model Input Data			Model Results			
			10-Year Storm		100-Year Storm	
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft
L01-0009	Node turned off in model					
L01-0010	Node turned off in model					
L01-0130	Node turned off in model					
L01-0140	Node turned off in model					
L01-0150	Node turned off in model					
L01-0160	Node turned off in model					
L02-0311	Node turned off in model					
L02-0312	Node turned off in model					
L02-0313	Node turned off in model					
L02-0315	Node turned off in model					
L02-0316	Node turned off in model					
L02-0320	Node turned off in model					
L02-0330	Node turned off in model					
L02-0340	Node turned off in model					
L02-0360	Node turned off in model					
L02-0508	Node turned off in model					
L02-0509	Node turned off in model					
WIC0050	Node turned off in model					
WIC0060	Node turned off in model					

100-YEAR DESIGN STORM MODEL RESULTS

A comparison of the modeled 100-year storm water surface elevation, ground elevation, invert elevation, and freeboard for each model node is shown in Table 5-1 using the same color scheme as for the 10-year storm. A schematic of the 100-year flooding is shown in Figure 5-2. The elevations of the building pads are not available as part of this MDS. As determined through field observation, the elevations of the homes along many of the flooded storm drain systems are not significantly above the ground surface at the drain inlets. However, many houses are built on raised foundations, so flooding depths of less than 1-foot may not actually enter the houses. Modeled flooding depths of over 2 feet would likely cause actual flood damage at the node where the flooding is reported or at nearby locations.

Model results indicate that during the 100-year storm, much of the City would experience flooding problems with flooding depths of up to 1 foot being common.

The following areas appear to meet drainage criteria for the 100-year storm:

- Pennington Ranch (located west of Richard Avenue and south of Pennington Road): The streets in this area would flood less than 1-foot deep. This is a new neighborhood, and it appears that the building pads have been raised about 2 feet above the street levels; so the homes would be protected from flooding during the 100-year storm.
- Peachtree Estates (N Street from Ida Street to Apricot Street): The streets in this area would flood less than 1-foot deep. This is a new neighborhood, and it appears that the building pads have been raised about 1.5 to 2 feet above the street levels; so the homes would be protected from flooding during the 100-year storm.

COMPARISON OF MODEL RESULTS WITH OBSERVED FLOODING PROBLEMS

The model accurately reflects where flooding has been observed. The following is a summary of areas where flooding has previously occurred and the model results indicate flooding would occur.

- De Ree Road – The observed flooding along De Ree Road occurs because the area does not have a storm drain system. This flooding may be exacerbated by flooding from the storm drain systems on Apricot and Date Streets. As shown in Figures 5-1 and 5-2, the Apricot and Date Street storm drains near the De Ree Road area would flood up to 1-foot deep for the 100-year storm.
- Luther School - The Luther School area drains to the storm drain along Pennington Road at Connecticut Street. The model shows that this storm drain system would be flooded up to 1-foot deep during the 10-year and 100-year storms.
- L Street Between Birch Street and Pennington Road – The observed flooding along much of L Street (between Date Street and Pennington Road) occurs because this area does not have a storm drain system. The model shows up to 1-foot of flooding during the 10-year storm at L Street and Pennington Road, and at Birch Street. Thus, inadequate capacity in the storm drains in this area would contribute the flooding between Pennington Road and Date Street. The model results show up to 1-foot of flooding in this area during the 100-year storm.

- J Street south of Pennington Road – This area lacks storm drains, which causes the observed flooding. The model results show that this area and the adjacent drains/roadside ditches would experience flooding up to 1-foot deep during the 10-year storm and over 2 feet deep during the 100-year storm. This area drains to a roadside ditch along Pennington Road that will be flooded during the 10-year and 100-year storms. This ditch's limited capacity will cause the Sinnard Street storm drain system to back up.
- Highway 99 - The observed flooding along Highway 99 occurs because there are only bubble-up systems crossing Highway 99 and several intersecting roads. No full storm drain systems serve the Highway 99 area. The model shows that the drain inlet at Nevada Street and Highway 99 would flood up to a depth of 1-foot for the 10- and 100-year storms. Lateral 6, located west of Highway 99, mostly has over 1-foot of freeboard in the 10-year storm. In the 100-year storm, the model results indicate that the Lateral 6 water levels range from under 1-foot of freeboard to flooding depths of over 1-foot.
- West of P Street from Pennington Road to Date, Gum, Fir, and Elm Streets – The observed flooding in this area is partially due to the use of a small ditch to drain storm water. The model shows that the Apricot Street Pump Station - tributary storm drain system (in this area) would experience less than 1-foot of flooding during the 10-year storm and over 1-foot of flooding in the 100-year storm at a few locations.
- Larkin Road Storm Drain - The City and RD 777 have expressed concern that the Larkin Road storm drain does not have adequate capacity from the City limits to the open ditch between Ash and Birch Street. The model shows that the Larkin Road storm drain system appears to convey 10-year storm flows. However, the 1-foot minimum freeboard requirement would not be met along the northern portion of the storm drain system in the 10-year storm. For the 100-year storm, the model shows that there would be up to 2 feet of flooding along the Larkin Street storm drain. Many of the culverts serving the Larkin Road roadside ditches are partially to fully plugged with sediment. These plugged culverts reduce the flow reaching the Larkin Road storm drain. If the culverts were cleared, the model results would likely indicate significant flooding along the Larkin Road storm drain even in the 10-year storm.

Based on the model results described above and the comparison with observed flooding, it appears the existing conditions models reasonably simulate the actual storm drain and open channels systems serving the City. Consequently, these models are adequate for developing solutions to the City's existing flooding problems.

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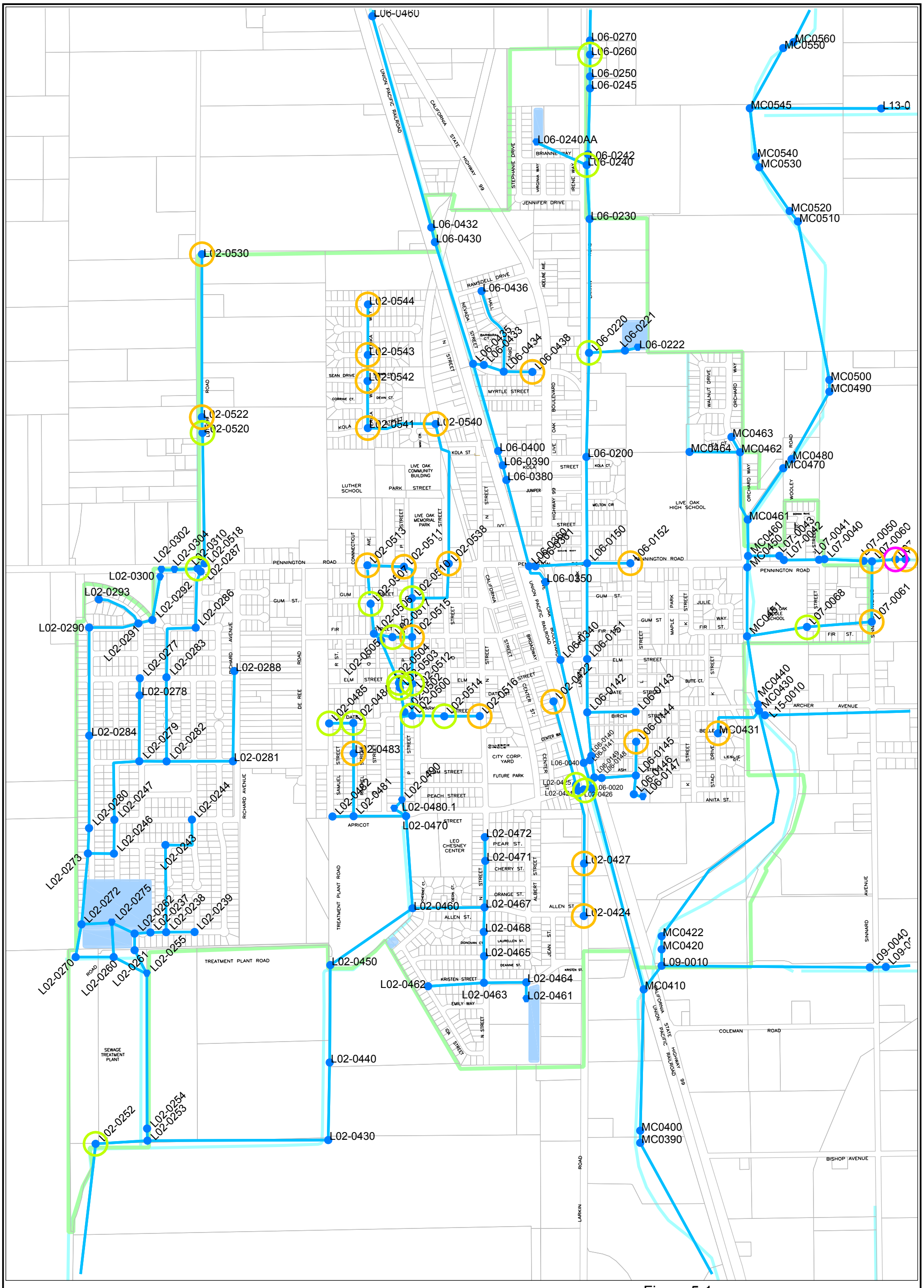

Figure 5-1

City of Live Oak
Master Drainage Study
10-YEAR DESIGN
STORM FLOODING

WEST YOST ASSOCIATES
Consulting Engineers

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LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK
- FLOOD DEPTH > 2 FT
- FLOOD DEPTH 1 - 2 FT
- FLOOD DEPTH 0 TO 1 FT
- FREEBOARD 0 TO 1 FT

N

0 450 900

SCALE IN FEET

Figure 5-2

City of Live Oak
Master Drainage Study
100-YEAR DESIGN STORM FLOODING
FOR EXISTING CONDITIONS

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 6. IMPROVEMENTS TO SOLVE EXISTING DRAINAGE/FLOODING PROBLEMS

This chapter identifies and evaluates improvements to solve the existing drainage/flooding problems at the following six locations. These drainage problems were specifically identified by City staff for development of drainage improvements. Elimination of these drainage problems is not intended to eliminate all flooding in the City or in RD 777.

- J Street south of Pennington Road
- L Street between Birch Street and Pennington Road
- Several Highway 99 cross culverts (bubble up systems) that do not have connections to District or City drains
- De Ree Road and Luther School
- West of P Street from Pennington Road to Date Street, Gum, Fir, and Elm Streets – Currently drainage flows in ditches between houses. The ditches have been blocked by overgrown vegetation and fences and are difficult to maintain.
- Q Street

City staff also expressed a concern that the Larkin Road Storm Drain may not have adequate capacity from the City limits to its discharge to the ditch between Birch and Ash Streets. However, based on the modeling presented in Chapter 5, this drain appears to have adequate capacity for existing conditions.

For these evaluations, existing land uses were assumed, and no excess capacity was included in the improvements for future development. Consistent with the design criteria recommendations for this MDS presented in Chapter 3, these storm drain improvements were sized to provide at least one foot of freeboard in the drain inlets and maintenance holes for the 10-year storm.

The overall performance of the City's storm drain system with these improvements is shown in Figure 6-1 and summarized in Table 6-1. The flooding shown in Figure 6-1 should be compared to that shown in Figure 5-1, which is a similar figure, but for existing conditions. Table 6-1 includes water levels for both existing conditions and with these improvements. In Table 6-1:

- The nodes with over one-foot of freeboard are in compliance with the 10-year storm drain criteria and are not shaded any color
- The nodes with less than one -foot of freeboard are shaded green
- The nodes with up to one -foot of flooding are shaded orange
- The nodes with one to two feet of flooding are shaded red
- The nodes with over two feet of flooding depth are shaded purple

The location of 10-year flooding is shown in Figure 6-1, using the same color scheme as listed above for Table 6-1.

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0
EIC0060	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0
EIC0070	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0
EIC0075	47.2	57.9	54.8	-3.0	54.8	-3.0	0.0
EIC0080	48.1	58.5	54.9	-3.6	54.9	-3.6	0.0
EIC0090	48.2	58.6	54.9	-3.7	54.9	-3.7	0.0
EIC0100	50.1	57.8	55.6	-2.3	55.6	-2.2	0.0
EIC0110	50.2	59.2	55.6	-3.7	55.6	-3.6	0.0
EIC0120	50.3	63.1	55.9	-7.2	55.9	-7.2	0.0
EIC0130	50.0	60.8	55.9	-4.9	55.9	-4.9	0.0
EIC0140	50.0	59.2	56.0	-3.2	56.0	-3.2	0.0
EIC0150	49.8	58.6	56.0	-2.6	56.0	-2.6	0.0
L01-0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L01-0008	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L01-0009	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L01-0010	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L01-0090	59.5	70.1	65.7	-4.4	65.8	-4.2	0.1
L01-0100	59.2	69.7	65.8	-4.0	65.9	-3.9	0.1
L01-0110	60.1	68.3	66.3	-2.1	66.3	-2.0	0.1
L01-0120	59.9	68.3	66.3	-2.0	66.3	-2.0	0.1
L01-0170	58.9	69.0	66.3	-2.7	66.4	-2.6	0.1
L01-0180	58.7	67.5	66.6	-0.9	66.6	-0.9	0.0
L01-0190	60.2	68.6	67.0	-1.6	67.0	-1.6	0.0
L01-0200	61.4	69.5	67.2	-2.3	67.2	-2.3	0.0
L01-0210	61.3	69.4	67.4	-2.0	67.4	-2.0	0.0
L01-0220	62.4	71.4	67.9	-3.5	67.9	-3.5	0.0
L01-0230	62.4	69.9	70.7	0.8	70.6	0.7	-0.1
L01-0240	63.9	70.5	70.9	0.4	70.8	0.4	-0.1
L01-0250	65.0	71.3	70.9	-0.4	70.9	-0.5	0.0
L01-0260	65.2	71.4	72.8	1.4	72.8	1.4	0.0
L01-0270	65.3	71.5	72.8	1.4	72.8	1.4	0.0
L01-0280	65.5	71.6	73.1	1.5	73.1	1.5	0.0
L01-0290	67.6	72.4	73.1	0.6	73.1	0.7	0.0
L01-0300	67.9	73.2	73.1	-0.1	73.1	0.0	0.0
L01-0310	67.3	73.4	73.1	-0.3	73.1	-0.2	0.0
L01-0320	66.9	73.5	73.1	-0.4	73.1	-0.4	0.0
L01-0330	67.0	74.1	73.1	-1.0	73.1	-1.0	0.0
L01-0340	69.9	72.6	73.1	0.5	73.1	0.5	0.0
L02-0010	55.4	63.3	62.0	-1.3	62.2	-1.0	0.3
L02-0020	55.5	63.5	62.2	-1.3	62.5	-1.0	0.3
L02-0030	55.1	63.7	62.2	-1.4	62.5	-1.2	0.3
L02-0032	55.9	64.3	63.1	-1.1	63.3	-0.9	0.2
L02-0040	56.8	65.0	64.2	-0.8	64.4	-0.6	0.2
L02-0042	57.0	65.3	64.6	-0.7	64.7	-0.5	0.2
L02-0044	57.1	65.4	64.7	-0.7	64.8	-0.6	0.2
L02-0050	59.7	70.4	65.5	-4.9	65.6	-4.8	0.1
L02-0060	60.2	66.9	66.7	-0.1	65.6	-1.2	-1.1
L02-0064	60.3	66.2	67.8	1.6	67.2	1.0	-0.5
L02-0070	58.9	65.5	67.8	2.3	67.2	1.8	-0.5
L02-0080	59.3	66.0	68.2	2.2	67.9	1.9	-0.3
L02-0086	59.2	68.9	68.2	-0.7	67.9	-1.0	-0.3
L02-0088	59.4	68.9	68.3	-0.7	68.0	-1.0	-0.3
L02-0090	62.5	68.2	68.3	0.1	68.0	-0.2	-0.3
L02-0095	62.7	68.6	68.3	-0.3	68.0	-0.6	-0.3
L02-0100	62.7	69.6	68.4	-1.2	68.2	-1.4	-0.3
L02-0102	64.2	68.8	68.5	-0.3	68.3	-0.5	-0.2
L02-0104	64.2	69.0	68.9	-0.1	68.7	-0.3	-0.2
L02-0106	64.0	68.5	68.9	0.4	68.8	0.3	-0.2
L02-0108	64.1	68.6	69.7	1.1	69.6	1.0	-0.1
L02-0110	64.9	69.5	69.7	0.2	69.6	0.1	-0.1
L02-0120	64.4	71.4	70.1	-1.3	70.0	-1.4	0.0
L02-0130	66.2	71.5	70.1	-1.4	70.0	-1.5	0.0
L02-0140	66.1	72.0	70.2	-1.8	70.1	-1.9	0.0
L02-0150	66.5	71.2	70.2	-1.0	70.2	-1.0	0.0
L02-0160	66.0	71.3	70.4	-0.8	70.4	-0.8	0.0
L02-0170	68.0	73.3	70.4	-2.9	70.4	-2.9	0.0
L02-0180	68.3	70.7	73.5	2.8	73.5	2.8	0.0
L02-0190	66.9	71.1	70.2	-0.9	70.1	-1.0	0.0
L02-0200	66.5	70.9	70.9	0.0	70.8	0.0	-0.1
L02-0210	64.0	70.5	70.9	0.4	70.8	0.3	-0.1
L02-0220	63.7	71.1	70.9	-0.2	70.8	-0.2	-0.1
L02-0230	62.9	70.4	70.9	0.5	70.9	0.4	0.0
L02-0237	67.1	75.2	72.7	-2.5	72.6	-2.6	-0.1
L02-0238	67.4	75.0	72.7	-2.3	72.6	-2.4	-0.1
L02-0239	67.7	75.4	72.7	-2.7	72.6	-2.8	-0.1

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0240	63.0	69.5	71.1	1.6	71.0	1.6	-0.1
L02-0243	68.3	75.4	72.7	-2.7	72.6	-2.8	-0.1
L02-0244	68.9	75.5	72.7	-2.8	72.6	-2.9	-0.1
L02-0246	67.8	75.0	72.7	-2.3	72.7	-2.3	-0.1
L02-0247	68.0	75.2	72.7	-2.5	72.7	-2.5	-0.1
L02-0250	64.1	72.7	71.1	-1.6	71.1	-1.6	0.0
L02-0252	65.7	73.2	72.5	-0.8	72.3	-0.9	-0.2
L02-0253	66.1	73.9	72.7	-1.2	72.5	-1.4	-0.2
L02-0254	66.1	73.9	72.7	-1.2	72.6	-1.3	-0.1
L02-0255	66.9	74.2	72.7	-1.5	72.6	-1.6	-0.1
L02-0260	67.1	74.7	72.7	-1.9	72.6	-2.0	-0.1
L02-0261	66.9	76.0	72.7	-3.3	72.6	-3.4	-0.1
L02-0262	67.1	75.0	72.7	-2.3	72.6	-2.4	-0.1
L02-0270	67.0	74.2	72.7	-1.5	72.6	-1.6	-0.1
L02-0272	66.6	73.8	72.7	-1.1	72.6	-1.1	-0.1
L02-0273	67.7	75.0	72.7	-2.3	72.7	-2.3	-0.1
L02-0275	70.0	75.0	70.8	-4.2	70.7	-4.3	0.0
L02-0277	69.4	76.0	72.8	-3.2	72.7	-3.3	-0.1
L02-0278	69.3	74.6	72.8	-1.9	72.7	-1.9	-0.1
L02-0279	68.3	75.6	72.8	-2.8	72.7	-2.9	-0.1
L02-0280	67.9	74.1	72.7	-1.4	72.7	-1.4	-0.1
L02-0281	69.0	77.0	72.8	-4.2	72.7	-4.3	-0.1
L02-0282	68.4	75.8	72.8	-3.0	72.7	-3.1	-0.1
L02-0283	68.9	75.2	72.8	-2.4	72.7	-2.5	-0.1
L02-0284	68.3	74.9	72.8	-2.1	72.8	-2.1	-0.1
L02-0286	69.4	76.2	72.8	-3.4	72.7	-3.5	-0.1
L02-0287	71.0	78.6	72.8	-5.8	72.7	-5.9	-0.1
L02-0288	70.4	77.5	72.8	-4.7	72.7	-4.7	-0.1
L02-0290	68.7	76.3	72.9	-3.4	72.9	-3.4	-0.1
L02-0291	68.9	76.0	73.0	-3.0	72.9	-3.1	-0.1
L02-0292	69.0	76.0	73.0	-3.0	72.9	-3.1	-0.1
L02-0293	69.9	75.3	73.0	-2.3	72.9	-2.4	-0.1
L02-0300	70.8	78.0	73.1	-4.9	73.1	-4.9	-0.1
L02-0302	72.8	78.3	75.3	-3.1	75.3	-3.1	0.0
L02-0304	73.2	76.7	75.6	-1.1	75.6	-1.1	0.0
L02-0310	73.8	76.7	75.9	-0.7	75.9	-0.7	0.0
L02-0360	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L02-0421	69.4	76.8	75.5	-1.3	75.5	-1.3	0.0
L02-0422	70.7	76.8	76.8	0.0	76.8	0.0	0.0
L02-0424	70.5	76.9	77.2	0.2	77.2	0.3	0.1
L02-0425	69.5	76.1	75.5	-0.6	75.5	-0.5	0.0
L02-0426	62.0	76.9	75.4	-1.5	75.4	-1.5	0.0
L02-0427	70.1	76.5	76.4	-0.1	76.5	0.0	0.1
L02-0428	72.1	77.0	76.1	-0.9	76.3	-0.6	0.3
L02-0430	66.9	75.1	72.9	-2.3	72.6	-2.5	-0.2
L02-0440	66.6	75.2	73.0	-2.2	72.7	-2.5	-0.3
L02-0450	66.4	75.4	73.1	-2.3	72.8	-2.6	-0.3
L02-0460	66.3	75.3	73.2	-2.1	72.8	-2.5	-0.4
L02-0461	70.7	76.0	72.9	-3.1	72.8	-3.2	-0.1
L02-0462	70.5	75.4	73.0	-2.4	72.8	-2.6	-0.2
L02-0463	70.1	76.1	72.9	-3.1	72.8	-3.3	-0.2
L02-0464	70.7	76.0	72.9	-3.2	72.8	-3.2	-0.1
L02-0465	69.9	75.4	73.1	-2.3	72.8	-2.6	-0.3
L02-0467	69.1	75.4	73.2	-2.2	72.8	-2.5	-0.4
L02-0468	69.6	75.2	73.2	-2.0	72.8	-2.4	-0.4
L02-0470	67.0	75.3	73.3	-2.0	72.9	-2.5	-0.5
L02-0471	70.9	75.2	73.3	-1.9	72.9	-2.3	-0.4
L02-0472	71.2	75.7	73.3	-2.4	73.1	-2.6	-0.3
L02-0480.1	67.7	76.9	74.8	-2.0	75.2	-1.7	0.4
L02-0481	68.6	76.3	74.1	-2.2	72.9	-3.4	-1.2
L02-0481A	68.3	75.8	--	--	72.9	-2.9	--
L02-0481B	68.9	75.0	--	--	72.9	-2.1	--
L02-0482	69.2	77.7	76.4	-1.2	72.8	-4.8	-3.6
L02-0483	69.1	74.4	74.4	0.0	72.9	-1.5	-1.5
L02-0484	69.6	75.2	74.7	-0.5	72.9	-2.3	-1.8
L02-0485	70.3	75.2	75.0	-0.2	73.1	-2.1	-1.9
L02-0485A	70.6	77.2	--	--	73.2	-4.0	--
L02-0485B	71.0	76.5	--	--	73.6	-2.9	--
L02-0485C	72.0	77.5	--	--	74.3	-3.2	--
L02-0485D	72.4	77.5	--	--	74.6	-2.9	--
L02-0485E	71.1	77.3	--	--	74.0	-3.3	--
L02-0490	59.5	76.9	73.4	-3.5	72.9	-3.9	-0.4
L02-0500	66.1	75.3	74.8	-0.5	74.5	-0.8	-0.3
L02-0502	72.5	77.0	74.8	-2.2	74.8	-2.3	0.0
L02-0503	69.0	75.6	74.8	-0.8	75.2	-0.5	0.4
L02-0504	69.0	75.4	75.0	-0.4	73.8	-1.6	-1.2
L02-0505	73.4	76.5	75.0	-1.5	74.3	-2.2	-0.7
L02-0506	72.0	77.7	75.1	-2.5	75.7	-2.0	0.6
L02-0507	71.0	77.1	76.5	-0.6	76.3	-0.8	-0.2

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0510	68.8	77.8	75.9	-1.8	75.6	-2.2	-0.4
L02-0511	71.6	76.9	77.0	0.0	76.0	-1.0	-1.0
L02-0512	68.2	75.0	75.0	-0.1	74.8	-0.3	-0.2
L02-0513	73.1	77.8	77.9	0.1	75.1	-2.7	-2.8
L02-0514	68.5	75.3	75.1	-0.2	74.8	-0.5	-0.3
L02-0515	68.6	76.4	76.4	0.0	75.3	-1.1	-1.1
L02-0516	69.4	75.9	76.1	0.1	76.0	0.0	-0.1
L02-0517	71.2	77.4	76.4	-1.0	75.7	-1.7	-0.7
L02-0518	74.4	78.5	77.4	-1.1	77.4	-1.1	0.0
L02-0520	74.5	78.4	77.6	-0.7	77.6	-0.7	0.0
L02-0522	74.6	78.1	78.8	0.6	78.7	0.6	0.0
L02-0530	76.4	79.2	79.3	0.1	79.4	0.3	0.2
L02-0538	68.6	76.0	76.3	0.3	76.0	0.0	-0.3
L02-0538AA	69.9	78.1	--	--	75.4	-2.7	--
L02-0538BB	69.9	78.1	--	--	77.1	-1.0	--
L02-0540	70.2	78.1	78.3	0.2	75.6	-2.5	-2.6
L02-0541	70.7	77.7	78.3	0.6	77.0	-0.7	-1.3
L02-0542	71.2	78.4	78.5	0.1	77.7	-0.7	-0.8
L02-0543	71.5	79.2	79.2	0.0	78.4	-0.8	-0.8
L02-0544	72.0	79.9	79.9	0.1	79.9	0.1	0.0
L03-0010	63.0	71.6	68.9	-2.7	68.8	-2.7	0.0
L03-0020	63.1	71.6	69.1	-2.6	69.1	-2.6	0.0
L03-0030	63.5	72.1	69.1	-2.9	69.1	-2.9	0.0
L03-0040	63.5	72.1	69.4	-2.7	69.3	-2.8	0.0
L03-0050	64.0	72.6	69.4	-3.2	69.4	-3.2	0.0
L03-0060	64.6	73.2	69.4	-3.8	69.4	-3.8	0.0
L03-0062	64.7	73.3	69.6	-3.8	69.6	-3.8	0.0
L03-0070	65.9	74.5	69.7	-4.8	69.7	-4.8	0.0
L03-0080	66.1	74.7	71.7	-3.0	71.7	-3.0	0.0
L03-0090	67.8	76.4	71.9	-4.5	71.9	-4.5	0.0
L03-0092	67.8	76.4	71.9	-4.5	71.9	-4.5	0.0
L03-0094	67.9	76.5	79.8	3.3	79.8	3.3	0.0
L04-0030	66.9	71.9	71.3	-0.6	71.3	-0.6	0.0
L04-0040	67.0	71.6	71.3	-0.3	71.3	-0.3	0.0
L04-0050	67.8	72.1	71.3	-0.7	71.4	-0.7	0.0
L04-0060	68.3	71.4	71.4	0.0	71.4	0.0	0.0
L04-0062	68.2	73.1	71.4	-1.7	71.4	-1.7	0.0
L04-0064	68.4	73.3	71.6	-1.7	71.6	-1.7	0.0
L04-0066	68.0	71.7	71.6	-0.1	71.6	-0.1	0.0
L04-0068	67.8	72.0	72.0	0.1	72.0	0.1	0.0
L04-0070	68.0	74.4	72.2	-2.3	72.2	-2.3	0.0
L04-0080	68.1	76.0	72.2	-3.8	72.2	-3.8	0.0
L04-0088	68.5	75.0	72.4	-2.7	72.3	-2.7	0.0
L04-0090	69.4	73.0	72.5	-0.5	72.5	-0.5	0.0
L04-0092	69.5	73.6	72.6	-1.1	72.6	-1.1	0.0
L04-0094	69.5	73.7	73.0	-0.7	73.0	-0.7	0.0
L04-0100	69.6	73.8	73.0	-0.8	73.0	-0.8	0.0
L05-0010	67.2	73.8	72.0	-1.8	72.2	-1.6	0.2
L05-0012	67.9	73.0	72.0	-0.9	72.2	-0.8	0.2
L05-0014	69.2	74.2	72.0	-2.2	72.2	-2.0	0.2
L05-0020	69.1	75.9	72.0	-3.8	72.2	-3.6	0.2
L05-0040	69.2	74.0	72.0	-2.0	72.2	-1.8	0.2
L05-0050	69.2	74.0	72.7	-1.3	72.7	-1.3	0.0
L05-0060	69.3	74.2	72.8	-1.4	72.8	-1.4	0.0
L05-0070	69.4	74.5	72.9	-1.6	72.9	-1.6	0.0
L05-0080	69.4	74.5	72.9	-1.6	72.9	-1.6	0.0
L05-0090	69.6	74.8	73.0	-1.9	73.0	-1.9	0.0
L05-0100	69.7	75.1	73.0	-2.1	73.0	-2.1	0.0
L05-0110	69.8	75.5	73.1	-2.4	73.1	-2.4	0.0
L06-0020	69.0	77.2	73.5	-3.6	73.7	-3.5	0.1
L06-0040	68.5	77.2	73.7	-3.5	73.8	-3.4	0.1
L06-0140	69.6	77.6	73.7	-3.9	73.8	-3.8	0.1
L06-0141	69.4	77.2	73.7	-3.5	73.8	-3.4	0.1
L06-0142	69.7	78.2	73.8	-4.4	73.9	-4.2	0.1
L06-0143	71.3	78.2	73.8	-4.4	73.9	-4.3	0.2
L06-0143NA	72.0	77.6	--	--	74.0	-3.6	--
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0
L06-0145	72.3	78.3	76.6	-1.7	76.6	-1.7	0.0
L06-0146	72.8	75.0	75.6	0.6	75.7	0.7	0.0
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0
L06-0148	71.8	77.5	73.7	-3.8	73.9	-3.7	0.2
L06-0149	71.5	77.5	73.7	-3.8	73.8	-3.6	0.2
L06-0150	71.6	77.7	74.2	-3.4	74.4	-3.3	0.2
L06-0150D	72.5	77.0	--	--	74.7	-2.3	--
L06-0151	69.9	77.6	74.0	-3.6	74.2	-3.4	0.2
L06-0151NA	70.5	76.2	--	--	74.2	-2.0	--
L06-0151NB	71.6	76.4	--	--	74.6	-1.7	--
L06-0151NC	72.0	76.5	--	--	75.2	-1.3	--
L06-0152	74.0	76.7	76.9	0.2	74.4	-2.3	-2.5

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L06-0200	73.0	79.7	76.6	-3.1	76.7	-3.0	0.1
L06-0220	73.5	79.0	78.3	-0.8	78.3	-0.7	0.0
L06-0221	77.0	79.5	78.1	-1.4	78.1	-1.4	0.0
L06-0222	77.0	79.5	77.9	-1.6	77.9	-1.6	0.0
L06-0230	75.1	80.5	79.4	-1.1	79.4	-1.0	0.0
L06-0240	77.2	80.3	79.5	-0.8	79.5	-0.8	0.0
L06-0240AA	67.3	80.5	74.7	-5.9	74.7	-5.9	0.0
L06-0242	77.2	80.8	79.5	-1.3	79.5	-1.3	0.0
L06-0245	76.8	80.9	79.5	-1.3	79.5	-1.3	0.0
L06-0250	77.2	81.4	79.7	-1.7	79.7	-1.7	0.0
L06-0260	77.5	79.9	79.7	-0.2	79.7	-0.2	0.0
L06-0270	77.5	81.3	79.7	-1.6	79.8	-1.6	0.0
L06-0280	77.1	82.9	79.8	-3.2	79.8	-3.1	0.0
L06-0290	77.6	83.3	79.9	-3.3	79.9	-3.3	0.0
L06-0292	78.0	82.8	79.9	-2.8	79.9	-2.8	0.0
L06-0294	78.4	83.3	80.0	-3.3	80.0	-3.3	0.0
L06-0300	78.0	83.2	80.0	-3.2	80.0	-3.2	0.0
L06-0310	78.7	84.0	85.6	1.6	85.6	1.6	0.0
L06-0340	68.3	77.1	74.1	-3.0	74.3	-2.8	0.2
L06-0350	69.1	78.1	74.5	-3.6	74.7	-3.4	0.2
L06-0360	70.0	79.1	74.6	-4.6	74.8	-4.4	0.2
L06-0361	70.0	79.1	74.3	-4.9	74.4	-4.7	0.2
L06-0380	70.9	76.7	75.6	-1.1	75.9	-0.8	0.3
L06-0390	71.7	78.8	75.7	-3.1	76.2	-2.6	0.5
L06-0390D	73.5	78.5	--	--	76.2	-2.3	--
L06-0390E	74.0	78.0	--	--	76.2	-1.8	--
L06-0390F	74.0	78.0	--	--	76.2	-1.8	--
L06-0400	72.5	78.2	76.7	-1.5	76.5	-1.7	-0.2
L06-0430	73.2	81.8	76.9	-4.8	76.8	-5.0	-0.1
L06-0432	73.3	81.8	77.0	-4.8	76.9	-4.9	-0.1
L06-0433	71.2	80.4	76.8	-3.6	76.6	-3.8	-0.2
L06-0434	72.2	80.5	76.8	-3.7	76.7	-3.8	-0.2
L06-0435	72.0	80.2	76.8	-3.4	76.6	-3.6	-0.2
L06-0436	73.3	80.4	77.4	-3.0	77.7	-2.7	0.3 (Note 1)
L06-0438	73.7	79.5	80.1	0.7	80.2	0.7	0.0
L06-0460	71.8	80.5	77.1	-3.4	77.0	-3.5	-0.1
L06-0480	71.9	80.8	77.1	-3.7	77.0	-3.8	-0.1
L06-0490	72.7	81.0	77.1	-3.9	77.0	-4.0	-0.1
L06-0492	72.8	81.1	77.6	-3.6	77.5	-3.6	0.0
L06-0500	74.4	81.5	77.6	-3.9	77.5	-3.9	0.0
L06-0502	74.6	81.0	77.7	-3.2	77.7	-3.3	0.0
L06-0510	75.3	82.7	77.9	-4.7	77.9	-4.7	0.0
L06-0520	77.5	82.8	78.9	-3.9	78.9	-3.8	0.0
L07-0040	74.4	78.7	75.2	-3.5	78.0	-0.7	2.8
L07-0041	74.4	81.4	75.2	-6.2	77.8	-3.6	2.6
L07-0042	73.7	80.2	74.2	-5.9	77.6	-2.6	3.3
L07-0043	72.9	80.2	74.1	-6.1	77.3	-2.9	3.2
L07-0050	76.2	80.0	76.5	-3.4	78.1	-1.8	1.6
L07-0060	74.8	79.6	80.6	1.0	78.9	-0.7	-1.7
L07-0061	73.3	78.3	79.2	0.9	74.7	-3.6	-4.4
L-070061N	74.0	79.2	--	--	74.8	-4.4	--
L07-0062	76.3	79.6	80.6	1.0	78.9	-0.7	-1.7
L07-0064	76.4	79.1	79.5	0.4	79.3	0.2	-0.3
L07-0068	72.5	79.8	79.2	-0.6	73.9	-5.9	-5.3
L07-0070	76.9	80.0	79.5	-0.5	79.3	-0.7	-0.3
L07-0080	77.3	80.1	80.3	0.3	80.3	0.3	0.0
L07-0100	75.0	81.0	79.8	-1.1	79.8	-1.2	0.0
L07-0130	72.6	91.7	80.6	-11.1	80.5	-11.2	0.0
L07-0140	66.9	72.8	80.6	7.8	80.5	7.8	0.0
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	64.9	-5.8	0.0
L08-0012	60.5	70.8	64.9	-5.8	64.9	-5.8	0.0
L08-0020	60.9	71.2	64.9	-6.3	64.9	-6.3	0.0
L08-0030	61.0	71.2	64.9	-6.3	64.9	-6.3	0.0
L08-0040	61.4	71.7	64.9	-6.8	64.9	-6.8	0.0
L08-0050	61.6	71.8	64.9	-6.9	64.9	-6.9	0.0
L08-0060	62.5	72.8	65.6	-7.2	65.6	-7.2	0.0
L09-0010	69.4	75.5	73.0	-2.5	73.1	-2.4	0.1
L09-0040	73.1	77.3	75.2	-2.1	75.2	-2.1	0.0
L09-0050	72.9	77.3	75.4	-2.0	75.4	-2.0	0.0
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0
L11-0020	79.6	85.6	81.1	-4.6	81.1	-4.6	0.0
L11-0030	79.6	85.6	87.1	1.4	87.1	1.5	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.4	-2.0	0.0
L13-0020	77.6	79.9	80.4	0.5	80.9	1.0	0.5
L15-0010	71.9	77.2	73.4	-3.7	73.5	-3.7	0.0
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0
MC0010	50.7	59.9	56.3	-3.6	56.3	-3.6	0.0

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0020	50.7	59.9	56.3	-3.6	56.3	-3.6	0.0
MC0030	51.1	60.3	56.6	-3.7	56.6	-3.7	0.0
MC0040	51.4	59.7	56.7	-3.0	56.7	-3.0	0.0
MC0050	51.5	60.1	56.9	-3.3	56.9	-3.3	0.0
MC0060	51.5	60.1	56.9	-3.3	56.9	-3.2	0.0
MC0070	52.2	64.1	57.1	-7.0	57.1	-7.0	0.0
MC0080	52.4	61.1	57.1	-4.1	57.1	-4.0	0.0
MC0090	53.3	63.2	58.3	-4.8	58.3	-4.8	0.0
MC0100	53.2	62.2	58.4	-3.9	58.4	-3.9	0.0
MC0110	54.3	63.6	59.9	-3.7	59.9	-3.8	0.0
MC0120	54.4	66.8	60.0	-6.8	60.0	-6.8	0.0
MC0130	54.2	64.0	60.3	-3.7	60.3	-3.7	0.0
MC0140	53.9	64.1	60.3	-3.8	60.3	-3.8	0.0
MC0150	57.2	68.6	62.5	-6.1	62.5	-6.1	0.0
MC0160	57.2	68.7	62.6	-6.2	62.6	-6.2	0.0
MC0170	57.9	69.2	63.0	-6.1	63.0	-6.1	0.0
MC0172	58.1	69.3	63.2	-6.1	63.2	-6.1	0.0
MC0174	58.2	69.3	63.2	-6.1	63.2	-6.1	0.0
MC0176	58.2	69.4	63.2	-6.1	63.2	-6.1	0.0
MC0178	58.2	69.4	63.2	-6.1	63.2	-6.1	0.0
MC0180	58.8	69.7	63.6	-6.1	63.6	-6.1	0.0
MC0190	58.8	69.7	63.6	-6.1	63.6	-6.1	0.0
MC0200	59.3	70.8	64.2	-6.6	64.2	-6.6	0.0
MC0210	58.5	70.2	64.3	-5.9	64.2	-5.9	0.0
MC0240	61.5	70.9	66.8	-4.1	66.8	-4.1	0.0
MC0250	62.0	71.1	67.7	-3.4	67.7	-3.4	0.0
MC0260	62.9	71.5	68.8	-2.6	68.8	-2.6	0.0
MC0270	62.2	70.5	68.9	-1.6	68.9	-1.6	0.0
MC0280	65.4	71.4	69.6	-1.9	69.6	-1.8	0.0
MC0282	65.5	71.5	69.7	-1.8	69.7	-1.8	0.0
MC0290	65.6	71.5	70.4	-1.1	70.4	-1.1	0.0
MC0292	67.1	71.9	71.3	-0.6	71.3	-0.6	0.0
MC0296	65.8	71.6	71.6	0.0	71.7	0.1	0.1
MC0298	65.4	71.6	71.6	0.0	71.7	0.1	0.1
MC0300	63.3	73.3	71.6	-1.6	71.8	-1.4	0.2
MC0310	63.3	72.5	71.7	-0.8	71.9	-0.6	0.2
MC0320	65.4	74.7	71.7	-3.0	71.9	-2.8	0.2
MC0330	65.2	71.6	72.0	0.4	72.2	0.6	0.2
MC0340	65.3	72.5	72.1	-0.4	72.3	-0.2	0.2
MC0350	65.3	72.8	72.1	-0.7	72.3	-0.5	0.2
MC0360	65.5	75.5	72.2	-3.2	72.4	-3.0	0.2
MC0370	64.9	75.5	72.2	-3.3	72.4	-3.1	0.2
MC0380	65.8	74.7	72.3	-2.4	72.5	-2.2	0.2
MC0390	67.1	73.5	72.4	-1.1	72.6	-0.9	0.2
MC0400	67.1	74.8	72.4	-2.4	72.6	-2.2	0.2
MC0410	68.1	78.7	72.9	-5.8	73.1	-5.6	0.1
MC0420	69.2	77.2	73.0	-4.2	73.1	-4.1	0.1
MC0422	69.2	77.2	73.1	-4.2	73.2	-4.1	0.1
MC0430	69.4	77.2	73.4	-3.8	73.4	-3.8	0.0
MC0430	69.4	77.2	73.4	-3.8	73.4	-3.8	0.0
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0
MC0440	69.0	76.0	73.4	-2.6	73.5	-2.5	0.0
MC0450	70.4	78.1	73.7	-4.3	73.8	-4.3	0.0
MC0451	69.7	77.4	73.6	-3.8	73.6	-3.8	0.0
MC0460	71.7	77.3	74.1	-3.3	74.1	-3.2	0.0
MC0461	70.4	77.6	74.2	-3.4	74.3	-3.3	0.0
MC0462	71.1	77.4	74.2	-3.2	74.3	-3.2	0.0
MC0463	71.3	76.7	74.2	-2.5	74.3	-2.4	0.0
MC0464	71.7	78.6	74.2	-4.4	74.3	-4.3	0.0
MC0464	71.7	78.6	74.2	-4.4	74.3	-4.3	0.0
MC0470	72.2	78.7	74.5	-4.2	74.6	-4.1	0.0
MC0480	71.8	77.5	74.7	-2.8	74.7	-2.7	0.0
MC0490	72.3	78.3	75.6	-2.7	75.7	-2.6	0.0
MC0500	72.4	78.4	75.8	-2.7	75.8	-2.6	0.0
MC0510	73.4	80.2	76.8	-3.5	76.8	-3.4	0.0
MC0520	73.0	81.1	77.1	-4.0	77.1	-3.9	0.0
MC0530	73.3	81.3	77.1	-4.2	77.2	-4.1	0.0
MC0540	73.3	81.4	77.3	-4.1	77.4	-4.0	0.1
MC0545	73.6	81.7	77.6	-4.1	77.7	-4.0	0.1
MC0550	74.0	81.9	77.9	-4.0	77.9	-4.0	0.0
MC0560	74.1	82.0	78.1	-3.9	78.1	-3.9	0.0
MC0570	74.5	82.1	78.3	-3.8	78.3	-3.8	0.0
MC0580	74.5	82.1	78.5	-3.7	78.5	-3.7	0.0
MC0590	75.6	82.9	79.3	-3.6	79.3	-3.6	0.0
MC0600	75.6	83.0	79.5	-3.4	79.5	-3.4	0.0
MC0610	76.0	83.2	79.7	-3.5	79.7	-3.5	0.0
MC0620	76.0	83.9	79.9	-4.0	79.9	-4.0	0.0
MC0630	75.1	83.2	80.0	-3.1	80.0	-3.1	0.0
MC0640	75.3	83.3	80.1	-3.2	80.1	-3.2	0.0

Table 6-1. Node Data and Model Results for 10-Year Storm

Model Input Data			Model Results				
			Existing Conditions		With Proposed Improvements		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0642	76.2	83.8	80.1	-3.7	80.1	-3.7	0.0
MC0644	76.3	83.9	80.8	-3.1	80.8	-3.1	0.0
MC0650	77.1	84.3	80.9	-3.4	80.9	-3.4	0.0
MC0660	76.2	83.7	80.1	-3.6	80.1	-3.6	0.0
MC0662	76.3	83.8	80.6	-3.2	80.6	-3.2	0.0
MC0670	78.0	84.8	80.9	-3.9	80.9	-3.9	0.0
WIC0005	50.5	56.7	57.0	0.4	56.9	0.2	-0.2
WIC0010	50.9	60.3	58.7	-1.6	59.8	-0.5	1.0
WIC0020	50.9	58.9	58.8	-0.1	59.8	0.9	1.0
WIC0030	51.8	59.4	59.4	0.0	60.3	0.9	0.9
WIC0032	52.5	60.1	59.9	-0.2	60.7	0.6	0.8
WIC0034	54.1	61.4	60.9	-0.5	61.4	0.0	0.5
WIC0040	54.9	62.1	61.3	-0.9	61.7	-0.4	0.4
WIC0050	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WIC0060	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

1. This increase is a result of the numerical calculation instability. At this node, there should be no increase in the water surface elevation.

Each of these six problem areas is discussed below, and is followed by additional discussion of the system performance.

J STREET SOUTH OF PENNINGTON ROAD

South of Pennington Road, J Street has rolled curbs and gutters, but has no storm drain system. The runoff flows south on J Street, and then flows east on Fir Street to Sinnard Avenue. At this point the runoff enters a storm drain that flows north into the ditch on the north side of Pennington Road (see Figure 6-2). However, the ground slopes downward to the south along Sinnard Avenue. The ditch flows west and enters the City's storm drain system near J Street.

The lack of a storm drain serving J and Fir Streets causes excessive gutter flow and minor street ponding. Also, the ditch on the north side of Pennington Road has a driveway culvert that is mostly plugged with sediment, causing a high water level at the end of the Sinnard Avenue storm drain. This high water level backs flow up the Sinnard Avenue drain and contributes to the street flooding at the intersection of Fir Street and Sinnard Avenue.

The proposed project to solve this problem is to construct a new storm drain as shown in Figure 6-2. This storm drain will flow south along Sinnard Avenue, turn west along Fir Street, cross the south end of the Live Oak Middle School field, and end in the Main Canal. The existing drain in Sinnard Avenue will be plugged where it enters the Pennington Road ditch. This project also includes clearing sediment from the driveway culvert at the north end of Sinnard Avenue to reduce the water level on the upstream side of the culvert.

The estimated cost for this project totals $535,000, including construction contingency, engineering, CM, administration and land easements as shown in Table 6-2.

L STREET BETWEEN BIRCH STREET AND PENNINGTON ROAD

There are no storm drains serving L Street between Birch Street and Pennington Road, nor are there curbs or gutters in this area. Many of the yards in this area are slightly lower than the streets. Runoff accumulates in the yards and flows south and west and slowly enters the surrounding storm drain systems or eventually infiltrates or evaporates.

In the future, the City intends to reconstruct the streets in this area, lowering them to facilitate drainage from the yards. Until that time, a storm drain system is proposed to serve this area as shown in Figure 6-3. This drain system includes field drain inlets in the street right of way, but at a level that will allow the yards to drain. When this project is designed, it will be important to use drain inlets that can be adapted to also serve the reconstructed, lowered street with curbs and gutters.

The estimated cost for this project totals $632,000, including construction contingency, engineering, CM, and contract administration as shown in Table 6-2.

Table 6-2. Cost Estimate for Improvements to Solve Existing Flooding and Drainage Problems

Item	Unit of Measure	Unit Cost	Quantity	Item Cost
1. J STREET SOUTH OF PENNINGTON ROAD				
24 inch RCP	feet	144	1,380	198,720
18 inch RCP	feet	108	365	39,420
12 inch RCP	feet	72	190	13,680
Maintenance holes	each	6,000	2	12,000
Drain inlets	each	5,000	6	30,000
Conflicts with Existing Utilities at (at 2 percent)				5,876
Mobilization/demobilization (at 5 percent)				14,691
Construction Contingency (at 20 percent)				58,764
Estimated Construction Cost				373,151
Land/Easements (20 feet wide across the Live Oak Middle School field)	acre	50,000	0.262	13,085
Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				149,261
Estimated Capital Cost				535,000
2. L STREET BETWEEN BIRCH STREET AND PENNINGTON ROAD				
24 inch RCP	feet	144	990	142,560
18 inch RCP	feet	108	610	65,880
12 inch RCP	feet	72	460	33,120
Maintenance holes	each	6,000	1	6,000
Field drain inlets	each	4,000	27	108,000
Conflicts with Existing Utilities at (at 2 percent)				7,111
Mobilization/demobilization (at 5 percent)				17,778
Construction Contingency (at 20 percent)				71,112
Estimated Construction Cost				451,561
Land/Easements	acre	50,000	0.0	0
Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				180,624
Estimated Capital Cost				632,000
3. HIGHWAY 99 CROSS CULVERTS				
30 inch RCP	feet	180	370	66,600
18 inch RCP	feet	108	1,100	118,800
12 inch RCP	feet	72	200	14,400
Maintenance holes	each	6,000	2	12,000
Drain inlets	each	5,000	12	60,000
Bore and jack 24-inch casing under Highway 99	feet	480	480	230,400
Conflicts with Existing Utilities at (at 2 percent)				10,044
Mobilization/demobilization (at 5 percent)				25,110
Construction Contingency (at 20 percent)				100,440
Subtotal				637,794
Land/Easements (Ex at 100 feet wide)	acre	50,000	0	0
Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				255,118
Estimated Capital Cost				893,000
4. LUTHER SCHOOL AND DE REE ROAD				
42 inch RCP	feet	252	1,700	428,400
36 inch RCP	feet	216	1,090	235,440
30 inch RCP	feet	180	2,210	397,800
18 inch RCP	feet	108	510	55,080
12 inch RCP	feet	72	360	25,920
Maintenance holes	each	6,000	4	24,000
Drain inlets	each	5,000	22	110,000
Conflicts with Existing Utilities at (at 2 percent)				25,533
Mobilization/demobilization (at 5 percent)				63,832
Construction Contingency (at 20 percent)				255,328
Subtotal				1,621,333
Land/Easements (Ex at 100 feet wide)	acre	50,000	0	0
Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				648,533
Estimated Capital Cost				2,270,000
5. WEST OF P STREET FROM PENNINGTON ROAD TO DATE STREET, GUM, FIR, AND ELM STREETS				
48 inch RCP	feet	288	840	241,920
30 inch RCP	feet	180	580	104,400
Maintenance holes	each	6,000	2	12,000
Field drain inlets	each	4,000	13	52,000
Orifice Plate	each	1,000	1	1,000
Headwall	CY	1,000	13	13,000
48-inch flap gate	each	7,000	1	7,000
Conflicts with Existing Utilities at (at 2 percent)				43,132
Mobilization/demobilization (at 5 percent)				21,566
Construction Contingency (at 20 percent)				86,264
Subtotal				582,282
Land/Easements (Ex at 100 feet wide)	acre	50,000	0	0
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				232,913
Estimated Capital Cost				815,000
6. Q STREET				
24 inch RCP	feet	144	580	83,520
18 inch RCP	feet	108	350	37,800
12 inch RCP	feet	72	200	14,400
Maintenance holes	each	6,000	1	6,000
Field drain inlets	each	4,000	12	48,000
Conflicts with Existing Utilities at (at 2 percent)				3,794
Mobilization/demobilization (at 5 percent)				9,486
Construction Contingency (at 20 percent)				37,944
Subtotal				240,944
Land/Easements (Ex at 40 feet wide, Require 100 feet wide)	acre	50,000	0	0
Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				96,378
Estimated Capital Cost				337,000
Total Estimated Construction Cost				3,907,066
Total Land/Easement Cost				13,085
Total Engineering, CM/Insp, CEQA and Permitting, City Admin (Note 1, at 40 percent)				1,562,826
Total Estimated Capital Cost				5,483,000

Note 1:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent

HIGHWAY 99 CROSS CULVERTS

A section of the downtown area, along Live Oak Boulevard/Highway 99 is not served by a storm drain system. Instead, there are several bubble up systems at the road crossings (south of Myrtle Street, at Kola Street, South of Kola Street and at Ivy Street). There is also one shallow culvert crossing of Highway 99 that discharges onto the ground surface on the west side of the highway. These systems do not effectively drain the Highway 99 in this area of downtown, resulting in ponding of water along and into the travel lanes of Highway 99 and the cross streets.

The proposed project to solve this problem is shown in Figure 6-4, and includes a storm drain system with only one crossing of Highway 99 that discharges to Lateral 6 at Kola Street. A smaller system drains the intersection of Ivy Street and Highway 99 southward into an existing 48-inch drain in Pennington Road.

The estimated cost for this project totals $893,000, including construction contingency, engineering, CM, and contract administration as shown in Table 6-2.

LUTHER SCHOOL AND DE REE ROAD

Luther School is drained by a 12-inch drain in Connecticut Street that flows south to a 24-inch drain in Pennington Road. At the connection of these two drains, the model results indicate that street flooding about 0.1 foot deep will occur during a 10-year storm. This high water level contributes to ponding upstream in the school.

De Ree Road has rural residential development along the west side and open space (orchards) along the east side. The elevations of the orchard and many of the yards are below the elevation of De Ree Road. De Ree Road lacks curbs and gutters, and is not served by a storm drain system; however, there are some cross culverts that are partially or fully plugged with sediment. Runoff accumulates in the yards/orchard until it eventually infiltrates or evaporates.

The proposed project to solve this problem is shown in Figure 6-5, and includes a storm drain system that starts at the intersection of Connecticut Street and Pennington Road, flows west and turns south down De Ree Road, crosses the orchard, turns south in Samuel Street, and ends in Lateral 2.

The estimated cost of this project totals $2,270,000, including construction contingency, engineering, CM, and contract administration as shown in Table 6-2.

WEST OF P STREET FROM PENNINGTON ROAD TO DATE STREET, GUM, FIR, AND ELM STREETS

A small ditch drains the area west of P Street between Pennington Road and Park Street. This ditch is located in the backyards of many houses and is nearly impossible for City staff to access and maintain. At numerous locations, this ditch is overgrown with vegetation and clogged with debris. In some locations, its condition is unknown. Also, drainage along Elm Street is provided by small roadside ditches with driveway culverts, and many of the culverts are partially plugged with sediment. These conditions lead to street and yard flooding.

Most of this area ultimately drains into the 54-inch trunk drain in P Street. Modeling of the 10-year storm shows that much of the trunk drain and tributary smaller storm drains in this area have less than one foot of freeboard to flooding depths of up to one foot (see Figure 5-1).

This project includes constructing local improvements in Gum, Fir, and Elm Streets and diverting flow from the trunk drain at the intersection of Kola and O Streets. This diversion lowers the water levels in the P Street trunk drain and thereby allows flow from the back yard ditch to discharge into the P Street trunk drain. This is accomplished by the following improvements (see Figure 6-6):

- A 48-inch diversion drain from the 42-inch drain in O Street north of Pennington Road, flowing eastward along Kola Street to Lateral 6. This diversion drain includes a flap gate at Lateral 6 to prevent back flows in the 42" drain. High flow would be forced into this diversion by an 18-inch diameter orifice that would restrict the flow southward to the O Street drain.
- A 30-inch drain with two inlets in Gum Street from the backyard ditch to the P Street trunk drain.
- Drain inlets on Fir Street at the backyard ditch that connect to the existing 21-inch and 24-inch drain flowing to the P Street trunk drain.
- A 30-inch drain with two inlets in Elm Street from the backyard ditch to the P Street trunk drain. This drain system would also extend west of the backyard ditch to facilitate draining/removal of the road side ditches. This drain system includes field drain inlets in the street right of way, but at a level that will allow the yards to drain. These drain inlets should be designed to also serve a future reconstructed, lowered street with curbs and gutters.

The estimated cost of this project totals $815,000 including construction contingency, engineering, CM and contract administration as shown in Table 6-2.

Q STREET

Along Q Street, north of Apricot Street, drainage is provided by small roadside ditches with driveway culverts. Many of the culverts are partially plugged with sediment. This condition leads to street and yard flooding.

The proposed project to solve this problem is shown in Figure 6-7 and includes an 18-inch to 24-inch drain along Q Street. This drain includes field drain inlets in the street right of way, but at a level that will allow the yards to drain. These drain inlets should be designed so that they can be adapted to also serve a future reconstructed, lowered street with curbs and gutters.

The estimated cost of this project totals $337,000 including construction contingency, engineering, CM, and contract administration as shown in Table 6-2.

SYSTEM PERFORMANCE

The proposed improvements described above result in improved drainage and decreased flooding at the existing problem areas. However, there are some locations in the City at which these improvements result in increased water levels, but in almost all cases, there is still at least one foot of freeboard. In a few locations, the increased water levels results in less than one foot of freeboard, but does not cause street flooding.

Several of these improvements either redirect runoff into the RD 777 Main Canal or result in runoff reaching the Main Canal more quickly. These changes result in increased maximum water levels in the Main Canal and tributary channels downstream of the City by 0.1 feet to 0.2 feet. This increase represents a drainage impact to these agricultural areas. For future growth of the City, stormwater detention basins will be utilized to eliminate impacts to the agricultural areas upstream and downstream of the City. These basins will be sized to also eliminate the increased water levels from the improvements that address existing flooding and drainage problems within the City.

As shown in Table 6-2, the estimated total construction cost for all of the projects is $3.9 million. The estimated total capital cost for all of these projects, including land, engineering, CM, CEQA, and contract administration costs, is $5.5 million.

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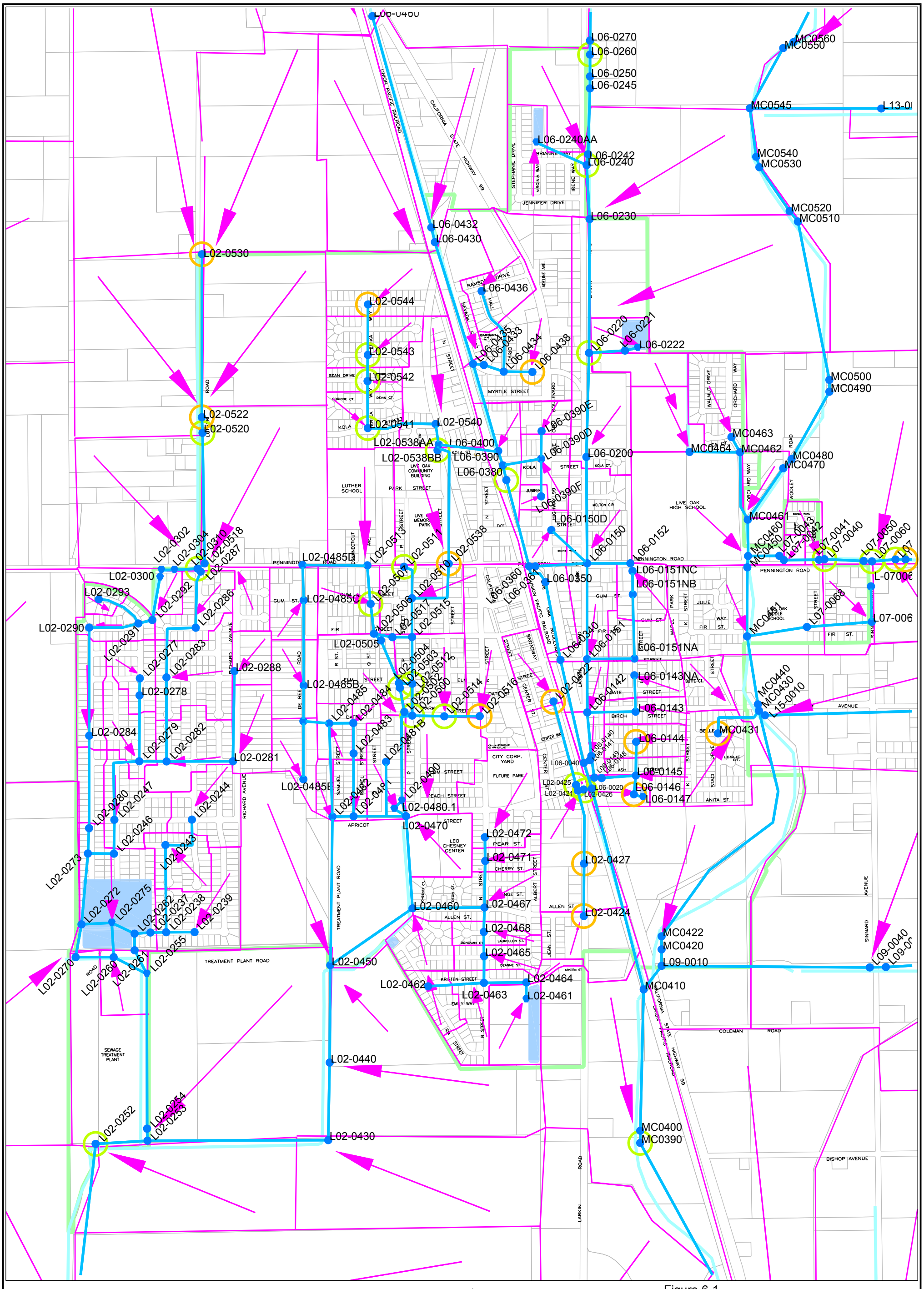

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK
- SHED BOUNDARY
- FLOOD DEPTH 1 - 2 FT
- FLOOD DEPTH 0 TO 1 FT
- FREEBOARD 0 TO 1 FT

N

0 450 900

SCALE IN FEET

Figure 6-1

City of Live Oak
Master Drainage Study
10-YEAR DESIGN STORM FLOODING WITH PROPOSED IMPROVEMENTS TO SOLVE EXISTING DRAINAGE/FLOODING PROBLEMS

WEST YOST ASSOCIATES
Consulting Engineers

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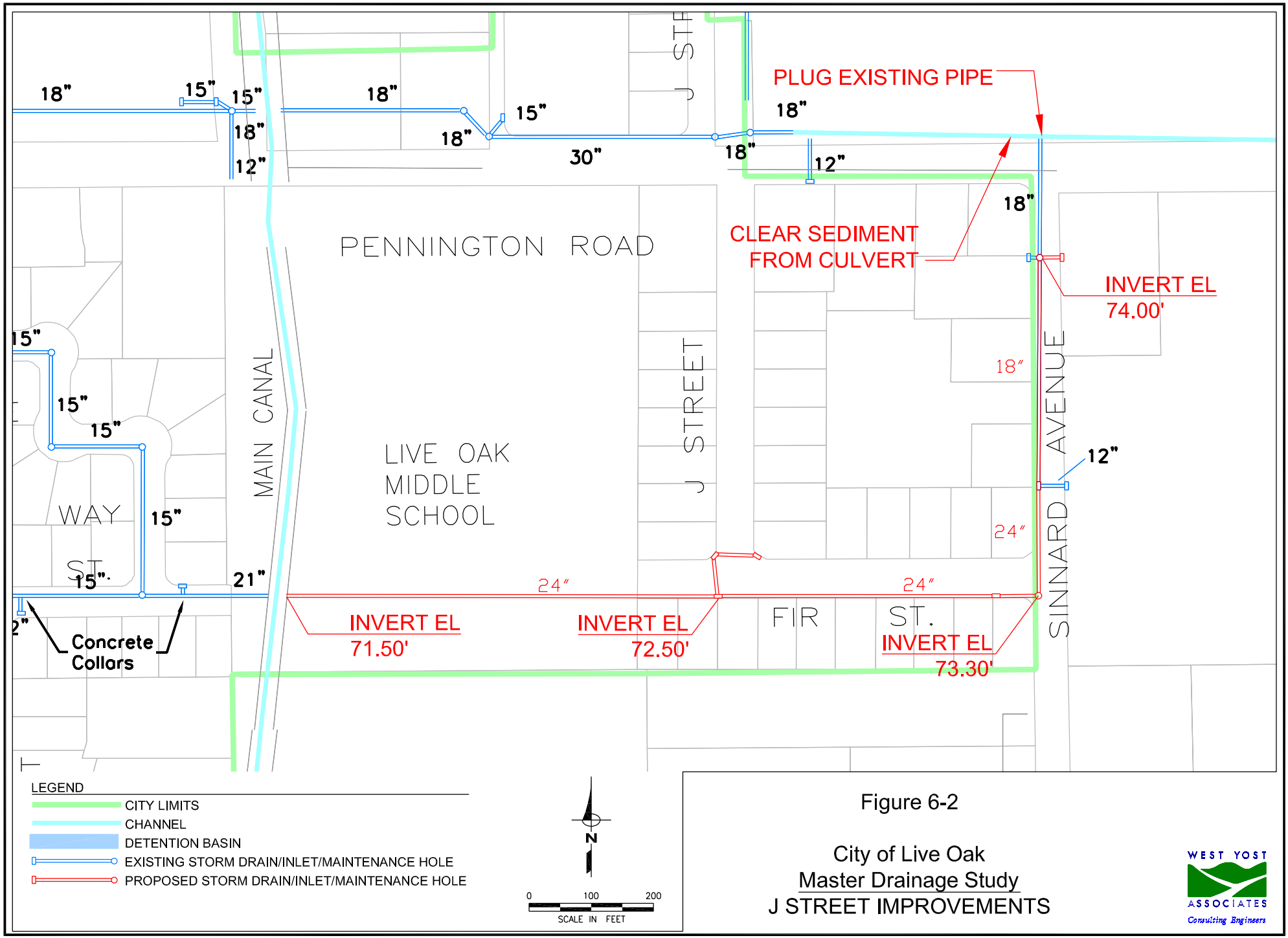

Figure 6-2

City of Live Oak
Master Drainage Study
J STREET IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

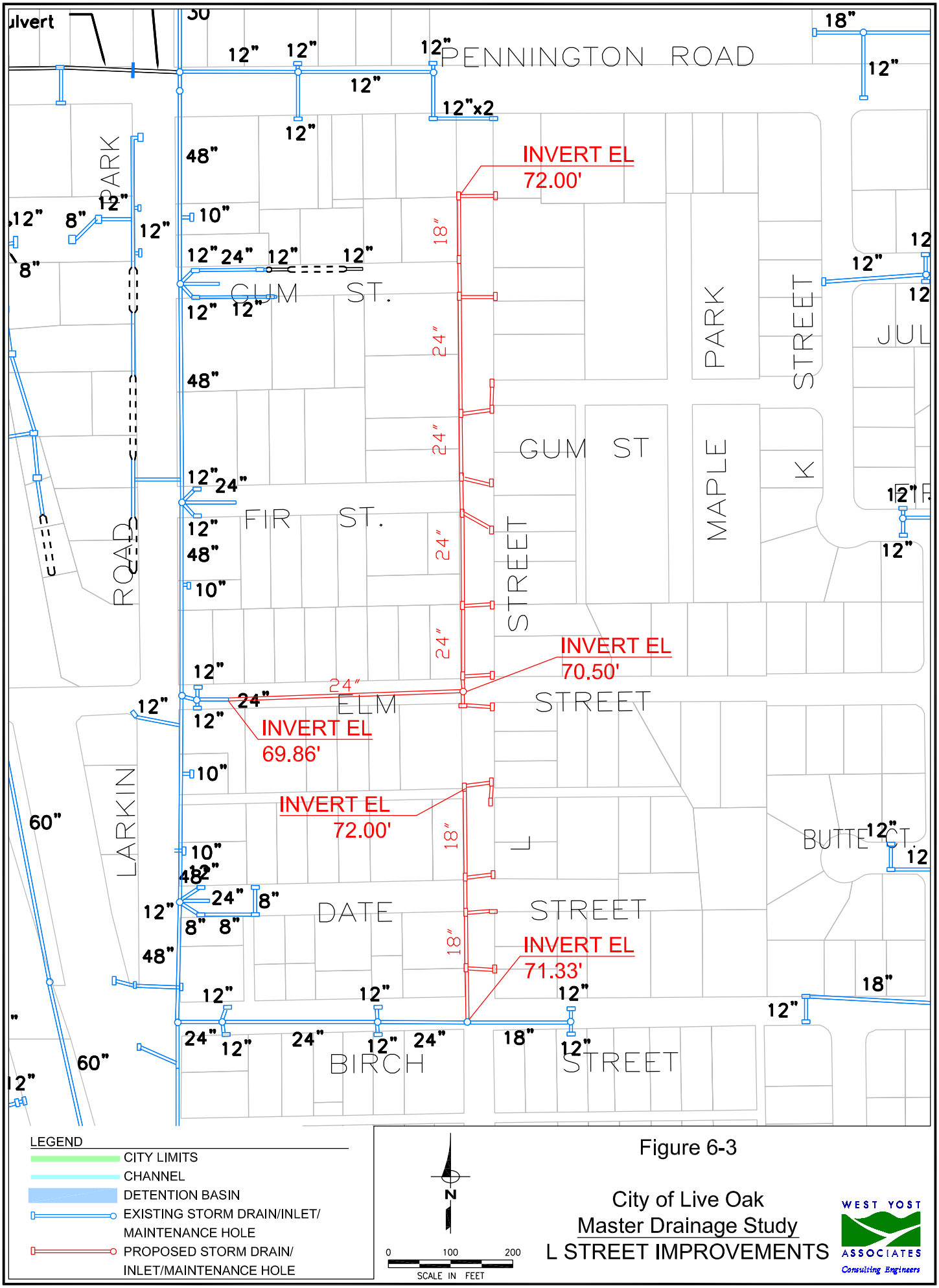

Figure 6-3

City of Live Oak
Master Drainage Study
L STREET IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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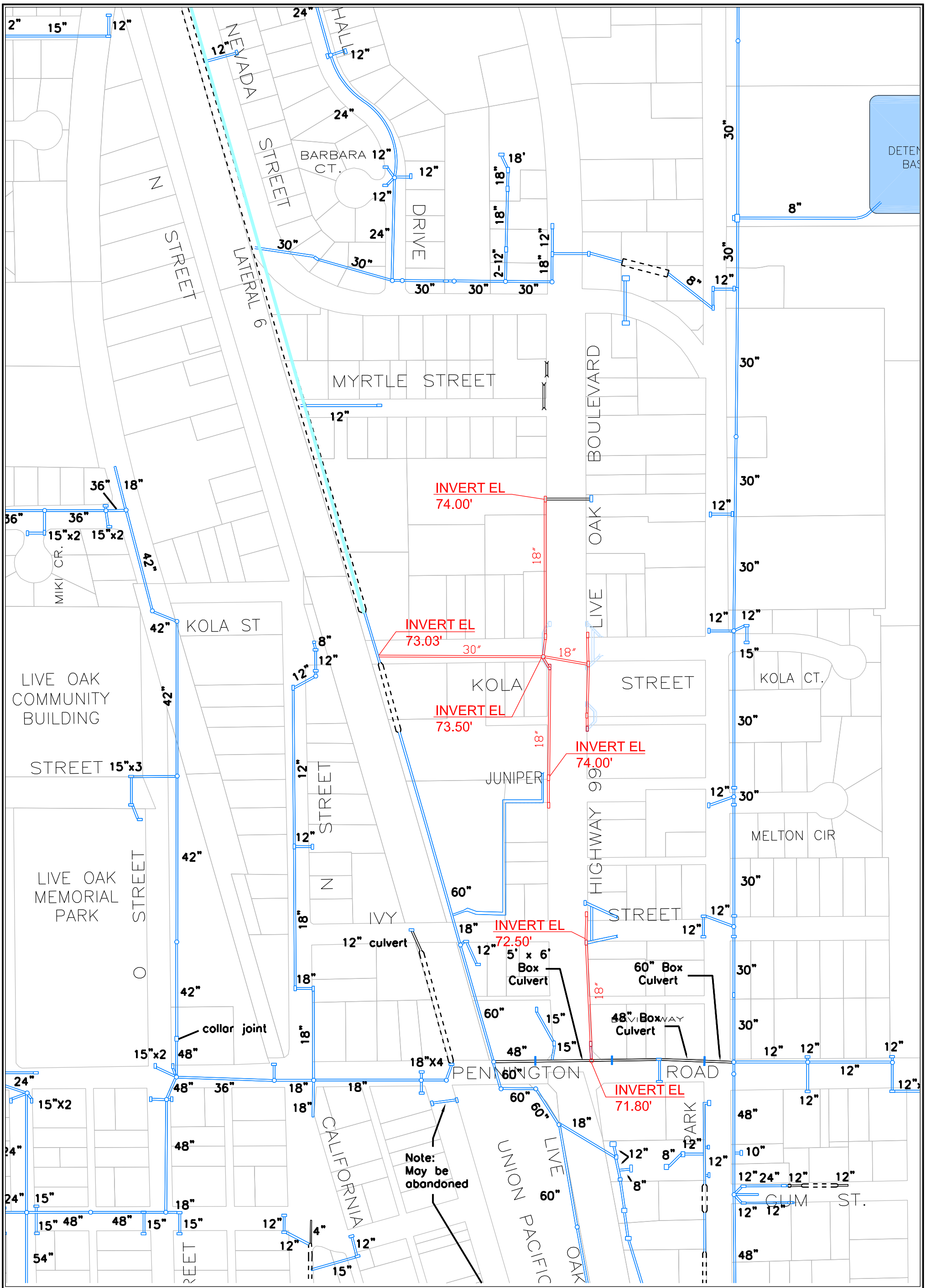

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- EXISTING STORM DRAIN/INLET/MAINTENANCE HOLE
- PROPOSED STORM DRAIN/INLET/MAINTENANCE HOLE

N

0 100 200
SCALE IN FEET

Figure 6-4

City of Live Oak
Master Drainage Study
HIGHWAY 99 IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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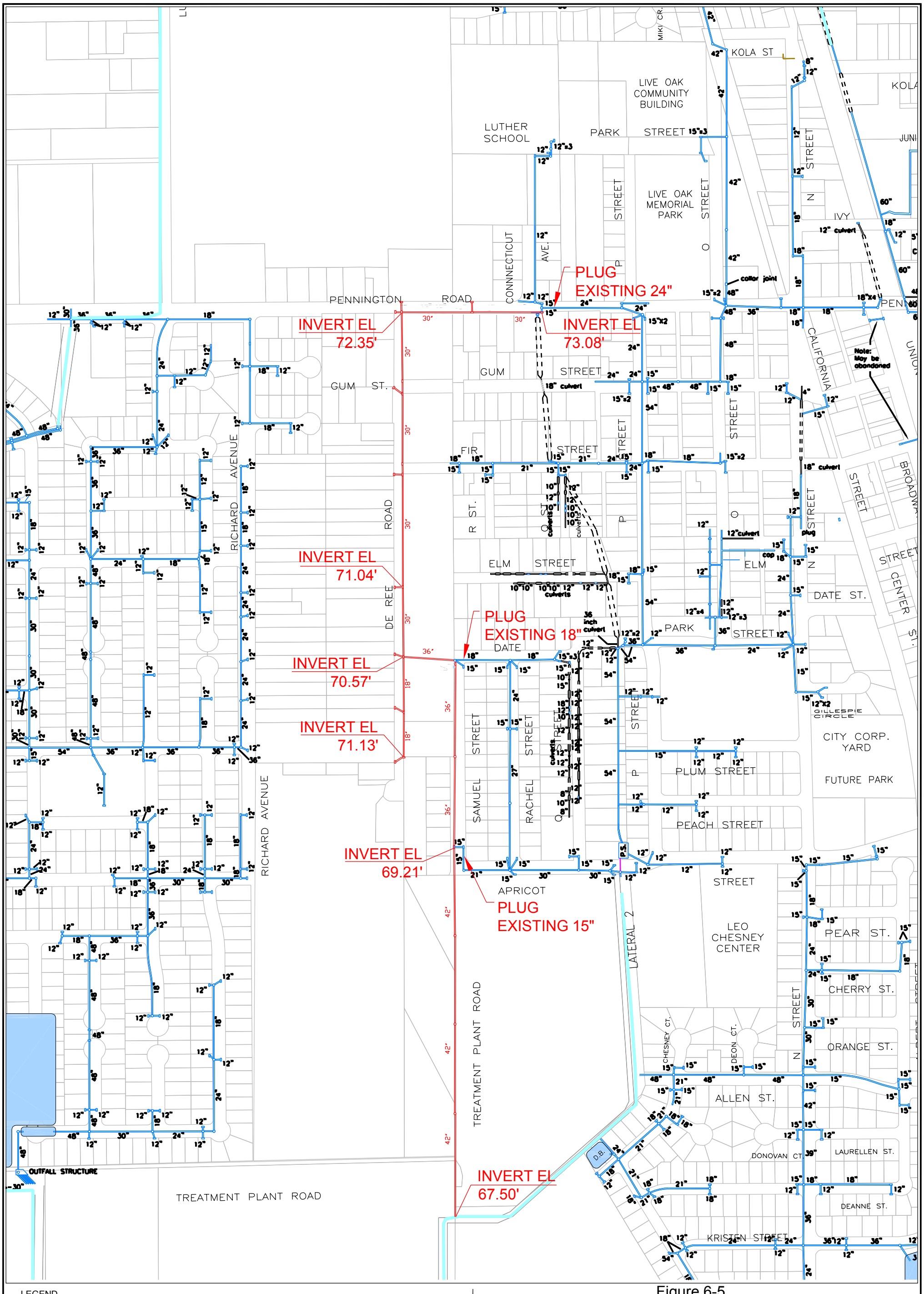

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- EXISTING STORM DRAIN/INLET/MAINTENANCE HOLE
- PROPOSED STORM DRAIN/INLET/MAINTENANCE HOLE

N

0 150 400

SCALE IN FEET

Figure 6-5

City of Live Oak
Master Drainage Study
LUTHER SCHOOL AND DE REE ROAD IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

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HEADWALL WITH FLAPGATE

INVERT EL 72.50'

INVERT EL 72.45'

INVERT EL 73.10'

INSTALL 18" DIAMETER ORIFICE PLATE

INVERT EL 70.89'

INVERT EL 71.00'

INVERT EL 70.50'

INVERT EL 69.00'

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- EXISTING STORM DRAIN/INLET/MAINTENANCE HOLE
- PROPOSED STORM DRAIN/INLET/MAINTENANCE HOLE

N

0 200 400

SCALE IN FEET

Figure 6-6

City of Live Oak
Master Drainage Study
WEST OF P STREET IMPROVEMENTS

WEST YOST ASSOCIATES
Consulting Engineers

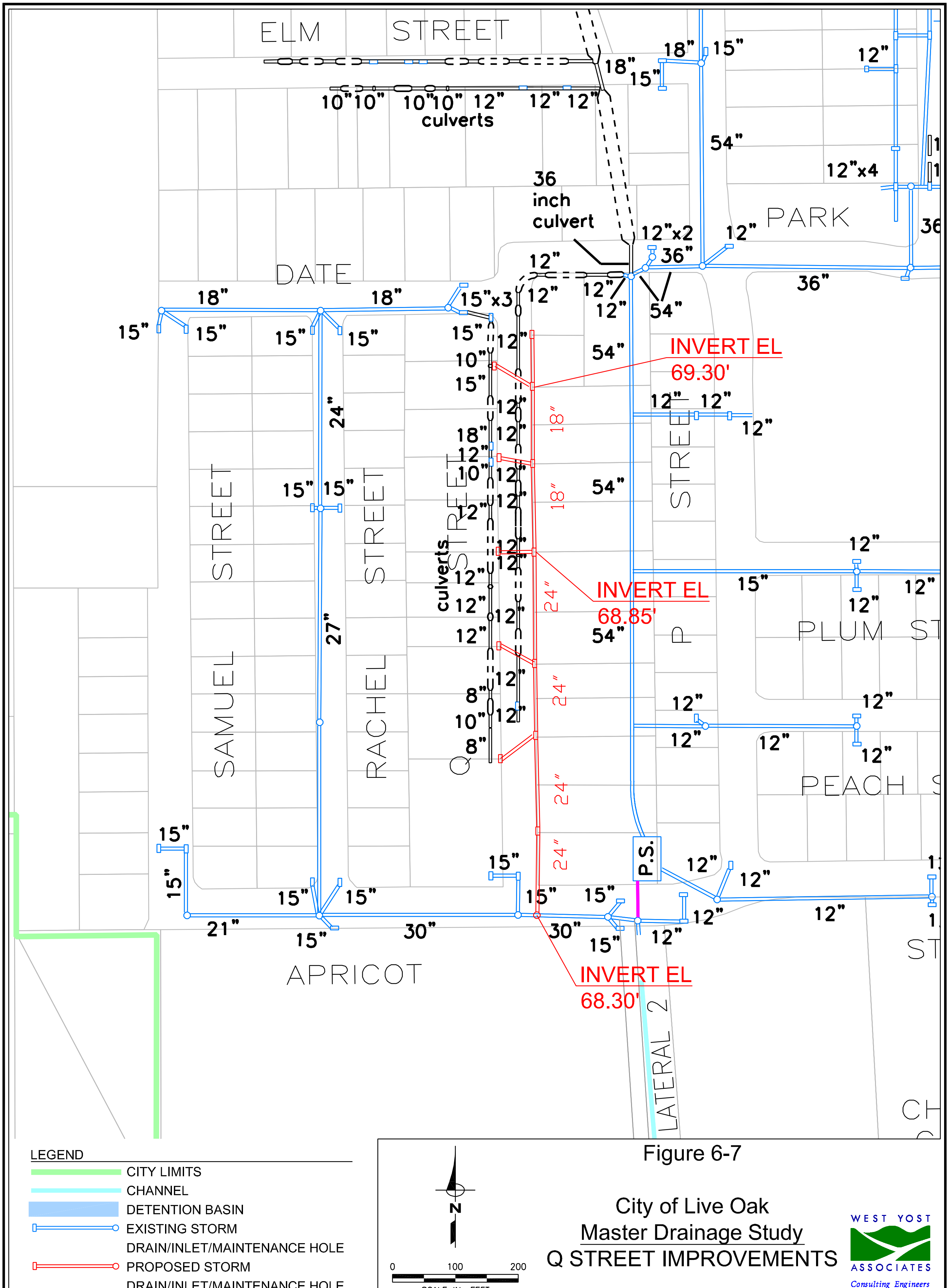


Figure 6-7

City of Live Oak
Master Drainage Study
Q STREET IMPROVEMENTS

CHAPTER 7. GENERAL PLAN BUILDOUT LAND USE

Development in the greater Live Oak area, within RD 777 (the District) will cause increased runoff rates which could exacerbate existing flooding. Presented in this chapter is a summary of the planned future development of the City of Live Oak (City), the resulting increases in runoff rates, and the potential increases in flooding depths. This chapter presents the analysis of a condition in which the land uses within the City's proposed General Plan Update area are fully developed, but no drainage improvements have been made. This condition is evaluated as an intermediate analysis step in the preparation of this MDS, but it is not anticipated that this condition would actually occur.

FUTURE LAND USES

Future land uses are shown in Figure 7-1. The future land uses were based on the recommended land use plan from City's General Plan Update. These future land uses were obtained from EDAW/AECOM, the City's General Plan Update consultant. The future land uses include:

- Low-Density Residential – This land use includes single-family, detached homes, one to each lot, with a density of approximately three to four units per acre.
- Small-Lot Residential – This land use involves the development of smaller single-family, detached bungalows and other types of homes, one to each lot, with a density of approximately five to seven units per acre.
- Medium Density Residential – This land use includes townhomes and other attached single-family homes, zero-lot line single family detached units, and other residences with an approximate density of 10 dwelling units per gross acre (du/ac).
- Higher-Density Residential - This land use category accommodates a mix of land uses, but with the primary land use being apartments or condominiums at or above 20 units per acre. This category could include residential units above commercial uses in a vertically mixed use design or one property that has a residential component along with a commercial or office component but in a separate building.
- Commercial Mixed Use - This land use category accommodates a mix of land uses including commercial retail and commercial service businesses. This category could include residential units above commercial uses in a vertically mixed use design or one property that has a commercial component along with a residential or office component but in a separate building.
- Downtown Mixed Use – This land use category accommodates a mix of land uses including commercial retail and commercial service businesses.
- Community Commercial – This land use category includes commercial retail and commercial service businesses.
- Employment - This land use involves the development of professional offices, light industrial development, and other land uses that would result in job opportunities for existing and future local residents.

- Parks and Open Space – This land use includes active and passive parkland of all types, including community and regional parks, neighborhood parks, public plazas, town squares, pocket parks, tot lots, parkways, linear parks, and other configurations. This land use category might include areas proposed for stormwater management, including areas that are developed to be both an attractive community amenity, as well as a metering device during storm events.
- Civic – This land use includes schools, churches and other places of worship, public facilities and infrastructure, community halls, and other cultural and civic land uses.
- Urban Reserve – This land use would include ongoing agricultural operations, land uses compatible with ongoing agricultural operations, very low-density rural residential development, and natural resource areas. These are areas surrounding the City that will remain in some type of primarily open space land use during the General Plan Planning Period but may eventually develop.
- Preserve – This land use includes ongoing agricultural operations, land uses compatible with ongoing agricultural operations, very low-density rural residential development, and natural resource areas. These are areas surrounding the City that will remain in some type of primarily open space land use permanently.
- Neighborhood Center – This land use includes commercial mixed use, higher-density residential, medium-density residential, parks and other civic uses.
- Civic Center – This land use includes higher-density residential, medium-density residential, parks, schools and other civic uses.

Relevant hydrologic data for each land use is summarized in Table 7-1.

Table 7-1. Hydrologic Data for each Land Use

Land Use	% Impervious	Slope
Low-Density Residential	30	0.01
Small Lot Residential	40	0.01
Medium-Density Residential	60	0.01
High-Density Residential	80	0.01
Commercial Mixed Use	85	0.01
Downtown Mixed Use	85	0.01
Community Commercial	85	0.01
Employment	85	0.01
Park and Open Space	5	0.01
Civic	85	0.01
Urban Reserve	1	0.001
Neighborhood Center	71	0.01
Civic Center	61	0.01
Buffer	5	0.01

INCREASED RUNOFF RATES FROM DEVELOPMENT

Presented in Table 7-2 are the peak runoff rates from each subshed for existing and future conditions for the 10-year storm. Table 7-3 shows the same data as in Table 7-2 for the 100-year storm. The highlighted rows indicate subsheds in which updated land uses were included.

As shown, for the 10-year storm, development of agricultural lands (1 percent impervious) to low and medium density residential land uses (300 to 60 percent impervious) causes the runoff rates to increase from at least three to more than eight times the existing runoff rates, and development of agricultural land to commercial uses causes the runoff rates to increase approximately by six times. For low density residential land uses, the unit runoff rates range from 0.56 to 1.11 cfs per acre depending on the subshed size (294.6 to 35.1 acres respectively) and the soil type.

For the 100-year storm, development of agricultural lands to low and medium density residential uses causes the runoff rates to increase from at least four to more than eight times the 100-year rate under existing conditions. Development of agricultural land to commercial uses causes the runoff rates to increase by approximately seven times from existing conditions. For low density residential land uses, the unit runoff rates rage from 0.78 to 1.48 cfs per acre depending on the subshed size (245.8 to 35.1 acres respectively) and the soil type.

These 10-year and 100-year runoff rates appear reasonable for fully developed conditions.

POTENTIAL FOR INCREASED FLOODING FROM DEVELOPMENT

As shown in Table 7-4, the General Plan growth (without mitigation) causes increased flooding depths upstream, through, and downstream of the City.

For the 10-year storm, WSELs in the City and upstream of the City increase by 0 to 4.4 feet as compared to WSELs under existing conditions. The average increase in flooding depths in areas of future development is about 1.8 feet. South of the future development WSELs may increase by up to 3.2 feet, with an average increase of 0.8 feet.

For the 100-year storm, WSELs in the City and upstream of the City increase by 0 to 2.6 feet as compared to WSELs under existing conditions. The average flooding depth increase will be about 1.3 feet in areas of future development. South of the future development WSELs may increase by up to 2.6 feet, with an average increase of 0.6 feet.

In the upper reaches of RD 777, the WSELs increase significantly in both the 10-year and 100-year storms. This occurs because a significant portion of the upper watershed will be developed. In the lower watershed, the WSELs increase only slightly because there is not additional development in the lower watershed and therefore the increase in flows is not as great as in the upper reaches. In addition, the increased runoff from development is unable to reach the lower watersheds because of the undersized culverts at some of the road and irrigation canal crossings.

Table 7-2. 10-Year Hydrologic Model Input for Existing Conditions and Future Conditions

Subshed/ Tributary Node	Subcatch-ment No.	Area, ac	Existing Conditions						Future Conditions						Change in Max Flow, cfs
			Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	Land Use	% Imperv-ious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	
EIC0075	1	113.7	Ag	1.0	0.001	42,755	17	0.15	Ag	1	0.001	42,755	17	0.15	0
EIC0090	1	145.2	Ag	5.7	0.001	50,137	34	0.23	Ag	6	0.001	50,137	34	0.23	0
EIC0100	1	283.2	Ag	1.0	0.001	92,778	32	0.11	Ag	1	0.001	92,778	32	0.11	0
EIC0140	1	163.1	Ag	1.0	0.001	58,412	24	0.15	Ag	1	0.001	58,412	24	0.15	0
L01-0008	1	209.8	Ag	1.0	0.001	72,403	19	0.09	Ag	1	0.001	72,403	19	0.09	0
L01-0010	1	402.3	Ag	3.8	0.001	117,903	113	0.28	Ag	4	0.001	117,903	113	0.28	0
L01-0120	1	77.4	Ag	1.0	0.001	30,682	18	0.24	Ag	1	0.001	30,682	18	0.24	0
L01-0150	1	43.8	Ag	1.0	0.001	19,123	7	0.16	Ag	1	0.001	19,123	7	0.16	0
L01-0160	1	24.7	Ag	1.0	0.001	12,345	3	0.13	Ag	1	0.001	12,345	3	0.13	0
L01-0180	1	194.8	Ag	1.0	0.001	67,987	42	0.22	Ag	1	0.001	67,987	42	0.22	0
L01-0210	1	216.5	Ag	1.0	0.001	74,349	52	0.24	Ag	1	0.001	74,349	52	0.24	0
L01-0230	1	208.4	Ag	1.0	0.001	71,983	24	0.12	Ag	1	0.001	71,983	24	0.12	0
L01-0290	1	294.6	Ag	1.0	0.001	95,798	61	0.21	Res	17	0.006	23,883	164	0.56	103
L02-0020	1	193.6	Ag	5.2	0.002	62,992	80	0.41	Ag	5	0.002	62,992	80	0.41	0
L02-0030	1	223.9	Ag	1.0	0.001	76,474	56	0.25	Ag	1	0.001	76,474	56	0.25	0
L02-0040	1	145.8	Ag	1.0	0.001	53,031	35	0.24	Ag	1	0.001	53,031	35	0.24	0
L02-0042	1	110.6	Ag	1.0	0.001	41,738	28	0.25	Ag	1	0.001	41,738	28	0.25	0
L02-0070	1	137.4	Ag	1.0	0.001	50,373	36	0.26	Ag	1	0.001	50,373	36	0.26	0
L02-0080	1	127.8	Ag	1.0	0.001	47,306	34	0.26	Ag	1	0.001	47,306	34	0.26	0
L02-0088	1	138.7	Ag	1.0	0.001	50,786	31	0.22	Ag	1	0.001	50,786	31	0.22	0
L02-0100	1	108.9	Ag	1.0	0.001	41,172	31	0.28	Ag	1	0.001	41,172	31	0.28	0
L02-0108	1	37.1	Ag	1.0	0.001	16,749	11	0.29	Ag	1	0.001	16,749	11	0.29	0
L02-0120	1	185.2	Ag	1.0	0.001	65,118	50	0.27	Ag	1	0.001	65,118	50	0.27	0
L02-0140	1	35.1	Ag	1.0	0.001	16,031	10	0.29	Res	29	0.010	6,500	39	1.11	29
L02-0160	1	74.7	Ag	1.0	0.001	29,773	21	0.28	Res	35	0.010	5,700	75	1.01	54
L02-0180	1	56.8	Ag	1.0	0.001	23,651	16	0.29	Ag	1	0.001	23,651	16	0.29	0
L02-0220	1	52.3	Ag	1.0	0.001	22,080	16	0.31	Res	21	0.007	9,980	47	0.89	31
L02-0239	1	15.6	Res	60.0	0.010	669	17	1.08	Res	60	0.010	669	17	1.08	0
L02-0240	1	37.3	Ag	1.0	0.001	16,821	14	0.38	Res	37	0.010	5,364	50	1.33	36
L02-0243	1	8.0	Res	60.0	0.010	346	9	1.08	Res	60	0.010	346	9	1.08	0
L02-0244	1	11.2	Res	60.0	0.010	481	12	1.08	Res	60	0.010	481	12	1.08	0
L02-0247	1	10.9	Res	60.0	0.010	468	12	1.08	Res	60	0.010	468	12	1.08	0
L02-0250	1	173.5	Ag	1.0	0.001	61,585	38	0.22	Res	51	0.011	7,103	176	1.02	138
L02-0252	1	44.7	Ag	1.0	0.001	19,424	9	0.20	Res	30	0.010	14,418	51	1.15	42
L02-0253	1	129.8	Ag	1.0	0.001	47,913	19	0.15	Res	42	0.010	8,787	133	1.03	114
L02-0255	1	36.1	Res	59.3	0.010	1,193	35	0.96	Res	59	0.010	1,193	35	0.96	0
L02-0260	1	7.4	Ag	1.0	0.001	3,455	1	0.12	Ag	1	0.001	3,455	1	0.12	0
L02-0270	1	163.2	Ag	1.0	0.001	58,440	36	0.22	Res	34	0.010	15,060	166	1.02	130
L02-0275	1	21.0	OS	5.0	0.010	7,434	5	0.24	OS	5	0.010	7,434	5	0.24	0
L02-0277	1	6.9	Res	60.0	0.010	296	7	1.08	Res	60	0.010	296	7	1.08	0
L02-0279	1	8.4	Res	60.0	0.010	363	9	1.08	Res	60	0.010	363	9	1.08	0
L02-0280	1	5.8	Res	60.0	0.010	249	6	1.08	Res	60	0.010	249	6	1.08	0
L02-0281	1	8.5	Res	40.0	0.010	943	9	1.11	Res	40	0.010	943	9	1.11	0
L02-0282	1	14.6	OS	5.0	0.010	5,238	4	0.24	OS	5	0.010	5,238	4	0.24	0
L02-0283	1	15.2	Res	60.0	0.010	653	17	1.09	Res	60	0.010	653	17	1.09	0
L02-0284	1	7.6	Res	60.0	0.010	328	8	1.08	Res	60	0.010	328	8	1.08	0
L02-0286	1	9.2	Res	60.0	0.010	397	10	1.09	Res	60	0.010	397	10	1.09	0
L02-0287	1	6.0	Res	60.0	0.010	259	7	1.09	Res	60	0.010	259	7	1.09	0
L02-0288	1	5.1	mix	40.0	0.010	565	6	1.11	mix	40	0.010	565	6	1.11	0
L02-0290	1	5.8	Res	60.0	0.010	249	6	1.08	Res	60	0.010	249	6	1.08	0
L02-0292	1	7.4	OS	5.0	0.010	2,664	2	0.24	OS	5	0.010	2,664	2	0.24	0
L02-0293	1	2.6	Res	60.0	0.010	114	3	1.08	Res	60	0.010	114	3	1.08	0
L02-0304	1	40.5	Ag	1.0	0.001	17,952	5	0.12	Res	31	0.010	6,885	39	0.97	34
L02-0310	1	49.6	mix	7.7	0.002	18,918	14	0.28	mix	40	0.010	5,565	55	1.11	41
L02-0320	1	103.3	Ag	1.0	0.001	39,359	11	0.10	Ag	1	0.001	39,359	11	0.10	0
L02-0330	1	110.2	Ag	1.1	0.001	41,545	11	0.10	Ag	1	0.001	41,545	11	0.10	0
L02-0340	1	199.9	Ag	1.0	0.001	69,501	25	0.12	Ag	1	0.001	69,501	25	0.12	0
L02-0360	1	304.2	Ag	1.0	0.001	98,295	32	0.11	Ag	1	0.001	98,295	32	0.11	0
L02-0421	1	28.4	Res	40.0	0.005	1,032	20	0.69	Res	40	0.005	1,032	20	0.69	0
L02-0422	1	7.2	Res	40.0	0.005	309	5	0.74	Res	40	0.005	309	5	0.74	0
L02-0424	1	13.5	mix	40.0	0.005	1,500	14	1.02	mix	40	0.005	1,500	14	1.02	0
L02-0430	1	55.1	Ag	1.0	0.001	23,043	13	0.24	mix	51	0.010	3,495	65	1.17	51
L02-0440	1	62.3	Ag	1.0	0.001	25,795	15	0.24	res	26	0.010	9,802	59	0.95	45
L02-0450	1	62.5	mix	25.7	0.005	9,245	50	0.79	mix	40	0.010	6,352	69	1.11	20
L02-0460	1	7.2	Res	40.0	0.005	309	5	0.76	Res	40	0.005	309	5	0.76	0
L02-0461	1	10.1	OS	5.0	0.010	3,647	5	0.54	OS	5	0.010	3,647	5	0.54	0
L02-0462	1	5.1	Res	60.0	0.010	220	6	1.12	Res	60	0.010	220	6	1.12	0
L02-0463	1	9.2	Res	60.0	0.010	396	10	1.12	Res	60	0.010	396	10	1.12	0
L02-0464	1	1.2	Res	40.0	0.005	50	1	0.76	Res	40	0.005	50	1	0.76	0
L02-0465	1	5.9	Res	40.0	0.005	253	5	0.76	Res	40	0.005	253	5	0.76	0
L02-0467	1	15.5	Res	40.0	0.005	667	12	0.76	Res	40	0.005	667	12	0.76	0
L02-0468	1	4.1	Res	40.0	0.005	176	3	0.76	Res	40	0.005	176	3	0.76	0
L02-0470	1	9.7	Res	40.0	0.005	418	14	0.74	Res	40	0.005	418	14	0.74	0
L02-0470	2	9.6	Res	40.0	0.005	414	--	--	Res	40	0.005	414	--	--	--
L02-0471	1	4.4	Res	40.0	0.005	191	3	0.76	Res	40	0.005	191	3	0.76	0
L02-0472	1	16.5	mix	20.0	0.005	1,836	11	0.66	mix	20	0.005	1,836	11	0.66	0
L02-0481	1	5.0	Res	40.0	0.005	217	4	0.74	Res	40	0.005	217	4	0.74	0
L02-0482	1	26.9	mix	20.0	0.005	2,680	16	0.59	mix	20	0.005	2,680	16	0.59	0
L02-0485	1	7.4	Res	40.0	0.005	319	5	0.74	Res	40	0.005	319	5	0.74	0
L02-0490	1	16.2	Res	40.0	0.005	696	12	0.74	Res	40	0.005	696	12	0.74	0
L02-0502	1	14.3	Res	40.0	0.005	615	11	0.74	Res	40	0.005	615	11	0.74	0
L02-0507	1	10.3	Res	40.0	0.005	443	8	0.74	Res	40	0.005	443	8	0.74	0
L02-0510	1	14.2	Res	40.0	0.005	610	11	0.74	Res	40	0.005	610	11	0.74	0
L02-0513	1	19.2	Res	40.0	0.005	825	14	0.74	Res	40	0.005	825	14	0.74	0
L02-0514	1	13.6	Res	40.0	0.005	584	10	0.74	Res	40	0.005	584	10	0.74	0
L02-0516	1	25.3	Res	40.0	0.005	968	18	0.71	Res	40	0.005	968	18	0.71	0
L02-0522	1	103.3	Ag	1.0	0.001	39,359	10	0.10	Res	30	0.010	12,180	92	0.89	81
L02-0530	1	249.8	Ag	1.0	0.001	83,754	23	0.09	mix	58	0.010	3,105	150	0.60	127
L02-0538	1	31.5	Res	40.0	0.005	1,096	21	0.68	Res	40	0.005	1,096	21	0.68	0
L02-0540	1	19.2	Res	40.0	0.005	825	14	0.74	Res	40	0.005	825	14	0.74	0
L02-0541	1	10.4	Res	40.0	0.005	447	8	0.74	Res	40	0.005	447	8	0.74	0
L02-0542	1	4.5	Res	40.0	0.005	192	3	0.74	Res	40	0.005	192	3	0.74	0
L02-0543	1	11.1	Res	40.0	0.005	479	8	0.74	Res	40	0.005	479	8	0.74	0
L02-0544	1	17.7	mix	20.0	0.005	1,969	10	0.59	mix	20	0.005	1,969	10	0.59	0
L03-0020	1	23.5	Ag	1.0	0.001	11,905	3	0.13	Ag	1	0.001	11,905	3	0.13	0
L03-0040	1	68.8	Ag	1.0	0.001	27,776	7	0.11	Ag	1	0.001	27,776	7	0.11	0
L03-0050	1	157.4	Ag	1.0	0.001	56,639	16	0.10	Ag	1	0.001	56,639	16	0.10	0
L03-0080	1	45.1	Ag	1.0	0.001	19,565	7	0.17	Ag	1	0.001	19,565	7	0.17	0
L03-0094	1	196.9	Ag	1.0	0.001	68,613	43	0.22	Ag	1	0.001	68,613	43	0.22	0
L04-0070	1	173.8	Ag	1.0	0.001	61,672	25	0.14	Ag	1	0.001	61,672	25	0.14	0
L04-0100	1	186.4	Ag	1.0	0.001	65,487	27	0.14	Ag	1	0.001	65,487	27	0.14	0

Table 7-2. 10-Year Hydrologic Model Input for Existing Conditions and Future Conditions

Subshed/ Tributary Node	Subcatch-ment No.	Area, ac	Existing Conditions						Future Conditions						Change in Max Flow, cfs
			Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	Land Use	% Imperv-ious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	
L05-0010	1	20.0	mix	66.4	0.008	2,185	31	1.55	mix	66	0.008	2,185	31	1.55	0
L05-0050	1	122.0	Ag	1.4	0.001	45,238	13	0.10	CI	56	0.008	3,873	105	0.86	93
L05-0080	1	145.0	Ag	1.0	0.001	52,762	14	0.10	Ag	1	0.001	52,762	14	0.10	0
L05-0110	1	169.2	Ag	1.0	0.001	60,282	17	0.10	Ag	1	0.001	60,282	17	0.10	0
L06-0140	1	4.7	Res	40.0	0.005	201	3	0.74	Res	40	0.005	201	3	0.74	0
L06-0142	1	13.0	Res	40.0	0.005	558	10	0.74	Res	40	0.005	558	10	0.74	0
L06-0143	1	5.2	Res	40.0	0.005	221	4	0.74	Res	40	0.005	221	4	0.74	0
L06-0144	1	6.7	Res	40.0	0.005	286	5	0.74	Res	40	0.005	286	5	0.74	0
L06-0145	1	6.5	Res	40.0	0.005	277	5	0.74	Res	40	0.005	277	5	0.74	0
L06-0147	1	4.2	CI	65.0	0.005	317	5	1.23	CI	65	0.005	317	5	1.23	0
L06-0150	1	14.6	Res	40.0	0.005	629	11	0.74	Res	40	0.005	629	11	0.74	0
L06-0151	1	17.3	Res	40.0	0.005	743	13	0.74	Res	40	0.005	743	13	0.74	0
L06-0152	1	6.9	Res	40.0	0.005	295	5	0.74	Res	40	0.005	295	5	0.74	0
L06-0200	1	21.2	Res	40.0	0.005	884	16	0.73	Res	62	0.010	936	24	1.12	8
L06-0220	1	73.8	Ag	1.0	0.001	29,813	8	0.11	Res	43	0.010	6,282	81	1.09	73
L06-0222	1	4.9	CI	65.0	0.005	371	4	0.77	CI	65	0.005	371	4	0.77	0
L06-0230	1	47.3	Ag	1.1	0.001	20,312	5	0.11	Ag	1	0.001	20,312	5	0.11	0
L06-0240	1	77.1	Ag	1.0	0.001	30,609	8	0.11	mix	41	0.010	7,011	83	1.07	75
L06-0240AA	1	16.4	Res	60.0	0.010	782	18	1.13	Res	60	0.010	782	18	1.13	0
L06-0290	1	50.8	Ag	1.0	0.001	21,552	6	0.11	Res	43	0.011	5,076	59	1.15	53
L06-0310	1	68.6	Ag	1.0	0.001	27,696	7	0.11	Ag	10	0.004	14,502	24	0.34	16
L06-0350	1	7.9	CI	65.0	0.010	591	11	1.40	CI	65	0.010	591	11	1.40	0
L06-0360	1	28.2	Res	40.0	0.005	1,646	23	0.83	Res	40	0.005	1,646	23	0.83	0
L06-0430	1	42.0	Ag	1.0	0.001	18,489	5	0.11	Res	26	0.010	11,661	37	0.87	32
L06-0432	1	48.3	Res	40.0	0.005	1,376	30	0.62	CI	72	0.010	1,741	54	1.12	24
L06-0435	1	12.3	Res	40.0	0.005	528	9	0.74	mix	62	0.010	560	14	1.13	5
L06-0436	1	11.1	Res	40.0	0.005	478	8	0.74	mix	67	0.010	610	14	1.28	6
L06-0438	1	32.7	Res	40.0	0.005	1,120	22	0.67	Res	40	0.005	1,120	22	0.67	0
L06-0460	1	102.1	Ag	1.0	0.001	38,942	13	0.13	Res	33	0.010	11,087	98	0.96	85
L06-0480	1	245.8	Ag	1.0	0.001	82,615	28	0.11	mix	59	0.010	3,605	164	0.67	136
L06-0520	1	251.7	Ag	1.0	0.001	84,294	29	0.11	Ag	1	0.001	84,294	29	0.11	0
L07-0041	1	4.2	Res	40.0	0.005	182	3	0.74	Res	40	0.005	182	3	0.74	0
L07-0042	1	1.6	OS	5.0	0.005	558	0	0.22	OS	5	0.005	558	0	0.22	0
L07-0060	1	101.0	OS	3.4	0.001	37,128	11	0.11	Res	29	0.010	12,432	88	0.87	77
L07-0061	1	10.9	Res	40.0	0.005	470	8	0.74	Res	40	0.005	470	8	0.74	0
L07-0062	1	14.8	OS	5.0	0.005	5,339	3	0.22	Res	29	0.010	3,286	14	0.94	11
L07-0080	1	54.1	Ag	1.0	0.001	22,707	7	0.13	Ag	1	0.001	22,707	7	0.13	0
L07-0100	1	266.6	Ag	1.0	0.001	88,375	25	0.09	Ag	1	0.001	88,375	25	0.09	0
L08-0010	1	159.7	Ag	1.0	0.001	57,356	16	0.10	Ag	1	0.001	57,356	16	0.10	0
L08-0060	1	160.2	Ag	1.0	0.001	57,514	16	0.10	Ag	1	0.001	57,514	16	0.10	0
L09-0040	1	127.5	Ag	3.0	0.001	45,738	14	0.11	Ag	3	0.001	45,738	14	0.11	0
L09-0070	1	139.7	Ag	1.0	0.001	51,103	14	0.10	Ag	1	0.001	51,103	14	0.10	0
L11-0030	1	110.3	Ag	1.0	0.001	41,637	11	0.10	Ag	1	0.001	41,637	11	0.10	0
L13-0020	1	114.2	Ag	1.0	0.001	42,914	14	0.12	Ag	1	0.001	42,914	14	0.12	0
L15-0050	1	102.4	Ag	2.7	0.001	38,048	11	0.11	Ag	3	0.001	38,048	11	0.11	0
MC0050	1	121.2	Ag	1.0	0.001	45,188	12	0.10	Ag	1	0.001	45,188	12	0.10	0
MC0100	1	95.4	Ag	1.0	0.001	36,734	10	0.10	Ag	1	0.001	36,734	10	0.10	0
MC0110	1	472.5	Ag	1.0	0.001	136,521	59	0.12	Ag	1	0.001	136,521	59	0.12	0
MC0160	1	58.7	Ag	1.0	0.001	24,297	9	0.16	Ag	1	0.001	24,297	9	0.16	0
MC0170	1	198.0	Ag	1.0	0.001	68,938	23	0.12	Ag	1	0.001	68,938	23	0.12	0
MC0172	1	119.4	Ag	1.0	0.001	44,607	18	0.15	Ag	1	0.001	44,607	18	0.15	0
MC0190	1	71.8	Ag	1.0	0.001	28,778	9	0.13	Ag	1	0.001	28,778	9	0.13	0
MC0210	1	88.4	Ag	1.0	0.001	34,386	9	0.10	Ag	1	0.001	34,386	9	0.10	0
MC0230	1	24.7	Ag	1.0	0.001	12,345	3	0.14	Ag	1	0.001	12,345	3	0.14	0
MC0270	1	153.2	Ag	1.0	0.001	55,354	22	0.15	Ag	1	0.001	55,354	22	0.15	0
MC0290	1	150.0	Ag	1.0	0.001	54,339	33	0.22	Ag	1	0.001	54,339	33	0.22	0
MC0310	1	54.4	Ag	1.0	0.001	22,801	9	0.16	Ag	1	0.001	22,801	9	0.16	0
MC0340	1	79.2	Ag	1.8	0.001	31,030	11	0.13	Res	66	0.010	1,981	71	0.90	61
MC0370	1	47.6	Ag	1.0	0.001	20,448	9	0.20	Res	40	0.010	5,526	56	1.17	46
MC0400	1	85.7	Ag	1.0	0.001	34,009	9	0.11	Res	40	0.010	7,804	40	0.47	31
MC0420	1	77.0	Ag	3.6	0.001	29,655	9	0.12	CI	76	0.010	2,307	81	1.06	72
MC0430	1	5.7	Res	40.0	0.005	245	35	0.56	Res	40	0.010	901	37	0.61	3
MC0430	2	56.0	Res	20.0	0.005	4,188	--	--	Res	20	0.005	4,188	--	--	--
MC0431	1	16.1	Res	40.0	0.005	692	12	0.74	Res	40	0.005	692	12	0.74	0
MC0450	1	17.6	Res	40.0	0.005	758	13	0.74	Res	40	0.005	758	13	0.74	0
MC0451	1	16.1	mix	20.0	0.005	1,797	10	0.59	mix	20	0.005	1,797	10	0.59	0
MC0460	1	35.4	OS	5.0	0.005	10,708	7	0.21	Res	77	0.010	1,658	46	1.30	39
MC0461	1	7.3	mix	20.0	0.005	811	4	0.59	mix	20	0.005	811	4	0.59	0
MC0463	1	13.0	Res	40.0	0.005	560	10	0.74	Res	40	0.005	560	10	0.74	0
MC0464	1	6.4	Res	40.0	0.005	273	5	0.32	Res	40	0.005	273	17	1.03	12
MC0464	2	10.2	OS	1.0	0.001	4,794	--	--	Res	56	0.010	674	--	--	--
MC0510	1	95.3	Ag	1.0	0.001	36,702	10	0.10	Res	36	0.010	9,750	95	1.00	85
MC0550	1	142.8	Ag	1.0	0.001	52,089	14	0.10	Res	9	0.004	24,566	44	0.30	29
MC0630	1	115.7	Ag	1.0	0.001	43,418	12	0.10	Ag	1	0.001	43,418	12	0.10	0
MC0650	1	129.7	Ag	1.0	0.001	47,923	13	0.10	Ag	1	0.001	47,923	13	0.10	0
MC0670	1	244.3	Ag	1.0	0.001	82,236	23	0.09	Ag	1	0.001	82,236	23	0.09	0
WIC0005	1	291.2	Ag	2.4	0.001	93,418	40	0.14	Ag	2	0.001	93,418	40	0.14	0
WIC0020	1	101.1	Ag	1.0	0.001	38,624	12	0.11	Ag	1	0.001	38,624	12	0.11	0
WIC0030	1	162.2	Ag	1.0	0.001	58,130	105	0.65	Ag	1	0.001	58,130	105	0.65	0
WIC0032	1	124.0	Ag	1.0	0.001	46,092	17	0.14	Ag	1	0.001	46,092	17	0.14	0
WIC0034	1	154.1	Ag	1.0	0.001	55,622	42	0.27	Ag	1	0.001	55,622	42	0.27	0
WIC0040	1	296.0	Ag	1.0	0.001	96,161	75	0.25	Ag	1	0.001	96,161	75	0.25	0

Note: Shaded rows indicate subsheds that have future land-uses different from existing conditions.

Table 7-3. 100-Year Hydrologic Model Input for Existing Conditions and Future Conditions

Subshed/ Tributary Node	Subcatch-ment No.	Area, ac	Existing Conditions						Future Land Use						Change in Max Flow, cfs
			Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	
EIC0075	1	113.7	Ag	1	0.001	10,091	25	0.22	Ag	1	0.001	10,091	25	0.22	0
EIC0090	1	145.2	Ag	5.7	0.001	11,973	57	0.40	Ag	6	0.001	11,973	57	0.40	0
EIC0100	1	283.2	Ag	1	0.001	21,895	51	0.18	Ag	1	0.001	21,895	51	0.18	0
EIC0140	1	163.1	Ag	1	0.001	13,803	35	0.22	Ag	1	0.001	13,803	35	0.22	0
L01-0008	1	209.8	Ag	1	0.001	17,107	33	0.16	Ag	1	0.001	17,107	33	0.16	0
L01-0010	1	402.3	Ag	3.8	0.001	27,828	113	0.28	Ag	4	0.001	27,828	113	0.28	0
L01-0120	1	77.4	Ag	1	0.001	7,219	24	0.31	Ag	1	0.001	7,219	24	0.31	0
L01-0150	1	43.8	Ag	1	0.001	4,463	11	0.24	Ag	1	0.001	4,463	11	0.24	0
L01-0160	1	24.7	Ag	1	0.001	2,845	5	0.21	Ag	1	0.001	2,845	5	0.21	0
L01-0180	1	194.8	Ag	1	0.001	16,066	55	0.28	Ag	1	0.001	16,066	55	0.28	0
L01-0210	1	216.5	Ag	1	0.001	17,566	66	0.30	Ag	1	0.001	17,566	66	0.30	0
L01-0230	1	208.4	Ag	1	0.001	17,008	39	0.19	Ag	1	0.001	17,008	39	0.19	0
L01-0290	1	294.6	Ag	1	0.001	22,600	79	0.27	Res	17	0.006	8,029	231	0.78	151
L02-0020	1	193.6	Ag	5.2	0.002	15,009	114	0.59	Ag	5	0.002	15,009	114	0.59	0
L02-0030	1	223.9	Ag	1	0.001	18,066	71	0.31	Ag	1	0.001	18,066	71	0.31	0
L02-0040	1	145.8	Ag	1	0.001	12,528	45	0.31	Ag	1	0.001	12,528	45	0.31	0
L02-0042	1	110.6	Ag	1	0.001	9,849	36	0.33	Ag	1	0.001	9,849	36	0.33	0
L02-0070	1	137.4	Ag	1	0.001	11,898	46	0.33	Ag	1	0.001	11,898	46	0.33	0
L02-0080	1	127.8	Ag	1	0.001	11,171	43	0.33	Ag	1	0.001	11,171	43	0.33	0
L02-0088	1	138.7	Ag	1	0.001	11,996	41	0.30	Ag	1	0.001	11,996	41	0.30	0
L02-0100	1	108.9	Ag	1	0.001	9,714	38	0.35	Ag	1	0.001	9,714	38	0.35	0
L02-0108	1	37.1	Ag	1	0.001	3,897	14	0.37	Ag	1	0.001	3,897	14	0.37	0
L02-0120	1	185.2	Ag	1	0.001	15,388	62	0.33	Ag	1	0.001	15,388	62	0.33	0
L02-0140	1	35.1	Ag	1	0.001	3,725	13	0.37	Res	29	0.010	1,587	52	1.48	39
L02-0160	1	74.7	Ag	1	0.001	7,003	26	0.35	Res	35	0.010	1,513	87	1.17	61
L02-0180	1	56.8	Ag	1	0.001	5,544	21	0.36	Ag	1	0.001	5,544	21	0.36	0
L02-0220	1	52.3	Ag	1	0.001	5,169	20	0.38	Res	21	0.007	2,412	62	1.19	42
L02-0239	1	15.6	Res	60	0.010	459	26	1.69	Res	60	0.010	459	26	1.69	0
L02-0240	1	37.3	Ag	1	0.001	3,914	16	0.44	Res	37	0.010	1,469	62	1.68	46
L02-0243	1	8.0	Res	60	0.010	237	14	1.69	Res	60	0.010	237	14	1.69	0
L02-0244	1	11.2	Res	60	0.010	330	19	1.69	Res	60	0.010	330	19	1.69	0
L02-0247	1	10.9	Res	60	0.010	321	18	1.69	Res	60	0.010	321	18	1.69	0
L02-0250	1	173.5	Ag	1	0.001	14,553	50	0.29	Res	51	0.011	3,223	237	1.37	187
L02-0252	1	44.7	Ag	1	0.001	4,535	13	0.28	Res	30	0.010	4,322	82	1.84	70
L02-0253	1	129.8	Ag	1	0.001	11,316	29	0.22	Res	42	0.010	3,036	167	1.29	138
L02-0255	1	36.1	Res	59.3	0.010	866	55	1.53	Res	59	0.010	866	55	1.53	0
L02-0260	1	7.4	Ag	1	0.001	809	2	0.20	Ag	1	0.001	809	2	0.20	0
L02-0270	1	163.2	Ag	1	0.001	13,809	47	0.29	Res	34	0.010	4,821	217	1.33	170
L02-0275	1	21.0	OS	5	0.010	1,178	9	0.44	OS	5	0.010	1,178	9	0.44	0
L02-0277	1	6.9	Res	60	0.010	203	12	1.69	Res	60	0.010	203	12	1.69	0
L02-0279	1	8.4	Res	60	0.010	249	14	1.69	Res	60	0.010	249	14	1.69	0
L02-0280	1	5.8	Res	60	0.010	171	10	1.69	Res	60	0.010	171	10	1.69	0
L02-0281	1	8.5	Res	40	0.010	283	12	1.41	Res	40	0.010	283	12	1.41	0
L02-0282	1	14.6	OS	5	0.010	815	6	0.44	OS	5	0.010	815	6	0.44	0
L02-0283	1	15.2	Res	60	0.010	448	26	1.73	Res	60	0.010	448	26	1.73	0
L02-0284	1	7.6	Res	60	0.010	225	13	1.69	Res	60	0.010	225	13	1.69	0
L02-0286	1	9.2	Res	60	0.010	273	16	1.73	Res	60	0.010	273	16	1.73	0
L02-0287	1	6.0	Res	60	0.010	178	10	1.73	Res	60	0.010	178	10	1.73	0
L02-0288	1	5.1	mix	40	0.010	170	7	1.41	mix	40	0.010	170	7	1.41	0
L02-0290	1	5.8	Res	60	0.010	171	10	1.69	Res	60	0.010	171	10	1.69	0
L02-0292	1	7.4	OS	5	0.010	414	3	0.44	OS	5	0.010	414	3	0.44	0
L02-0293	1	2.6	Res	60	0.010	78	4	1.69	Res	60	0.010	78	4	1.69	0
L02-0304	1	40.5	Ag	1	0.001	4,184	8	0.20	Res	31	0.010	1,752	53	1.31	45
L02-0310	1	49.6	mix	7.7	0.002	4,510	25	0.50	mix	40	0.010	1,661	70	1.41	45
L02-0320	1	103.3	Ag	1	0.001	9,283	18	0.18	Ag	1	0.001	9,283	18	0.18	0
L02-0330	1	110.2	Ag	1.1	0.001	9,805	19	0.17	Ag	1	0.001	9,805	19	0.17	0
L02-0340	1	199.9	Ag	1	0.001	16,423	39	0.19	Ag	1	0.001	16,423	39	0.19	0
L02-0360	1	304.2	Ag	1	0.001	23,183	53	0.17	Ag	1	0.001	23,183	53	0.17	0
L02-0421	1	28.4	Res	40	0.005	732	31	1.11	Res	40	0.005	732	31	1.11	0
L02-0422	1	7.2	Res	40	0.005	212	8	1.17	Res	40	0.005	212	8	1.17	0
L02-0424	1	13.5	mix	40	0.005	930	22	1.65	mix	40	0.005	930	22	1.65	0
L02-0430	1	55.1	Ag	1	0.001	5,399	18	0.33	mix	51	0.010	1,423	86	1.56	68
L02-0440	1	62.3	Ag	1	0.001	5,983	20	0.32	res	26	0.010	2,548	81	1.31	62
L02-0450	1	62.5	mix	25.7	0.005	2,482	65	1.04	mix	40	0.010	1,963	89	1.42	23
L02-0460	1	7.2	Res	40	0.005	212	9	1.24	Res	40	0.005	212	9	1.24	0
L02-0461	1	10.1	OS	5	0.010	567	7	0.65	OS	5	0.010	567	7	0.65	0
L02-0462	1	5.1	Res	60	0.010	151	9	1.80	Res	60	0.010	151	9	1.80	0
L02-0463	1	9.2	Res	60	0.010	271	17	1.80	Res	60	0.010	271	17	1.80	0
L02-0464	1	1.2	Res	40	0.005	35	1	1.24	Res	40	0.005	35	1	1.24	0
L02-0465	1	5.9	Res	40	0.005	174	7	1.24	Res	40	0.005	174	7	1.24	0
L02-0467	1	15.5	Res	40	0.005	458	19	1.24	Res	40	0.005	458	19	1.24	0
L02-0468	1	4.1	Res	40	0.005	121	5	1.24	Res	40	0.005	121	5	1.24	0
L02-0470	1	9.7	Res	40	0.005	287	18	0.91	Res	40	0.005	287	23	1.17	5
L02-0470	2	9.6	Res	40	0.005	284	--	--	Res	40	0.005	284	--	--	--
L02-0471	1	4.4	Res	40	0.005	131	6	1.24	Res	40	0.005	131	6	1.24	0
L02-0472	1	16.5	mix	20	0.005	551	15	0.90	mix	20	0.005	551	15	0.90	0
L02-0481	1	5.0	Res	40	0.005	149	6	1.17	Res	40	0.005	149	6	1.17	0
L02-0482	1	26.9	mix	20	0.005	816	21	0.79	mix	20	0.005	816	21	0.79	0
L02-0485	1	7.4	Res	40	0.005	319	10	1.38	Res	40	0.005	319	10	1.38	0
L02-0490	1	16.2	Res	40	0.005	478	19	1.17	Res	40	0.005	478	19	1.17	0
L02-0502	1	14.3	Res	40	0.005	422	17	1.17	Res	40	0.005	422	17	1.17	0
L02-0507	1	10.3	Res	40	0.005	304	12	1.17	Res	40	0.005	304	12	1.17	0
L02-0510	1	14.2	Res	40	0.005	419	17	1.17	Res	40	0.005	419	17	1.17	0
L02-0513	1	19.2	Res	40	0.005	566	23	1.17	Res	40	0.005	566	23	1.17	0
L02-0514	1	13.6	Res	40	0.005	400	16	1.17	Res	40	0.005	400	16	1.17	0
L02-0516	1	25.3	Res	40	0.005	679	28	1.13	Res	40	0.005	679	28	1.13	0
L02-0522	1	103.3	Ag	1	0.001	9,283	18	0.17	Res	30	0.010	3,547	123	1.19	105
L02-0530	1	249.8	Ag	1	0.001	19,778	40	0.16	mix	58	0.010	2,404	245	0.98	205
L02-0538	1	31.5	Res	40	0.005	786	34	1.08	Res	40	0.005	786	34	1.08	0
L02-0540	1	19.2	Res	40	0.005	566	22	1.16	Res	40	0.005	566	22	1.16	0
L02-0541	1	10.4	Res	40	0.005	307	12	1.16	Res	40	0.005	1,205	20	1.91	8
L02-0542	1	4.5	Res	40	0.005	132	5	1.16	Res	40	0.005	132	5	1.16	0
L02-0543	1	11.1	Res	40	0.005	328	13	1.16	Res	40	0.005	328	13	1.16	0
L02-0544	1	17.7	mix	20	0.005	591	14	0.80	mix	20	0.005	591	14	0.80	0
L03-0020	1	23.5	Ag	1	0.001	2,740	5	0.22	Ag	1	0.001	2,740	5	0.22	0
L03-0040	1	68.8	Ag	1	0.001	6,527	13	0.18	Ag	1	0.001	6,527	13	0.18	0
L03-0050	1	157.4	Ag	1	0.001	13,383	27	0.17	Ag	1	0.001	13,383	27	0.17	0
L03-0080	1	45.1	Ag	1	0.001	4,569	11	0.25	Ag	1	0.001	4,569	11	0.25	0
L03-0094	1	196.9	Ag	1	0.001	16,214	56	0.28	Ag	1	0.001	16,214	56	0.28	0
L04-0070	1	173.8	Ag	1	0.001	14,574	37	0.22	Ag	1	0.001	14,574	37	0.22	0
L04-0100	1	186.4	Ag	1	0.001	15,476	40	0.21	Ag	1	0.001	15,476	40	0.21	0

Table 7-3. 100-Year Hydrologic Model Input for Existing Conditions and Future Conditions

Subshed/ Tributary Node	Subcatch-ment No.	Area, ac	Existing Conditions						Future Land Use						Change in Max Flow, cfs
			Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	Land Use	% Imper-vious	Slope	Width, ft	Max Flow, cfs	Unit Runoff, cfs/ac	
L05-0010	1	20.0	mix	66.4	0.008	1,737	52	2.62	mix	66	0.008	1,737	52	2.62	0
L05-0050	1	122.0	Ag	1.4	0.001	10,690	21	0.18	CI	56	0.008	2,159	150	1.23	128
L05-0080	1	145.0	Ag	1	0.001	12,465	25	0.17	Ag	1	0.001	12,465	25	0.17	0
L05-0110	1	169.2	Ag	1	0.001	14,245	29	0.17	Ag	1	0.001	14,245	29	0.17	0
L06-0140	1	4.7	Res	40	0.005	138	5	1.16	Res	40	0.005	138	5	1.16	0
L06-0142	1	13.0	Res	40	0.005	383	15	1.16	Res	40	0.005	383	15	1.16	0
L06-0143	1	5.2	Res	40	0.005	152	6	1.16	Res	40	0.005	152	6	1.16	0
L06-0144	1	6.7	Res	40	0.005	196	8	1.16	Res	40	0.005	196	8	1.16	0
L06-0145	1	6.5	Res	40	0.005	190	7	1.16	Res	40	0.005	190	7	1.16	0
L06-0147	1	4.2	CI	65	0.005	226	8	1.97	CI	65	0.005	226	8	1.97	0
L06-0150	1	14.6	Res	40	0.005	432	17	1.16	Res	40	0.005	432	17	1.16	0
L06-0151	1	17.3	Res	40	0.005	510	20	1.16	Res	40	0.005	510	20	1.16	0
L06-0152	1	6.9	Res	40	0.005	202	8	1.16	Res	40	0.005	202	8	1.16	0
L06-0200	1	21.2	Res	40	0.005	610	25	1.16	Res	62	0.010	649	38	1.77	13
L06-0220	1	73.8	Ag	1	0.001	6,955	13	0.18	Res	43	0.010	2,105	102	1.38	88
L06-0222	1	4.9	CI	65	0.005	264	6	1.18	CI	65	0.005	264	6	1.18	0
L06-0230	1	47.3	Ag	1.1	0.001	4,748	9	0.19	Ag	1	0.001	4,748	9	0.19	0
L06-0240	1	77.1	Ag	1	0.001	7,202	14	0.18	mix	41	0.010	2,274	105	1.36	91
L06-0240AA	1	16.4	Res	60	0.010	526	29	1.75	Res	60	0.010	526	29	1.75	0
L06-0290	1	50.8	Ag	1	0.001	5,043	10	0.19	Res	43	0.011	1,621	75	1.47	65
L06-0310	1	68.6	Ag	1	0.001	6,508	13	0.18	Ag	10	0.004	3,449	38	0.55	25
L06-0350	1	7.9	CI	65	0.005	422	16	1.97	CI	65	0.005	422	16	1.97	0
L06-0360	1	28.2	Res	40	0.005	729	31	1.09	Res	40	0.005	729	31	1.09	0
L06-0430	1	42.0	Ag	1	0.001	4,312	8	0.20	Res	26	0.010	3,174	58	1.39	50
L06-0432	1	48.3	Res	40	0.005	1,022	48	1.00	CI	72	0.010	1,340	88	1.82	40
L06-0435	1	12.3	Res	40	0.005	362	14	1.17	mix	62	0.010	386	22	1.79	8
L06-0436	1	11.1	Res	40	0.005	328	13	1.17	mix	67	0.010	425	23	2.04	10
L06-0438	1	32.7	Res	40	0.005	806	35	1.08	Res	40	0.005	806	35	1.08	0
L06-0460	1	102.1	Ag	1	0.001	9,184	21	0.20	Res	33	0.010	3,326	129	1.26	108
L06-0480	1	245.8	Ag	1	0.001	19,512	45	0.18	mix	59	0.010	2,751	264	1.07	219
L06-0520	1	251.7	Ag	1	0.001	19,905	46	0.18	Ag	1	0.001	19,905	46	0.18	0
L07-0041	1	4.2	Res	40	0.005	125	5	1.16	Res	40	0.005	125	5	1.16	0
L07-0042	1	1.6	OS	5	0.005	87	1	0.38	OS	5	0.005	87	1	0.38	0
L07-0060	1	101.0	OS	3.4	0.001	8,806	19	0.19	Res	29	0.010	3,581	119	1.17	100
L07-0061	1	10.9	Res	40	0.005	322	13	1.16	Res	40	0.005	322	13	1.16	0
L07-0062	1	14.8	OS	5	0.005	1,631	8	0.51	Res	29	0.010	751	20	1.32	12
L07-0080	1	54.1	Ag	1	0.001	5,318	12	0.22	Ag	1	0.001	5,318	12	0.22	0
L07-0100	1	266.6	Ag	1	0.001	20,862	43	0.16	Ag	1	0.001	20,862	43	0.16	0
L08-0010	1	159.7	Ag	1	0.001	13,553	27	0.17	Ag	1	0.001	13,553	27	0.17	0
L08-0060	1	160.2	Ag	1	0.001	13,590	27	0.17	Ag	1	0.001	13,590	27	0.17	0
L09-0040	1	127.5	Ag	3	0.001	10,848	23	0.18	Ag	3	0.001	10,848	23	0.18	0
L09-0070	1	139.7	Ag	1	0.001	12,072	24	0.17	Ag	1	0.001	12,072	24	0.17	0
L11-0030	1	110.3	Ag	1	0.001	9,825	19	0.18	Ag	1	0.001	9,825	19	0.18	0
L13-0020	1	114.2	Ag	1	0.001	10,128	23	0.20	Ag	1	0.001	10,128	23	0.20	0
L15-0050	1	102.4	Ag	2.7	0.001	9,010	19	0.18	Ag	3	0.001	9,010	19	0.18	0
MC0050	1	121.2	Ag	1	0.001	10,668	21	0.17	Ag	1	0.001	10,668	21	0.17	0
MC0100	1	95.4	Ag	1	0.001	8,659	17	0.18	Ag	1	0.001	8,659	17	0.18	0
MC0110	1	472.5	Ag	1	0.001	32,008	88	0.19	Ag	1	0.001	32,008	88	0.19	0
MC0160	1	58.7	Ag	1	0.001	5,698	14	0.24	Ag	1	0.001	5,698	14	0.24	0
MC0170	1	198.0	Ag	1	0.001	16,290	37	0.19	Ag	1	0.001	16,290	37	0.19	0
MC0172	1	119.4	Ag	1	0.001	10,530	27	0.22	Ag	1	0.001	10,530	27	0.22	0
MC0190	1	71.8	Ag	1	0.001	6,766	15	0.21	Ag	1	0.001	6,766	15	0.21	0
MC0210	1	88.4	Ag	1	0.001	8,101	16	0.18	Ag	1	0.001	8,101	16	0.18	0
MC0230	1	24.7	Ag	1	0.001	12,345	16	0.66	Ag	1	0.001	12,345	16	0.66	0
MC0270	1	153.2	Ag	1	0.001	13,079	33	0.22	Ag	1	0.001	13,079	33	0.22	0
MC0290	1	150.0	Ag	1	0.001	12,838	44	0.29	Ag	1	0.001	12,838	44	0.29	0
MC0310	1	54.4	Ag	1	0.001	5,341	13	0.24	Ag	1	0.001	5,341	13	0.24	0
MC0340	1	79.2	Ag	1.8	0.001	7,318	17	0.21	Res	66	0.010	1,552	118	1.49	102
MC0370	1	47.6	Ag	1	0.001	4,780	13	0.28	Res	40	0.010	1,646	72	1.50	58
MC0400	1	85.7	Ag	1	0.001	6,502	13	0.16	Res	40	0.010	2,521	115	1.34	101
MC0420	1	77.0	Ag	3.6	0.001	7,028	15	0.19	CI	76	0.010	1,844	135	1.75	120
MC0430	1	5.7	Res	40	0.005	168	28	0.45	Res	40	0.010	246	48	0.78	20
MC0430	2	56.0	Res	20	0.005	1,325	--	--	Res	20	0.005	1,325	--	--	--
MC0431	1	16.1	Res	40	0.005	475	19	1.16	Res	40	0.005	475	19	1.16	0
MC0450	1	17.6	Res	40	0.005	520	20	1.16	Res	40	0.005	520	20	1.16	0
MC0451	1	16.1	mix	20	0.005	539	13	0.80	mix	20	0.005	539	13	0.80	0
MC0460	1	35.4	OS	5	0.005	1,741	13	0.36	Res	77	0.010	1,259	75	2.11	62
MC0461	1	7.3	mix	20	0.005	243	6	0.80	mix	20	0.005	243	6	0.80	0
MC0463	1	13.0	Res	40	0.005	384	15	1.16	Res	40	0.005	384	15	1.16	0
MC0464	1	6.4	Res	40	0.005	187	8	0.47	Res	40	0.005	187	25	3.87	17
MC0464	2	10.2	OS	1	0.001	1,122	--	--	Res	56	0.010	329	-	--	--
MC0510	1	95.3	Ag	1	0.001	8,652	17	0.18	Res	36	0.010	3,014	123	1.29	106
MC0550	1	142.8	Ag	1	0.001	12,305	24	0.17	Res	9	0.004	6,540	71	0.50	47
MC0630	1	115.7	Ag	1	0.001	10,248	20	0.17	Ag	1	0.001	10,248	20	0.17	0
MC0650	1	129.7	Ag	1	0.001	11,317	22	0.17	Ag	1	0.001	11,317	22	0.17	0
MC0670	1	244.3	Ag	1	0.001	19,422	40	0.16	Ag	1	0.001	19,422	40	0.16	0
WIC0005	1	291.2	Ag	2.4	0.001	22,088	70	0.24	Ag	2	0.001	22,088	70	0.24	0
WIC0020	1	101.1	Ag	1	0.001	9,109	19	0.19	Ag	1	0.001	9,109	19	0.19	0
WIC0030	1	162.2	Ag	1	0.001	13,736	165	1.02	Ag	1	0.001	13,736	165	1.02	0
WIC0032	1	124.0	Ag	1	0.001	10,883	26	0.21	Ag	1	0.001	10,883	26	0.21	0
WIC0034	1	154.1	Ag	1	0.001	13,142	52	0.34	Ag	1	0.001	13,142	52	0.34	0
WIC0040	1	296.0	Ag	1	0.001	22,685	93	0.31	Ag	1	0.001	22,685	93	0.31	0

Note: Shaded rows indicate subsheds that have future land-uses different from existing conditions.

Table 7-4. Node Data and Model Results For Existing Conditions and Future Conditions

Model Input Data			Model Results									
			10-Year Storm					100-Year Storm				
			Existing		Future			Existing		Future		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.8	55.0	-0.7	0.1
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.7	55.1	-0.6	0.1
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.5	0.4	0.1
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.5	0.4	0.1
EIC0060	46.6	57.4	54.8	-2.6	54.9	-2.5	0.1	57.1	-0.3	57.3	-0.1	0.2
EIC0070	46.6	57.4	54.8	-2.6	55.0	-2.5	0.1	57.1	-0.4	57.3	-0.1	0.2
EIC0075	47.2	57.9	54.8	-3.0	55.0	-2.8	0.2	57.4	-0.4	57.7	-0.1	0.3
EIC0080	48.1	58.5	54.9	-3.6	55.1	-3.4	0.2	57.5	-1.0	57.9	-0.6	0.3
EIC0090	48.2	58.6	54.9	-3.7	55.1	-3.5	0.2	57.5	-1.1	57.9	-0.7	0.3
EIC0100	50.1	57.8	55.6	-2.3	56.6	-1.3	1.0	59.1	1.3	59.7	1.8	0.5
EIC0110	50.2	59.2	55.6	-3.7	56.6	-2.7	1.0	59.1	-0.1	59.6	0.4	0.5
EIC0120	50.3	63.1	55.9	-7.2	56.9	-6.1	1.1	59.4	-3.6	60.0	-3.0	0.6
EIC0130	50.0	60.8	55.9	-4.9	56.9	-3.8	1.1	59.4	-1.3	60.0	-0.7	0.6
EIC0140	50.0	59.2	56.0	-3.2	57.2	-2.1	1.1	59.6	0.4	60.3	1.0	0.6
EIC0150	49.8	58.6	56.0	-2.6	57.1	-1.5	1.1	59.6	1.0	60.3	1.6	0.6
L01-0090	59.5	70.1	65.7	-4.4	66.3	-3.8	0.6	67.3	-2.7	67.7	-2.4	0.4
L01-0100	59.2	69.7	65.8	-4.0	66.4	-3.4	0.6	67.4	-2.3	67.8	-2.0	0.4
L01-0110	60.1	68.3	66.3	-2.1	66.9	-1.5	0.6	67.8	-0.5	68.2	-0.1	0.4
L01-0120	59.9	68.3	66.3	-2.0	66.9	-1.4	0.6	67.9	-0.4	68.3	0.0	0.4
L01-0170	58.9	69.0	66.3	-2.7	66.9	-2.1	0.6	67.9	-1.1	68.3	-0.7	0.4
L01-0180	58.7	67.5	66.6	-0.9	67.3	-0.2	0.7	68.4	0.9	68.9	1.4	0.5
L01-0190	60.2	68.6	67.0	-1.6	67.7	-1.0	0.7	68.7	0.1	69.1	0.5	0.5
L01-0200	61.4	69.5	67.2	-2.3	67.8	-1.7	0.6	68.8	-0.7	69.3	-0.3	0.4
L01-0210	61.3	69.4	67.4	-2.0	68.1	-1.3	0.7	69.1	-0.3	69.6	0.2	0.5
L01-0220	62.4	71.4	67.9	-3.5	68.5	-2.9	0.6	69.4	-2.0	69.8	-1.6	0.5
L01-0230	62.4	69.9	70.7	0.8	71.9	1.9	1.1	72.9	3.0	73.8	3.9	1.0
L01-0240	63.9	70.5	70.9	0.4	71.9	1.5	1.1	72.9	2.5	73.9	3.4	1.0
L01-0250	65.0	71.3	70.9	-0.4	72.0	0.6	1.1	73.0	1.6	73.9	2.6	1.0
L01-0260	65.2	71.4	72.8	1.4	73.6	2.2	0.8	74.6	3.2	75.1	3.7	0.5
L01-0270	65.3	71.5	72.8	1.4	73.6	2.1	0.8	74.6	3.1	75.1	3.6	0.5
L01-0280	65.5	71.6	73.1	1.5	73.8	2.3	0.8	74.8	3.2	75.3	3.7	0.5
L01-0290	67.6	72.4	73.1	0.6	73.8	1.4	0.7	74.8	2.4	75.3	2.8	0.5
L01-0300	67.9	73.2	73.1	-0.1	73.8	0.7	0.7	74.8	1.6	75.2	2.1	0.4
L01-0310	67.3	73.4	73.1	-0.3	73.8	0.5	0.7	74.8	1.4	75.2	1.9	0.4
L01-0320	66.9	73.5	73.1	-0.4	73.8	0.3	0.7	74.8	1.3	75.2	1.8	0.4
L01-0330	67.0	74.1	73.1	-1.0	73.8	-0.3	0.7	74.8	0.7	75.2	1.2	0.4
L01-0340	69.9	72.6	73.1	0.5	73.8	1.2	0.7	74.8	2.2	75.2	2.6	0.4
L02-0010	55.4	63.3	62.0	-1.3	62.6	-0.7	0.6	64.2	0.9	64.5	1.3	0.3
L02-0020	55.5	63.5	62.2	-1.3	62.9	-0.6	0.7	64.4	0.9	64.8	1.3	0.4
L02-0030	55.1	63.7	62.2	-1.4	62.9	-0.8	0.7	64.5	0.8	64.9	1.2	0.4
L02-0032	55.9	64.3	63.1	-1.1	63.8	-0.5	0.7	65.2	0.9	65.6	1.3	0.4
L02-0040	56.8	65.0	64.2	-0.8	64.9	-0.1	0.7	66.2	1.2	66.6	1.5	0.4
L02-0042	57.0	65.3	64.6	-0.7	65.2	0.0	0.6	66.5	1.2	66.8	1.6	0.4
L02-0044	57.1	65.4	64.7	-0.7	65.3	-0.1	0.6	66.5	1.2	66.9	1.5	0.4
L02-0050	59.7	70.4	65.5	-4.9	66.1	-4.3	0.6	67.1	-3.2	67.5	-2.9	0.4
L02-0060	60.2	66.9	66.7	-0.1	67.2	0.3	0.5	68.3	1.4	68.5	1.6	0.2
L02-0064	60.3	66.2	67.8	1.6	68.2	2.0	0.5	69.6	3.4	69.8	3.6	0.2
L02-0070	58.9	65.5	67.8	2.3	68.2	2.8	0.5	69.6	4.1	69.8	4.3	0.2
L02-0080	59.3	66.0	68.2	2.2	68.7	2.7	0.5	70.3	4.3	70.4	4.4	0.2
L02-0086	59.2	68.9	68.2	-0.7	68.7	-0.2	0.5	70.3	1.3	70.4	1.5	0.2
L02-0088	59.4	68.9	68.3	-0.7	68.8	-0.1	0.5	70.3	1.4	70.5	1.6	0.2
L02-0090	62.5	68.2	68.3	0.1	68.8	0.6	0.5	70.3	2.2	70.5	2.3	0.2
L02-0095	62.7	68.6	68.3	-0.3	68.9	0.2	0.5	70.4	1.8	70.6	2.0	0.2
L02-0100	62.7	69.6	68.4	-1.2	69.0	-0.6	0.6	70.5	1.0	70.7	1.2	0.2
L02-0102	64.2	68.8	68.5	-0.3	69.0	0.3	0.5	70.6	1.8	70.8	2.0	0.2
L02-0104	64.2	69.0	68.9	-0.1	69.5	0.5	0.6	71.0	2.1	71.3	2.3	0.2
L02-0106	64.0	68.5	68.9	0.4	69.5	1.0	0.6	71.1	2.5	71.3	2.8	0.2
L02-0108	64.1	68.6	69.7	1.1	70.4	1.8	0.8	72.0	3.4	72.3	3.7	0.3
L02-0110	64.9	69.5	69.7	0.2	70.4	0.9	0.8	72.0	2.5	72.3	2.8	0.3
L02-0120	64.4	71.4	70.1	-1.3	70.9	-0.5	0.9	72.5	1.1	72.9	1.5	0.4
L02-0130	66.2	71.5	70.1	-1.4	70.9	-0.6	0.9	72.5	1.0	72.9	1.4	0.4
L02-0140	66.1	72.0	70.2	-1.8	71.1	-0.9	0.9	72.6	0.6	73.1	1.1	0.5
L02-0150	66.5	71.2	70.2	-1.0	71.1	0.0	0.9	72.6	1.5	73.1	1.9	0.5
L02-0160	66.0	71.3	70.4	-0.8	71.5	0.2	1.0	73.0	1.7	73.5	2.3	0.5
L02-0170	68.0	73.3	70.4	-2.9	71.5	-1.8	1.0	73.0	-0.3	73.5	0.2	0.5
L02-0180	68.3	70.7	73.5	2.8	73.6	2.8	0.0	74.5	3.8	74.5	3.8	0.0
L02-0190	66.9	71.1	70.2	-0.9	71.0	-0.1	0.8	72.5	1.4	72.9	1.8	0.4
L02-0200	66.5	70.9	70.9	0.0	71.9	1.1	1.1	72.9	2.1	73.9	3.0	1.0
L02-0210	64.0	70.5	70.9	0.4	72.0	1.5	1.1	72.9	2.5	73.9	3.4	1.0
L02-0220	63.7	71.1	70.9	-0.2	72.0	0.9	1.1	72.9	1.9	73.9	2.8	1.0
L02-0230	62.9	70.4	70.9	0.5	72.0	1.6	1.1	73.0	2.5	73.9	3.5	1.0
L02-0237	67.1	75.2	72.7	-2.5	73.3	-1.9	0.6	73.9	-1.3	75.0	-0.2	1.2
L02-0238	67.4	75.0	72.7	-2.3	73.3	-1.7	0.6	73.9	-1.1	75.0	0.0	1.2
L02-0239	67.7	75.4	72.7	-2.7	73.5	-1.9	0.8	73.9	-1.5	75.2	-0.2	1.3
L02-0240	63.0	69.5	71.1	1.6	72.1	2.7	1.1	73.2	3.7	74.2	4.8	1.1
L02-0243	68.3	75.4	72.7	-2.7	73.5	-1.9	0.8	73.9	-1.5	75.0	-0.4	1.2
L02-0244	68.9	75.5	72.7	-2.8	73.8	-1.7	1.1	73.9	-1.6	75.1	-0.4	1.2
L02-0246	67.8	75.0	72.7	-2.3	73.4	-1.6	0.6	73.9	-1.1	75.2	0.2	1.3
L02-0247	68.0	75.2	72.7	-2.5	74.0	-1.2	1.3	73.9	-1.3	75.2	0.0	1.3
L02-0250	64.1	72.7	71.1	-1.6	72.2	-0.5	1.1	73.2	0.5	74.2	1.5	1.1
L02-0252	65.7	73.2	72.5	-0.8	73.4	0.1	0.9	73.7	0.5	74.8	1.6	1.1
L02-0253	66.1	73.9	72.7	-1.2	73.5	-0.4	0.9	73.8	-0.1	74.9	1.0	1.1
L02-0254	68.0	73.9	72.7	-1.2	73.5	-0.4	0.8	73.8	-0.1	75.0	1.1	1.2
L02-0255	66.5	74.2	72.7	-1.5	73.4	-0.8	0.7	73.9	-0.4	75.0	0.8	1.2
L02-0260	67.1	74.7	72.7	-1.9	73.4	-1.3	0.6	73.9	-0.7	75.2	0.5	1.3
L02-0261	66.9	76.0	72.7	-3.3	73.4	-2.6	0.7	73.9	-2.1	75.0	-1.0	1.2
L02-0262	67.1	75.0	72.7	-2.3	73.3	-1.7	0.6	73.9	-1.1	75.0	0.0	1.2
L02-0270	67.0	74.2	72.7	-1.5	73.4	-0.9	0.6	73.9	-0.3	75.2	1.0	1.3
L02-0272	66.6	73.8	72.7	-1.1	73.3	-0.4	0.6	73.9	0.1	75.2	1.4	1.3
L02-0273	67.7	75.0	72.7	-2.3	73.4	-1.6	0.6	73.9	-1.1	75.2	0.2	1.3
L02-0275	70.0	75.0	70.8	-4.2	72.9	-2.1	2.1	73.9	-1.1	75.0	0.0	1.1
L02-0277	69.4	76.0	72.8	-3.2	75.1	-0.9	2.3	75.3	-0.7	75.7	-0.3	0.4
L02-0278	69.3	74.6	72.8	-1.9	74.7	0.1	1.9	74.8	0.1	75.5	0.9	0.8
L02-0279	68.3	75.6	72.8	-2.8	75.0	-0.6	2.2	75.6	0.0	75.4	-0.2	-0.2
L02-0280	67.9	74.1	72.7	-1.4	73.4	-0.7	0.7	73.9	-0.2	75.2	1.1	1.3
L02-0281	69.0	77.0	72.8	-4.2	75.7	-1.3	3.0	77.0	0.0	76.1	-0.9	-0.9
L02-0282	68.4	75.8	72.8	-3.0	75.2	-0.6	2.5	75.8	0.0	75.5	-0.3	-0.3

Table 7-4. Node Data and Model Results For Existing Conditions and Future Conditions

Model Input Data			Model Results									
			10-Year Storm					100-Year Storm				
			Existing		Future			Existing		Future		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing
L02-0283	68.9	75.2	72.8	-2.4	75.2	0.1	2.5	75.5	0.3	76.0	0.9	0.6
L02-0284	68.3	74.9	72.8	-2.1	73.7	-1.2	0.9	74.0	-0.9	75.3	0.4	1.3
L02-0286	69.4	76.2	72.8	-3.4	76.1	-0.1	3.3	76.4	0.2	76.6	0.4	0.2
L02-0287	71.0	78.6	72.8	-5.8	76.7	-1.9	3.9	78.5	-0.1	77.8	-0.8	-0.7
L02-0288	70.4	77.5	72.8	-4.7	76.6	-0.8	3.8	77.5	0.0	77.3	-0.2	-0.2
L02-0290	68.7	76.3	72.9	-3.4	74.0	-2.3	1.1	74.1	-2.2	75.6	-0.7	1.4
L02-0291	68.9	76.0	73.0	-3.0	74.2	-1.8	1.2	74.2	-1.8	75.6	-0.4	1.4
L02-0292	69.0	76.0	73.0	-3.0	74.3	-1.8	1.2	74.2	-1.8	75.7	-0.3	1.4
L02-0293	69.9	75.3	73.0	-2.3	74.2	-1.1	1.2	74.2	-1.1	75.6	0.3	1.4
L02-0300	70.8	78.0	73.1	-4.9	74.3	-3.7	1.2	74.3	-3.7	75.7	-2.3	1.4
L02-0302	72.8	78.3	75.3	-3.1	77.3	-1.1	2.0	76.2	-2.1	78.2	-0.1	2.0
L02-0304	73.2	76.7	75.6	-1.1	78.2	1.5	2.6	76.9	0.2	79.2	2.5	2.3
L02-0310	73.8	76.7	75.9	-0.7	78.2	1.5	2.2	77.0	0.4	79.2	2.5	2.2
L02-0421	69.4	76.8	75.5	-1.3	76.2	-0.6	0.7	76.5	-0.3	76.9	0.1	0.5
L02-0422	70.7	76.8	76.8	0.0	76.9	0.1	0.1	77.0	0.2	77.1	0.3	0.2
L02-0424	70.5	76.9	77.2	0.2	77.3	0.4	0.1	77.7	0.8	77.8	0.9	0.1
L02-0425	69.5	76.1	75.5	-0.6	76.2	0.1	0.7	76.5	0.4	76.9	0.9	0.4
L02-0426	62.0	76.9	75.4	-1.5	76.1	-0.8	0.7	76.4	-0.5	76.9	-0.1	0.5
L02-0427	70.1	76.5	76.4	-0.1	76.7	0.2	0.3	77.1	0.6	77.4	0.9	0.3
L02-0428	72.1	77.0	76.1	-0.9	77.1	0.1	1.0	77.1	0.1	77.3	0.3	0.2
L02-0430	66.9	75.1	72.9	-2.3	73.8	-1.3	1.0	73.9	-1.3	75.0	-0.1	1.2
L02-0440	66.6	75.2	73.0	-2.2	74.0	-1.3	1.0	74.1	-1.2	75.2	-0.1	1.1
L02-0450	66.4	75.4	73.1	-2.3	74.1	-1.3	1.0	74.2	-1.1	75.3	-0.1	1.1
L02-0460	66.3	75.3	73.2	-2.1	74.2	-1.1	1.0	74.4	-1.0	75.4	0.0	1.0
L02-0461	70.7	76.0	72.9	-3.1	73.5	-2.5	0.6	74.3	-1.7	75.2	-0.8	0.9
L02-0462	70.5	75.4	73.0	-2.4	73.8	-1.6	0.8	75.4	0.0	75.5	0.1	0.1
L02-0463	70.1	76.1	72.9	-3.1	73.7	-2.4	0.8	74.3	-1.7	75.5	-0.6	1.2
L02-0464	70.7	76.0	72.9	-3.2	73.5	-2.6	0.6	74.3	-1.7	75.2	-0.8	0.9
L02-0465	69.9	75.4	73.1	-2.3	73.9	-1.5	0.8	74.3	-1.1	75.4	0.0	1.1
L02-0467	69.1	75.4	73.2	-2.2	74.2	-1.2	1.0	74.4	-1.0	75.4	0.0	1.0
L02-0468	69.6	75.2	73.2	-2.0	74.1	-1.1	0.9	74.3	-0.8	75.2	0.1	0.9
L02-0470	67.0	75.3	73.3	-2.0	74.3	-1.0	1.0	74.5	-0.9	75.4	0.1	0.9
L02-0470	67.0	75.3	73.3	-2.0	74.3	-1.0	1.0	74.5	-0.9	75.4	0.1	0.9
L02-0471	70.9	75.2	73.3	-1.9	74.3	-1.0	1.0	74.9	-0.3	75.6	0.4	0.7
L02-0472	71.2	75.7	73.3	-2.4	74.5	-1.2	1.2	75.7	0.0	75.9	0.2	0.2
L02-0480.1	67.7	76.9	74.8	-2.0	75.6	-1.3	0.7	75.7	-1.2	77.4	0.6	1.7
L02-0481	68.6	76.3	74.1	-2.2	74.5	-1.7	0.4	75.0	-1.3	75.7	-0.6	0.7
L02-0482	69.0	77.7	76.4	-1.2	77.0	-0.7	0.5	77.7	0.1	77.8	0.1	0.0
L02-0483	69.1	74.4	74.4	0.0	74.5	0.1	0.1	75.0	0.7	75.7	1.3	0.6
L02-0484	69.6	75.2	74.7	-0.5	74.7	-0.5	0.0	75.2	0.0	75.7	0.5	0.5
L02-0485	70.1	75.2	75.0	-0.2	75.1	-0.2	0.0	75.4	0.2	75.8	0.5	0.3
L02-0490	59.5	76.9	73.4	-3.5	74.4	-2.5	1.0	74.5	-2.3	75.2	-1.7	0.7
L02-0500	66.1	75.3	74.8	-0.5	75.3	0.0	0.5	75.9	0.6	76.3	1.0	0.4
L02-0502	72.5	77.0	74.8	-2.2	75.3	-1.7	0.6	75.9	-1.1	76.3	-0.7	0.4
L02-0503	72.4	75.6	74.8	-0.8	75.3	-0.3	0.6	75.9	0.3	76.3	0.7	0.4
L02-0504	72.4	75.4	75.0	-0.4	75.5	0.1	0.5	76.1	0.7	76.4	1.0	0.3
L02-0505	73.4	76.5	75.0	-1.5	75.5	-1.0	0.5	76.1	-0.4	76.4	0.0	0.3
L02-0506	73.7	77.7	75.1	-2.5	75.6	-2.1	0.4	76.2	-1.4	76.5	-1.1	0.3
L02-0507	75.6	77.1	76.5	-0.6	76.5	-0.6	0.0	76.7	-0.3	76.7	-0.3	0.0
L02-0510	68.8	77.8	75.9	-1.8	77.0	-0.8	1.0	77.2	-0.6	77.8	0.0	0.6
L02-0511	71.6	76.9	77.0	0.0	77.0	0.1	0.1	77.5	0.6	77.6	0.7	0.1
L02-0512	68.2	75.0	75.0	-0.1	75.5	0.4	0.5	76.1	1.1	76.4	1.4	0.3
L02-0513	72.2	77.8	77.9	0.1	77.9	0.1	0.0	78.5	0.7	78.5	0.7	0.0
L02-0514	68.5	75.3	75.1	-0.2	75.4	0.1	0.3	76.0	0.7	76.4	1.1	0.3
L02-0515	68.6	76.4	76.4	0.0	76.4	0.0	0.0	76.4	0.1	76.7	0.3	0.3
L02-0516	69.4	75.9	76.1	0.1	76.1	0.2	0.1	77.0	1.0	77.0	1.1	0.0
L02-0517	71.2	77.4	76.4	-1.0	76.4	-0.9	0.1	76.4	-0.9	76.7	-0.7	0.3
L02-0518	74.4	78.5	77.4	-1.1	79.8	1.3	2.3	79.1	0.6	81.0	2.5	1.8
L02-0520	74.5	78.4	77.6	-0.7	79.8	1.4	2.2	79.2	0.8	81.0	2.6	1.8
L02-0522	74.6	78.1	78.8	0.6	82.1	3.9	3.3	81.0	2.9	83.1	4.9	2.1
L02-0530	76.4	79.2	79.3	0.1	82.1	2.9	2.8	81.0	1.9	83.1	3.9	2.0
L02-0538	68.6	76.0	76.3	0.3	76.5	0.5	0.1	77.2	1.2	77.3	1.3	0.1
L02-0540	70.2	78.1	78.3	0.2	78.3	0.2	0.0	78.4	0.3	78.5	0.4	0.0
L02-0541	70.7	77.7	78.3	0.6	78.4	0.7	0.1	79.0	1.3	79.0	1.3	0.0
L02-0542	71.2	78.4	78.5	0.1	78.6	0.2	0.1	79.2	0.8	79.2	0.8	0.0
L02-0543	71.5	79.2	79.2	0.0	79.3	0.1	0.0	79.4	0.2	79.4	0.2	0.0
L02-0544	72.0	79.9	79.9	0.1	80.0	0.1	0.1	80.1	0.3	80.1	0.3	0.0
L03-0010	63.0	71.6	68.9	-2.7	70.1	-1.5	1.3	70.8	-0.8	71.3	-0.3	0.5
L03-0020	63.1	71.6	69.1	-2.6	70.3	-1.3	1.2	71.6	0.0	72.3	0.6	0.7
L03-0030	63.5	72.1	69.1	-2.9	70.3	-1.7	1.2	71.6	-0.4	72.3	0.2	0.7
L03-0040	63.5	72.1	69.4	-2.7	70.5	-1.6	1.2	72.5	0.4	73.2	1.1	0.7
L03-0050	64.0	72.6	69.4	-3.2	70.6	-2.0	1.1	72.5	-0.1	73.3	0.7	0.7
L03-0060	64.6	73.2	69.4	-3.8	70.6	-2.7	1.1	72.5	-0.7	73.3	0.0	0.7
L03-0062	64.7	73.3	69.6	-3.8	70.7	-2.7	1.1	72.7	-0.6	73.4	0.1	0.7
L03-0070	65.9	74.5	69.7	-4.8	70.7	-3.8	1.0	72.7	-1.8	73.4	-1.1	0.7
L03-0080	66.1	74.7	71.7	-3.0	72.4	-2.3	0.7	74.7	0.0	75.3	0.6	0.5
L03-0090	67.8	76.4	71.9	-4.5	72.5	-3.9	0.6	74.8	-1.6	75.3	-1.1	0.5
L03-0092	67.8	76.4	71.9	-4.5	72.5	-3.9	0.6	74.8	-1.6	75.3	-1.1	0.5
L03-0094	67.9	76.5	79.8	3.3	79.8	3.3	0.0	80.9	4.4	80.9	4.5	0.0
L04-0030	66.9	71.9	71.3	-0.6	73.2	1.3	1.9	73.9	2.0	74.8	2.8	0.9
L04-0040	67.0	71.6	71.3	-0.3	73.2	1.6	1.9	73.9	2.3	74.8	3.2	0.9
L04-0050	67.8	72.1	71.3	-0.7	73.2	1.1	1.9	73.9	1.9	74.8	2.7	0.9
L04-0060	68.3	71.4	71.4	0.0	73.2	1.8	1.9	73.9	2.6	74.8	3.4	0.9
L04-0062	68.2	73.1	71.4	-1.7	73.2	0.2	1.9	73.9	0.9	74.8	1.7	0.9
L04-0064	68.4	73.3	71.6	-1.7	73.2	-0.1	1.6	74.0	0.7	74.8	1.5	0.8
L04-0066	68.0	71.7	71.6	-0.1	73.2	1.5	1.6	74.0	2.3	74.8	3.1	0.8
L04-0068	67.8	72.0	72.0	0.1	73.2	1.3	1.2	74.2	2.3	74.9	3.0	0.7
L04-0070	68.0	74.4	72.2	-2.3	73.2	-1.2	1.1	74.2	-0.2	74.9	0.5	0.7
L04-0080	68.1	76.0	72.2	-3.8	73.2	-2.8	1.0	74.3	-1.7	74.9	-1.1	0.7
L04-0088	68.5	75.0	72.4	-2.7	73.2	-1.8	0.9	74.4	-0.6	75.0	0.0	0.6
L04-0090	69.4	73.0	72.5	-0.5	73.2	0.3	0.8	74.5	1.5	75.1	2.1	0.6
L04-0092	69.5	73.6	72.6	-1.1	73.3	-0.4	0.7	74.5	0.9	75.1	1.5	0.6
L04-0094	69.5	73.7	73.0	-0.7	73.6	-0.1	0.6	75.1	1.3	75.5	1.8	0.5
L04-0100	69.6	73.8	73.0	-0.8	73.6	-0.2	0.6	75.1	1.2	75.5	1.7	0.5
L05-0010	67.2	73.8	72.0	-1.8	74.4	0.6	2.4	75.0	1.2	76.3	2.5	1.3
L05-0012	67.9	73.0	72.0	-0.9	74.4	1.4	2.4	75.0	2.0	76.4	3.4	1.4
L05-0014	69.2	74.2	72.0	-2.2	74.4	0.2	2.4	75.0	0.8	76.4	2.1	1.4
L05-0020	69.1	75.9	72.0	-3.8	74.4	-1.5	2.4	75.0	-0.9	76.4	0.5	1.4

Table 7-4. Node Data and Model Results For Existing Conditions and Future Conditions

Model Input Data			Model Results									
			10-Year Storm					100-Year Storm				
			Existing		Future			Existing		Future		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing
L05-0040	69.2	74.0	72.0	-2.0	74.4	0.4	2.4	75.0	1.0	76.4	2.3	1.4
L05-0050	69.2	74.0	72.7	-1.3	75.1	1.1	2.4	75.6	1.6	77.0	3.0	1.3
L05-0060	69.3	74.2	72.8	-1.4	75.1	0.8	2.3	75.6	1.4	77.0	2.7	1.3
L05-0070	69.4	74.5	72.9	-1.6	75.1	0.6	2.2	75.7	1.2	77.0	2.5	1.3
L05-0080	69.4	74.5	72.9	-1.6	75.1	0.6	2.2	75.7	1.1	77.0	2.5	1.3
L05-0090	69.6	74.8	73.0	-1.9	75.1	0.3	2.1	75.7	0.8	77.0	2.1	1.3
L05-0100	69.7	75.1	73.0	-2.1	75.1	0.0	2.1	75.7	0.5	77.0	1.8	1.3
L05-0110	69.8	75.5	73.1	-2.4	75.1	-0.4	2.0	75.7	0.2	77.0	1.5	1.3
L06-0020	69.0	77.2	73.5	-3.6	75.2	-1.9	1.7	75.7	-1.5	76.9	-0.3	1.2
L06-0040	68.5	77.2	73.7	-3.5	75.3	-1.9	1.6	75.7	-1.5	76.9	-0.3	1.2
L06-0140	69.6	77.6	73.7	-3.9	75.3	-2.3	1.6	75.8	-1.8	76.9	-0.7	1.2
L06-0141	69.4	77.2	73.7	-3.5	75.3	-1.9	1.6	75.7	-1.5	76.9	-0.3	1.2
L06-0142	69.7	78.2	73.8	-4.4	75.5	-2.6	1.7	76.0	-2.2	77.4	-0.8	1.4
L06-0143	71.3	78.2	73.8	-4.4	75.5	-2.7	1.7	76.0	-2.2	78.3	0.1	2.3
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0	78.4	0.4	78.5	0.5	0.1
L06-0145	72.3	78.3	76.6	-1.7	77.0	-1.3	0.4	77.6	-0.6	78.1	-0.1	0.5
L06-0146	72.8	75.0	75.6	0.6	75.9	0.9	0.2	76.6	1.6	76.9	1.9	0.4
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0	77.0	-2.0	77.0	-2.0	0.0
L06-0148	71.8	77.5	73.7	-3.8	75.3	-2.2	1.6	75.8	-1.8	76.9	-0.6	1.2
L06-0149	71.5	77.5	73.7	-3.8	75.3	-2.2	1.6	75.8	-1.7	76.9	-0.5	1.2
L06-0150	71.6	77.7	74.2	-3.4	76.3	-1.3	2.1	76.7	-1.0	78.0	0.3	1.3
L06-0151	69.9	77.6	74.0	-3.6	75.9	-1.7	1.9	76.3	-1.2	77.7	0.1	1.4
L06-0152	74.0	76.7	76.9	0.2	77.1	0.3	0.1	77.3	0.6	78.0	1.3	0.7
L06-0200	73.0	79.7	76.6	-3.1	79.5	-0.2	2.9	78.5	-1.2	80.3	0.6	1.8
L06-0220	73.5	79.0	78.3	-0.8	80.2	1.2	2.0	80.0	1.0	81.6	2.6	1.6
L06-0221	77.0	79.5	78.1	-1.4	80.2	0.7	2.1	80.0	0.5	81.6	2.1	1.6
L06-0222	77.0	79.5	77.9	-1.6	78.5	-1.0	0.6	78.8	-0.7	79.5	0.0	0.7
L06-0230	75.1	80.5	79.4	-1.1	81.6	1.1	2.1	81.5	1.0	82.8	2.3	1.3
L06-0240	77.2	80.3	79.5	-0.8	81.6	1.3	2.1	81.5	1.2	82.8	2.5	1.3
L06-0240AA	67.3	80.5	74.7	-5.9	74.7	-5.8	0.0	75.8	-4.7	75.9	-4.7	0.0
L06-0242	77.2	80.8	79.5	-1.3	81.6	0.8	2.1	81.6	0.8	82.8	2.0	1.3
L06-0245	76.8	80.9	79.5	-1.3	81.6	0.8	2.1	81.6	0.7	82.8	2.0	1.3
L06-0250	77.2	81.4	79.7	-1.7	81.9	0.5	2.2	81.7	0.3	83.1	1.6	1.3
L06-0260	77.5	79.9	79.7	-0.2	81.9	2.0	2.2	81.7	1.9	83.1	3.2	1.3
L06-0270	77.5	81.3	79.7	-1.6	82.0	0.6	2.2	81.8	0.5	83.1	1.8	1.3
L06-0280	77.1	82.9	79.8	-3.2	82.0	-1.0	2.2	81.8	-1.1	83.1	0.2	1.3
L06-0290	77.6	83.3	79.9	-3.3	82.6	-0.6	2.7	82.1	-1.2	84.0	0.7	1.9
L06-0292	78.0	82.8	79.9	-2.8	82.6	-0.1	2.7	82.1	-0.7	84.0	1.2	1.9
L06-0294	78.4	83.3	80.0	-3.3	82.7	-0.6	2.7	82.1	-1.2	84.0	0.7	1.9
L06-0300	78.0	83.2	80.0	-3.2	82.7	-0.6	2.7	82.1	-1.1	84.0	0.7	1.9
L06-0310	78.7	84.0	85.6	1.6	86.2	2.2	0.6	86.9	2.9	87.3	3.3	0.4
L06-0340	68.3	77.1	74.1	-3.0	75.8	-1.3	1.7	76.2	-0.9	77.5	0.4	1.3
L06-0350	69.1	78.1	74.5	-3.6	76.3	-1.8	1.8	76.6	-1.5	78.0	-0.1	1.4
L06-0360	70.0	79.1	74.6	-4.6	76.4	-2.7	1.9	76.7	-2.4	78.1	-1.0	1.4
L06-0361	70.0	79.1	74.3	-4.9	76.4	-2.7	2.1	76.6	-2.5	78.0	-1.1	1.4
L06-0380	70.9	76.7	75.6	-1.1	78.6	1.9	3.0	78.6	1.8	80.5	3.7	1.9
L06-0390	73.0	78.8	75.7	-3.1	78.6	-0.2	3.0	78.6	-0.2	80.5	1.7	1.9
L06-0400	73.8	78.2	76.7	-1.5	79.9	1.7	3.2	79.7	1.5	82.0	3.8	2.3
L06-0430	73.2	81.8	76.9	-4.8	80.0	-1.8	3.1	79.8	-2.0	82.0	0.3	2.3
L06-0432	73.3	81.8	77.0	-4.8	80.1	-1.7	3.1	79.9	-1.9	82.2	0.4	2.3
L06-0433	71.2	80.4	76.8	-3.6	80.0	-0.4	3.2	79.8	-0.6	82.0	1.6	2.3
L06-0434	72.2	80.5	76.8	-3.7	80.0	-0.5	3.2	79.8	-0.7	82.1	1.6	2.2
L06-0435	72.0	80.2	76.8	-3.4	80.0	-0.2	3.2	79.8	-0.4	82.0	1.8	2.3
L06-0436	73.3	80.4	77.4	-3.0	80.5	0.1	3.1	80.2	-0.2	82.1	1.7	1.9
L06-0438	73.7	79.5	80.1	0.7	80.6	1.1	0.5	81.0	1.5	82.2	2.7	1.2
L06-0460	71.8	80.5	77.1	-3.4	80.1	-0.3	3.1	79.9	-0.5	82.2	1.8	2.3
L06-0480	71.9	80.8	77.1	-3.7	80.1	-0.7	3.1	79.9	-0.9	82.3	1.5	2.4
L06-0490	72.7	81.0	77.1	-3.9	80.1	-0.9	3.1	79.9	-1.1	82.3	1.3	2.4
L06-0492	72.8	81.1	77.6	-3.6	80.4	-0.7	2.9	80.8	-0.3	83.0	1.9	2.2
L06-0500	74.4	81.5	77.6	-3.9	80.4	-1.1	2.8	80.8	-0.7	83.0	1.5	2.2
L06-0502	74.6	81.0	77.7	-3.2	80.5	-0.5	2.8	81.0	0.1	83.2	2.2	2.2
L06-0510	75.3	82.7	77.9	-4.7	80.5	-2.1	2.6	81.1	-1.6	83.2	0.6	2.2
L06-0520	77.5	82.8	78.9	-3.9	80.7	-2.1	1.8	81.5	-1.3	83.7	1.0	2.2
L07-0040	74.4	78.7	75.2	-3.5	75.8	-3.0	0.5	76.8	-1.9	78.1	-0.6	1.3
L07-0041	74.4	81.4	75.2	-6.2	75.8	-5.6	0.6	76.8	-4.6	78.1	-3.2	1.3
L07-0042	73.7	80.2	74.2	-5.9	75.7	-4.4	1.5	76.8	-3.4	78.1	-2.0	1.3
L07-0043	72.9	80.2	74.1	-6.1	75.7	-4.4	1.6	76.8	-3.4	78.1	-2.1	1.3
L07-0050	76.2	80.0	76.5	-3.4	76.5	-3.4	0.0	76.9	-3.1	78.1	-1.8	1.3
L07-0060	74.8	79.6	80.6	1.0	81.9	2.4	1.4	81.9	2.3	82.8	3.3	0.9
L07-0061	75.5	78.3	79.2	0.9	79.3	1.0	0.1	79.3	1.0	79.4	1.0	0.1
L07-0062	76.3	79.6	80.6	1.0	81.9	2.4	1.4	81.9	2.3	82.8	3.3	0.9
L07-0064	76.4	79.1	79.5	0.4	80.0	1.0	0.5	80.4	1.3	80.6	1.5	0.3
L07-0068	78.9	79.8	79.2	-0.6	79.3	-0.5	0.1	79.3	-0.5	79.4	-0.4	0.1
L07-0070	76.9	80.0	79.5	-0.5	80.0	0.0	0.5	80.4	0.4	80.6	0.6	0.3
L07-0080	77.3	80.1	80.3	0.3	80.4	0.4	0.1	81.4	1.4	81.5	1.4	0.1
L07-0100	75.0	81.0	79.8	-1.1	79.8	-1.1	0.0	81.3	0.4	81.4	0.4	0.1
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1	0.0	80.6	-11.1	80.5	-11.1	0.0
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8	0.0	80.6	7.8	80.5	7.8	0.0
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	66.1	-4.6	1.2	67.2	-3.5	67.9	-2.8	0.7
L08-0012	60.5	70.8	64.9	-5.8	66.1	-4.6	1.2	67.2	-3.5	68.0	-2.8	0.8
L08-0020	60.9	71.2	64.9	-6.3	66.1	-5.0	1.2	67.2	-3.9	68.0	-3.2	0.8
L08-0030	61.0	71.2	64.9	-6.3	66.1	-5.1	1.2	67.2	-4.0	68.1	-3.2	0.8
L08-0040	61.4	71.7	64.9	-6.8	66.1	-5.6	1.2	67.3	-4.5	68.1	-3.6	0.8
L08-0050	61.6	71.8	64.9	-6.9	66.1	-5.7	1.2	67.3	-4.5	68.3	-3.5	1.0
L08-0060	62.5	72.8	65.6	-7.2	66.1	-6.6	0.6	67.4	-5.3	68.4	-4.4	0.9
L09-0010	69.4	75.5	73.0	-2.5	75.0	-0.5	2.0	75.5	0.1	76.8	1.3	1.3
L09-0040	73.1	77.3	75.2	-2.1	75.4	-1.9	0.3	75.9	-1.4	76.8	-0.5	0.9
L09-0050	72.9	77.3	75.4	-2.0	75.6	-1.7	0.3	76.1	-1.2	77.0	-0.3	0.9
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0	77.6	-4.6	77.7	-4.5	0.1
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0	85.4	3.3	85.4	3.3	0.0
L11-0020	79.6	85.6	81.1	-4.6	81.1	-4.5	0.0	84.5	-1.1	84.7	-1.0	0.2
L11-0030	79.6	85.6	87.1	1.4	87.1	1.4	0.0	88.6	3.0	88.6	3.0	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.7	-1.6	0.3	80.8	0.5	81.5	1.2	0.7
L13-0020	77.6	79.9	80.4	0.5	80.4	0.5	0.0	81.1	1.3	81.6	1.7	0.5
L15-0010	71.9	77.2	73.4	-3.7	75.2	-2.0	1.7	75.8	-1.4	76.9	-0.3	1.2
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0	80.7	3.6	80.7	3.6	0.0
MC0010	50.7	59.9	56.3	-3.6	57.5	-2.4	1.2	59.9	0.0	60.6	0.7	0.6

Table 7-4. Node Data and Model Results For Existing Conditions and Future Conditions

Model Input Data			Model Results									
			10-Year Storm					100-Year Storm				
			Existing		Future			Existing		Future		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing
MC0020	50.7	59.9	56.3	-3.6	57.5	-2.4	1.2	59.9	0.0	60.6	0.7	0.6
MC0030	51.1	60.3	56.6	-3.7	57.8	-2.5	1.2	60.1	-0.2	60.8	0.5	0.6
MC0040	51.4	59.7	56.7	-3.0	57.9	-1.8	1.2	60.5	0.8	61.3	1.6	0.8
MC0050	51.5	60.1	56.9	-3.3	58.1	-2.0	1.3	60.6	0.5	61.4	1.3	0.8
MC0060	51.5	60.1	56.9	-3.3	58.1	-2.0	1.3	60.7	0.5	61.5	1.3	0.8
MC0070	52.2	64.1	57.1	-7.0	58.3	-5.8	1.3	60.8	-3.3	61.6	-2.5	0.8
MC0080	52.4	61.1	57.1	-4.1	58.3	-2.8	1.3	60.8	-0.3	61.6	0.5	0.8
MC0090	53.3	63.2	58.3	-4.8	59.5	-3.6	1.2	61.7	-1.5	62.5	-0.7	0.8
MC0100	53.2	62.2	58.4	-3.9	59.5	-2.7	1.2	61.7	-0.5	62.5	0.3	0.8
MC0110	54.3	63.6	59.9	-3.7	61.1	-2.5	1.2	63.1	-0.6	63.9	0.2	0.8
MC0120	54.4	66.8	60.0	-6.8	61.2	-5.6	1.2	63.1	-3.6	63.9	-2.8	0.8
MC0130	54.2	64.0	60.3	-3.7	61.5	-2.5	1.3	63.4	-0.6	64.2	0.2	0.8
MC0140	53.9	64.1	60.3	-3.8	61.6	-2.5	1.3	63.4	-0.7	64.2	0.1	0.8
MC0150	57.2	68.6	62.5	-6.1	63.8	-4.8	1.3	65.3	-3.3	66.1	-2.5	0.8
MC0160	57.2	68.7	62.6	-6.2	63.8	-4.9	1.3	65.3	-3.4	66.1	-2.6	0.8
MC0170	57.9	69.2	63.0	-6.1	64.3	-4.9	1.3	65.7	-3.4	66.5	-2.6	0.8
MC0172	58.1	69.3	63.2	-6.1	64.4	-4.9	1.3	65.9	-3.5	66.6	-2.7	0.8
MC0174	58.2	69.3	63.2	-6.1	64.5	-4.9	1.3	65.9	-3.5	66.7	-2.7	0.8
MC0176	58.2	69.4	63.2	-6.1	64.5	-4.9	1.3	65.9	-3.5	66.7	-2.7	0.8
MC0178	58.2	69.4	63.2	-6.1	64.5	-4.9	1.3	65.9	-3.5	66.7	-2.7	0.8
MC0180	58.8	69.7	63.6	-6.1	64.9	-4.9	1.2	66.2	-3.5	66.9	-2.8	0.8
MC0190	58.8	69.7	63.6	-6.1	64.9	-4.8	1.3	66.2	-3.5	67.0	-2.7	0.8
MC0200	59.3	70.8	64.2	-6.6	65.5	-5.4	1.2	66.7	-4.2	67.4	-3.4	0.8
MC0210	58.5	70.2	64.3	-5.9	65.5	-4.7	1.2	66.7	-3.5	67.4	-2.8	0.8
MC0220	60.1	70.4	64.9	-5.5	66.1	-4.2	1.2	67.2	-3.2	67.9	-2.4	0.7
MC0230	61.4	70.9	66.8	-4.1	68.0	-2.9	1.2	68.8	-2.1	69.3	-1.6	0.6
MC0240	61.5	70.9	66.8	-4.1	68.1	-2.8	1.3	68.9	-2.0	69.5	-1.4	0.6
MC0250	62.0	71.1	67.7	-3.4	69.0	-2.1	1.3	69.7	-1.4	70.3	-0.9	0.5
MC0260	62.9	71.5	68.8	-2.6	70.1	-1.4	1.3	70.8	-0.7	71.3	-0.2	0.5
MC0270	62.2	70.5	68.9	-1.6	70.2	-0.2	1.3	70.9	0.5	71.5	1.0	0.5
MC0280	65.4	71.4	69.6	-1.9	70.9	-0.6	1.3	71.4	0.0	71.9	0.5	0.5
MC0282	65.5	71.5	69.7	-1.8	70.9	-0.5	1.3	71.5	0.0	72.0	0.5	0.5
MC0290	65.6	71.5	70.4	-1.1	72.6	1.1	2.2	73.5	2.0	74.4	2.9	0.9
MC0292	67.1	71.9	71.3	-0.6	73.2	1.3	1.9	73.9	2.0	74.8	2.8	0.9
MC0296	65.8	71.6	71.6	0.0	73.4	1.8	1.8	74.1	2.5	74.9	3.3	0.9
MC0298	65.4	71.6	71.6	0.0	73.4	1.8	1.8	74.1	2.5	74.9	3.4	0.9
MC0300	63.3	73.3	71.6	-1.6	73.5	0.2	1.8	74.1	0.8	75.0	1.7	0.9
MC0310	63.3	72.5	71.7	-0.8	73.6	1.2	1.9	74.3	1.8	75.2	2.8	1.0
MC0320	65.4	74.7	71.7	-3.0	73.7	-1.1	1.9	74.3	-0.5	75.2	0.5	1.0
MC0330	65.2	71.6	72.0	0.4	74.4	2.8	2.4	75.0	3.4	76.3	4.7	1.3
MC0340	65.3	72.5	72.1	-0.4	74.4	2.0	2.3	75.0	2.6	76.4	3.9	1.3
MC0350	65.3	72.8	72.1	-0.7	74.5	1.7	2.4	75.1	2.3	76.5	3.7	1.4
MC0360	65.5	75.5	72.2	-3.2	74.6	-0.9	2.4	75.2	-0.2	76.6	1.1	1.3
MC0370	64.9	75.5	72.2	-3.3	74.6	-0.9	2.4	75.2	-0.3	76.6	1.1	1.4
MC0380	65.8	74.7	72.3	-2.4	74.7	0.0	2.3	75.3	0.6	76.6	1.9	1.3
MC0390	67.1	73.5	72.4	-1.1	74.7	1.2	2.3	75.3	1.8	76.6	3.1	1.3
MC0400	67.1	74.8	72.4	-2.4	74.7	-0.1	2.3	75.3	0.5	76.6	1.8	1.3
MC0410	68.1	78.7	72.9	-5.8	74.9	-3.8	2.0	75.5	-3.2	76.8	-1.9	1.3
MC0420	69.2	77.2	73.0	-4.2	75.0	-2.2	1.9	75.5	-1.7	76.8	-0.4	1.2
MC0422	69.2	77.2	73.1	-4.2	75.0	-2.3	1.9	75.6	-1.7	76.8	-0.4	1.2
MC0430	69.4	77.2	73.4	-3.8	75.1	-2.1	1.7	75.7	-1.5	76.9	-0.3	1.2
MC0430	69.4	77.2	73.4	-3.8	75.1	-2.1	1.7	75.7	-1.5	76.9	-0.3	1.2
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0	81.4	1.5	81.4	1.5	0.0
MC0440	69.0	76.0	73.4	-2.6	75.2	-0.8	1.8	75.8	-0.2	77.0	1.0	1.2
MC0450	70.4	78.1	73.7	-4.3	75.3	-2.8	1.6	76.0	-2.1	77.1	-1.0	1.1
MC0451	69.7	77.4	73.6	-3.8	75.2	-2.1	1.7	75.9	-1.5	77.0	-0.3	1.1
MC0460	71.7	77.3	74.1	-3.3	75.6	-1.7	1.6	76.7	-0.6	77.9	0.6	1.3
MC0461	70.4	77.6	74.2	-3.4	75.7	-1.9	1.4	76.7	-0.9	78.0	0.4	1.2
MC0462	71.1	77.4	74.2	-3.2	75.9	-1.5	1.6	76.7	-0.7	78.0	0.5	1.2
MC0463	71.3	76.7	74.2	-2.5	76.4	-0.3	2.1	76.7	0.0	78.0	1.3	1.2
MC0464	71.7	78.6	74.2	-4.4	76.6	-2.0	2.4	76.8	-1.8	78.0	-0.6	1.2
MC0464	71.7	78.6	74.2	-4.4	76.6	-2.0	2.4	76.8	-1.8	78.0	-0.6	1.2
MC0470	72.2	78.7	74.5	-4.2	75.8	-2.9	1.2	76.8	-1.9	78.0	-0.7	1.2
MC0480	71.8	77.5	74.7	-2.8	76.0	-1.5	1.2	77.3	-0.2	78.5	1.0	1.2
MC0490	72.3	78.3	75.6	-2.7	76.5	-1.8	0.8	77.7	-0.6	78.7	0.4	1.0
MC0500	72.4	78.4	75.8	-2.7	76.7	-1.8	0.9	78.2	-0.2	79.3	0.9	1.1
MC0510	73.4	80.2	76.8	-3.5	77.4	-2.8	0.6	78.7	-1.5	79.6	-0.7	0.8
MC0520	73.0	81.1	77.1	-4.0	77.8	-3.2	0.7	79.9	-1.1	80.7	-0.4	0.8
MC0530	73.3	81.3	77.1	-4.2	77.8	-3.5	0.7	79.9	-1.4	80.7	-0.6	0.8
MC0540	73.3	81.4	77.3	-4.1	78.1	-3.4	0.8	80.7	-0.7	81.4	0.0	0.7
MC0545	73.6	81.7	77.6	-4.1	78.3	-3.4	0.7	80.8	-0.9	81.5	-0.2	0.7
MC0550	74.0	81.9	77.9	-4.0	78.4	-3.5	0.6	80.9	-1.0	81.5	-0.4	0.7
MC0560	74.1	82.0	78.1	-3.9	78.6	-3.3	0.6	81.4	-0.5	82.0	0.1	0.6
MC0570	74.5	82.1	78.3	-3.8	78.8	-3.3	0.5	81.5	-0.6	82.1	0.0	0.6
MC0580	74.5	82.1	78.5	-3.7	78.9	-3.2	0.4	81.9	-0.2	82.5	0.3	0.5
MC0590	75.6	82.9	79.3	-3.6	79.5	-3.4	0.2	82.2	-0.8	82.6	-0.3	0.5
MC0600	75.6	83.0	79.5	-3.4	79.7	-3.2	0.2	82.7	-0.3	83.1	0.1	0.4
MC0610	76.0	83.2	79.7	-3.5	79.9	-3.4	0.2	82.7	-0.5	83.1	-0.1	0.4
MC0620	76.0	83.9	79.9	-4.0	80.1	-3.9	0.1	83.3	-0.6	83.6	-0.3	0.3
MC0630	75.1	83.2	80.0	-3.1	80.1	-3.0	0.1	83.3	0.2	83.7	0.5	0.3
MC0640	75.3	83.3	80.1	-3.2	80.2	-3.1	0.1	83.4	0.1	83.7	0.4	0.3
MC0642	76.2	83.8	80.1	-3.7	80.2	-3.6	0.1	83.4	-0.4	83.7	-0.1	0.3
MC0644	76.3	83.9	80.8	-3.1	80.9	-3.0	0.1	84.5	0.6	84.7	0.8	0.2
MC0650	77.1	84.3	80.9	-3.4	80.9	-3.4	0.0	84.5	0.2	84.7	0.3	0.2
MC0660	76.2	83.7	80.1	-3.6	80.2	-3.5	0.1	83.3	-0.4	83.7	0.0	0.3
MC0662	76.3	83.8	80.6	-3.2	80.6	-3.2	0.0	84.7	0.9	84.9	1.1	0.2
MC0670	78.0	84.8	80.9	-3.9	80.9	-3.9	0.0	84.7	-0.1	84.9	0.1	0.2
WIC0005	50.5	56.7	57.0	0.4	57.6	0.9	0.5	59.7	3.0	60.0	3.3	0.3
WIC0010	50.9	60.3	58.7	-1.6	59.3	-1.0	0.6	61.2	0.9	61.5	1.2	0.3
WIC0020	50.9	58.9	58.8	-0.1	59.4	0.5	0.6	61.3	2.5	61.6	2.8	0.3
WIC0030	51.8	59.4	59.4	0.0	60.0	0.6	0.6	61.9	2.5	62.3	2.9	0.3
WIC0032	52.5	60.1	59.9	-0.2	60.5	0.5	0.6	62.4	2.3	62.7	2.6	0.3
WIC0034	54.1	61.4	60.9	-0.5	61.6	0.2	0.7	63.3	1.9	63.7	2.3	0.3
WIC0040	54.9	62.1	61.3	-0.9	61.9	-0.2	0.7	63.6	1.5	64.0	1.8	0.3
L01-0006	Node turned off in model											
L01-0008	Node turned off in model											
L01-0009	Node turned off in model											
L01-0010	Node turned off in model											

Table 7-4. Node Data and Model Results For Existing Conditions and Future Conditions

Model Input Data			Model Results									
			10-Year Storm					100-Year Storm				
			Existing		Future			Existing		Future		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Elevation Difference between Future and Existing
L01-0130	Node turned off in model											
L01-0140	Node turned off in model											
L01-0150	Node turned off in model											
L01-0160	Node turned off in model											
L02-0311	Node turned off in model											
L02-0312	Node turned off in model											
L02-0313	Node turned off in model											
L02-0315	Node turned off in model											
L02-0316	Node turned off in model											
L02-0320	Node turned off in model											
L02-0330	Node turned off in model											
L02-0340	Node turned off in model											
L02-0360	Node turned off in model											
L02-0508	Node turned off in model											
L02-0509	Node turned off in model											
WIC0050	Node turned off in model											
WIC0060	Node turned off in model											
	Node turned off in model											

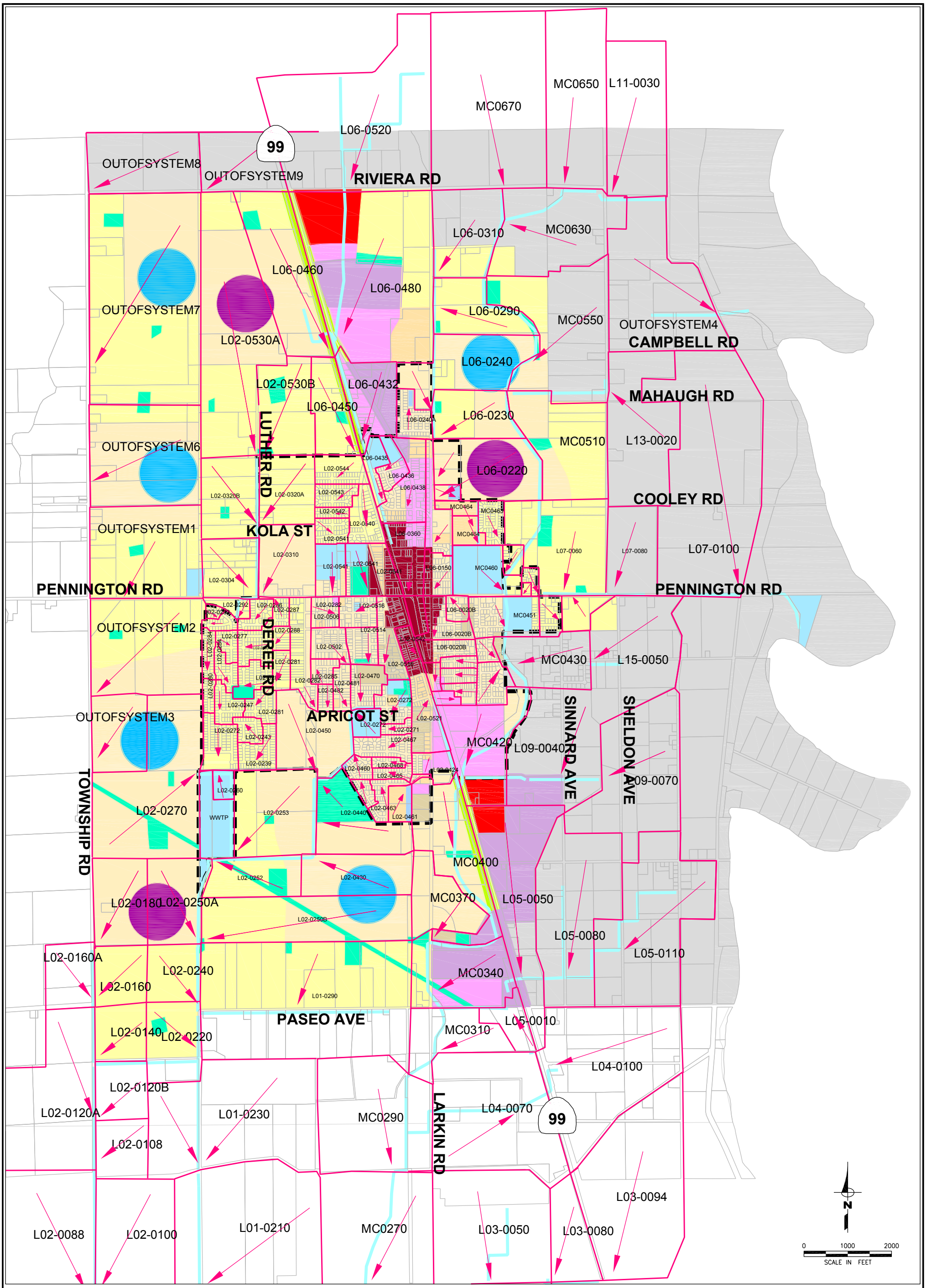
FUTURE IMPROVEMENT OPTIONS

Potential flooding caused by increased runoff from developed areas could be mitigated with following projects:

- Increasing the capacity of culverts and/or drainage channels
- Detention storage
- Redirection of flow to the Feather River

The following chapters will present improvement alternative that eliminate the increases in water surface elevations and eliminate flooding at full buildout land use conditions.

N:\Clients\047 EDAW\00-08-15 LOGP-MDS\CAD\Figures\047-08-15Fig 7-1.dwg 11/9/2010 2:27 PM jfugitt



LEGEND

- CITY LIMITS
- CHANNEL
- SUBSHED BOUNDARY
- SUBSHED TRIBUTARY ARROW
- LOW-DENSITY RESIDENTIAL
- SMALL-LOT RESIDENTIAL
- MEDIUM-DENSITY RESIDENTIAL
- HIGH-DENSITY RESIDENTIAL
- COMMERCIAL MIXED USE
- DOWNTOWN MIXED USE
- COMMUNITY COMMERCIAL
- PARK
- CIVIC
- EMPLOYMENT
- URBAN RESERVE
- BUFFER
- NEIGHBORHOOD CENTER
- CIVIC CENTER

SOURCE: FUTURE LAND USE FROM THE CITY OF LIVE OAK GENERAL PLAN PROVIDED BY EDAW AECOM

Figure 7-1

City of Live Oak
Master Drainage Study
FUTURE LAND USE CONDITIONS

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 8. ALTERNATIVE 1

Development within the City of Live Oak (City) General Plan area could cause increased runoff rates and increased flooding above that which occurs under existing conditions. Future development results in the construction of homes, buildings, and other high value infrastructure in existing agricultural lands. Minor flooding of agricultural lands from relatively small storms has been acceptable because it has not caused significant damage. However, after development, the minor flooding from small storms will no longer be acceptable. Consequently, several alternative sets of improvements have been developed to provide flood protection throughout the City and to prevent increased flooding upstream and downstream of the City.

Alternative 1 includes diverting flows from the Northeast Quadrant of the City to the Feather River, regional detention storage, and installation of large storm drains in the developed areas. Alternative 1 also includes the construction of five detention basins. The modeling of Alternative 1 also included the improvements presented in Chapter 6 to solve the existing flooding problems.

The proposed improvements are shown on Figure 8-1. The improvements are grouped into the following 11 sections as shown on Figure 8-1:

1. Main Canal Improvement and Diversion to East Basin
2. Larkin Road Storm Drain System and Diversion Pipe to Main Canal
3. East Detention Basin
4. Lateral 5 Improvement
5. South Detention Basin
6. Lateral 6 Improvements and Diversion to North Detention Basin
7. North Detention Basin and Storm Drain
8. Caltrans Property Detention Basin
9. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road
10. Lateral 2 Improved Channel and Culverts at Township Road
11. West Detention Basin

The details for the improvements are shown in Table 8-1. The details include new storm drain or channel inverts, sizes, and materials. Each of the improvement are discussed in the following sections.

As discussed below, this project includes minor increases in water levels in Lateral 4. These increases would be eliminated with annual maintenance of the channel funded through City drainage fees. Maintenance would include channel vegetation removal and culvert sediment removal.

Table 8-1. Alternative 1 Improvement Details

Link Name	US Node Name	DS Node Name	Type	No. Barrels	US Invert Elevation (ft)	DS Invert Elevation (ft)	Roughness	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Sideslope _H:1V	Right-hand Sideslope _H:1V
1. Main Canal Improvement and Diversion Channel to East Basin												
MC0600A	MC0600	MC0590	Circular	1	74.44	74.35	0.015	84	5.0	--	--	--
MC0590A	MC0590	MC0580	Circular	1	74.35	72.34	0.015	2,015	5.0	--	--	--
MC0580A	MC0580	MC0570	Circular	1	72.34	72.27	0.015	66	5.0	--	--	--
MC0570A	MC0570	MC0560	Circular	1	72.27	71.51	0.015	759	5.0	--	--	--
MC0560A	MC0560	MC0550	Circular	1	71.51	71.41	0.015	104	5.0	--	--	--
MC0550A	MC0550	MC0545	Circular	1	71.41	70.69	0.015	721	5.0	--	--	--
MC0545A	MC0545	MC0540	Circular	1	70.69	70.15	0.015	535	6.0	--	--	--
MC0540A	MC0540	MC0530	Circular	1	70.15	70.08	0.015	69	6.0	--	--	--
MC0530A	MC0530	MC0520	Circular	1	70.08	69.51	0.015	569	6.0	--	--	--
MC0520A	MC0520	MC0510	Circular	1	69.51	69.38	0.015	136	6.0	--	--	--
MC0510A	MC0510	MC0500	Circular	1	69.38	67.61	0.015	1,764	6.0	--	--	--
MC0500A	MC0500	MC0490	Circular	1	67.61	67.50	0.015	114	6.0	--	--	--
MC0491A	MC0490	EBSN	Trapezoidal	1	67.50	66.00	0.035	2,953	11.5	25	4	4
2. Larkin Road Storm Drain System and Diversion Pipe to Main Canal												
LO60310A	L06-0310	L06-0300	Circular	1	71.34	71.24	0.015	190.00	6.0	--	--	--
L06-0300A	L06-0300	L06-0294	Circular	1	71.24	71.00	0.015	488.00	6.0	--	--	--
L06-0294A	L06-0294	L06-0292	Circular	1	71.00	70.98	0.015	43.00	6.0	--	--	--
L06-0292A	L06-0292	L06-0290	Circular	1	70.98	70.67	0.015	610.00	6.0	--	--	--
L06-0290A	L06-0290	L06-0280	Circular	1	70.67	70.65	0.015	40.00	6.0	--	--	--
LO6-0280A	L06-0280	L06-0270	Circular	1	70.65	70.34	0.015	623.00	6.0	--	--	--
L06-0270A	L06-0270	L06-0260	Circular	1	70.34	70.31	0.015	62.00	6.0	--	--	--
L06-0260A	L06-0260	L06-0250	Circular	1	70.31	70.21	0.015	192.00	6.0	--	--	--
L06-0250A	L06-0250	L06-0245	Circular	1	70.21	70.16	0.015	106.00	6.0	--	--	--
L06-0245A	L06-0245	L06-0242	Circular	1	70.16	69.76	0.015	796.00	6.0	--	--	--
L06-0242A	L06-0242	L06-0240	Circular	1	69.76	69.74	0.015	30.00	6.0	--	--	--
L06-0240A	L06-0240	L06-0230	Circular	1	69.74	69.48	0.015	525.00	6.0	--	--	--
L06-0230A	L06-0230	L06-0220	Circular	1	69.48	68.80	0.015	1366.00	6.0	--	--	--
L06-0220B	L06-0220	MC0490	Circular	1	68.80	67.50	0.015	2523.27	6.0	--	--	--
3. East Detention Basin												
Epump	EBSN	L07-0130	Pump	1	--	--	--	--	--	--	--	--
4. Lateral 5 Improvement												
L05-0050A	L05-0050	L05-0040	Circular	1	66.62	66.50	0.015	117	4.0	--	--	--
L05-0040A	L05-0040	L05-0020	Circular	1	66.50	66.37	0.015	130	4.0	--	--	--
L05-0020B	L05-0020	SBSN2	Circular	1	66.37	65.24	0.015	1,463	5.0	--	--	--
L05-0010A	L05-0010	SBSN2	Circular	1	65.47	65.24	0.015	1,417	3.5	--	--	--
5. South Detention Basin												
S2_WEIR	MC0340	SBSN2	Weir	1	--	--	--	--	--	--	--	--
S2_out	SBSN2	MC0330	Circular	1	65.24	65.24	0.015	50	2.0	--	--	--
6. Lateral 6 Improvements and Diversion to North Detention Basin												
L06-0520A	L06-0520	L06-0510	Circular	1	75.50	75.19	0.014	80	4.5	--	--	--
L06-0510A	L06-0510	L06-0502	Circular	1	75.19	74.57	0.015	1,556	4.5	--	--	--
L06-0502A	L06-0502	L06-0500	Circular	1	74.57	74.56	0.015	20	4.5	--	--	--
L06-0500A	L06-0500	L06-0492	Circular	1	74.56	74.10	0.015	1,141	4.5	--	--	--
L06-0492A	L06-0492	L06-0490	Circular	2	74.10	74.09	0.015	30	4.5	--	--	--
L06-0490A	L06-0490	L06-0480	Circular	2	74.09	73.83	0.015	656	4.5	--	--	--
L06-0480A	L06-0480	L06-0460	Circular	2	73.83	73.76	0.015	177	4.5	--	--	--
L06-0460B	L06-0460	L06-0460F	Trapezoidal	1	73.76	73.20	0.08	1,382	5.7	6	4	4
L06-0432B	L06-0432	L06-0460F	Circular	1	73.45	73.20	0.014	247	5.0	--	--	--
L06-0460SA	L06-0460F	NBSN	Trapezoidal	1	73.2	72.50	0.08	2,176	5.8	6	4	4
7. North Detention Basin and Storm Drain												
NBSN_out	NBSN	L02-0530	Circular	1	72.50	72.00	0.015	100	1.5	--	--	--
L02-0530A	L02-0530	L02-0522A	Circular	1	72.00	70.40	0.015	1,940	3.5	--	--	--
L020518AA	L02-0518A	L02-0300	Circular	1	68.78	68.73	0.014	72	2.5	--	--	--
8. Caltrans Property Detention Basin												
SBSN_WEIR	L02-0450	SBSN	Weir	1	--	--	--	--	--	--	--	--
SBSN_Pump	SBSN	L02-0440	Circular	1	--	--	--	--	--	--	--	--
9. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road												
L02-0450A	L02-0450	L02-0440	Trapezoidal	1	66.35	65.87	0.08	1,004	8.2	5	4	4
L02-0440A	L02-0440	L02-0430	Trapezoidal	1	65.87	65.52	0.08	801	8.6	5	4	4
CNTR1	L02-0430	SBNS_CNTR	Circular	1	65.52	65.50	0.015	120	0.8	--	--	--
L02-0430A	SBNS_CNTR	L02-0253	Trapezoidal	1	65.50	64.70	0.08	1,862	7.5	15	4	4
L02-0253A	L02-0253	L02-0252	Trapezoidal	1	64.70	64.47	0.08	532	8.0	50	5	5
L02-0252A	L02-0252	L02-0250	Trapezoidal	1	64.47	63.61	0.08	2,003	8.5	60	5	5
SBSN_C	L02-0250	SBNS_CNTR	Circular	1	63.61	63.60	0.015	120	4.0	--	--	--
L02-0250A	SBNS_CNTR	L02-0240	Trapezoidal	1	63.60	62.95	0.035	1,511	7.7	60	5	5
10. Lateral 2 Improved Channel and Culverts at Township Road												
L02-0180A	L02-0180	L02-0170	Circular	1	65.85	65.75	0.015	100	6.0	--	--	--
L02-0170A	L02-0170	L02-0160	Circular	1	65.75	64.55	0.015	1,199	6.0	--	--	--
L02-0160A	L02-0160	L02-0150	Circular	1	64.55	64.51	0.015	120	6.0	--	--	--
L02-0150A	L02-0150	L02-0140	Circular	1	64.51	63.20	0.015	1,311	6.0	--	--	--
11. West Detention Basin												
L02-0140B	L02-0140	WBSN	Circular	1	63.20	63.00	0.014	120	6.0	--	--	--
WBSN_Pump	WBSN	L02-0130	Pump	1	--	--	--	--	--	--	--	--

MODIFIED HYDROLOGY

To develop Alternative 1, it was necessary to redirect several subsheds to be tributary to different or new model nodes. Presented in Table 8-2 are the subsheds that were redirected and the nodes to which they are tributary, the subshed size, and the impervious percentage for the buildout condition. Subsheds not listed in Table 8-2 are unchanged from Table 7-3.

Table 8-2. Summary of Redirected Subsheds

Subshed	Tributary Node	Area, acres
L01-0290	L02-0250	294.6
L02-0140	WBSN[(a)]	35.1
L02-0220	WBSN	52.1
L02-0180	L02-0252	56.8
L02-0304	L02-0518A	40.5
L02-0310	L02-0520A	49.6
L02-0440	SBSN[(b)]	62.3
L02-0522	NBSN[(c)]	103.3
L02-0530	NBSN	249.8
L05-0050	SBSN2[(d)]	122.0
L06-0200	L06-0220	21.2
L06-0220	MC0500	73.75
L06-0230	MC0510	47.3
L06-0290	MC0550	50.8
L06-0430(1)	NBSN	249.8
L06-0430(2)	L06-0432	4.3
L06-0460	NBSN	102.1
L06-0480[(e)]	L06-0480	163.4
L06-0480	L06-0290	81.7
L07-0060	EBSN	101.0
L07-0062	EBSN[(d)]	14.8
L07-0080	EBSN	54.1
MC0340	SBSN2[(e)]	79.2
MC0370	SBSN1	47.6
MC0464	L06-0220	6.4
MC0400	SBSN1	85.7

(a) WBSN - West Detention Basin

(b) SBSN - Caltrans Property Detention Basin

(c) NBSN - North Detention Basin

(d) EBSN - East Detention Basin

(e) SBSN2 - South Detention Basin

(f) L06-0480 was divided with 2/3 of the area tributary to L06-0480 and 1/3 of the area tributary to L06-0290.

DETENTION BASIN DATA

The model nodes NBSN, WBSN, SBSN, SBSN2, and EBSN refer to the North Detention Basin, West Detention Basin, Caltrans Property Detention Basin, South Detention Basin, and East Detention Basin, respectively. A summary of the detention basin data and results are shown in Table 8-3.

1. MAIN CANAL IMPROVEMENT AND DIVERSION TO EAST BASIN

Improvements would be necessary where the Main Canal (also called Live Oak Slough) flows through growth areas. The improvements include the construction of about 3,750 linear feet of a 60-inch storm drain and 3,190 linear feet of 72-inch storm drain. The flow continuing south in the Main Canal would be limited by constructing an 18-in low flow orifice in the canal. Excess flows will be diverted east via a constructed channel with a bottom width of 25 feet and side slopes of 4:1 (horizontal:vertical) to the East Detention Basin. The new channel will provide detention storage and will convey flow to the East Detention Basin.

2. LARKIN ROAD STORM DRAIN SYSTEM AND DIVERSION PIPE TO MAIN CANAL

The existing Larkin Road drainage facilities upstream of the City consist of a small road side ditch and several driveway culvers. Alternative 1 involves the construction of a 72-inch storm drain including a diversion pipe from Larkin Road, which connects with the diversion channel that drains to East Detention Basin.

3. EAST DETENTION BASIN

The runoff from the Northeast Quadrant of the City will be diverted to the Feather River. Near the end of the 72-inch diversion pipe from the Larkin Road storm drain system, an 18-inch orifice will allow low flows to continue draining to the Main Canal. The 100-year peak runoff inflow to the East Detention Basin is 146 cfs and the 100-year peak channel inflow from the west is 296 cfs. The East Detention Basin will detain 68.9 acre-feet of runoff during the 100-year storm. The East Detention Basin will be emptied by a 20 cfs pump station that discharges to the Feather River. The flow would be pumped through a 36-in force main. The elevation area data used in the model are shown in Table 8-3.

4. LATERAL 5 IMPROVEMENT

A section of Lateral 5 will be in developed areas in the future build out land use conditions. Alternative 1 includes the construction of a 48-inch to 60-inch storm drain from east of Highway 99 to the South Detention Basin, and a 42-inch storm drain from the developed areas west of Highway 99 to the South Detention Basin.

Table 8-3. Detention Basin Summary

	North Detention Basin NBSN		East Detention Basin EBSN		Caltrans Property Detention Basin SBSN		South Detention Basin SBSN2		West Detention Basin WBSN	
Basin Data										
Invert Elevation (ft)	72.5		66.0		65.3		65.2		63.0	
Area at Invert Elevation[(a)] (ac)	23.3		4.8		11.6		19.1		5.2	
Top Elevation (ft)	79.5		80.0		75.3		72.5		73.5	
Area at Top Elevation (ac)	25.3		6.6		13.7		21.0		6.5	
Inlet Data										
Type	Trapezoidal Channel		Trapezoidal Channel		Side Flow Weir		Side Flow Weir		Storm Drain	
Weir Length (ft)	-		-		100		50		-	
Weir Spill Crest Elev. (ft)	-		-		70.0		70.0		-	
Storm Drain Size (in dia.)	-		-		-		60 & 42		60	
Bottom width of Channel (ft)	6.0		25.0		-		-		-	
Outlet Data										
Type	Pipe		Pump Station		Pump Station		Pipe		Pump Station	
Size	18-inch RCP		20 cfs		10 cfs		24-inch RCP		5 cfs	
Results Data										
	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year
Peak WSE (ft)	78.4	76.0	78.3	74.0	74.3	70.7	71.2	67.8	72.1	69.8
Peak Storage (ac-ft)	142.4	82.8	68.9	42.6	112.3	66.0	118.1	50.6	52.3	38.0
Runoff to Node (cfs)	490	340	146	104	272	207	-	-	170	119
Channel Inflow (cfs)	181	103	296	179	-	-	-	-	-	-
Weir Inflow (cfs)	-	-	-	-	200	127	183	78	-	-
Pipe Inflow (cfs)	-	-	-	-	-	-	130[(b)]	102[(b)]	143	105
Pipe Outflow (cfs)	17	12	-	-	-	-	14	3	-	-

(a) The basin would be graded to drain to the outlet culvert or pump station.

(b) The pipe inflow is the total peak flow for the two storm drains that empty to SBSN2.

5. SOUTH DETENTION BASIN

The South Detention Basin will be constructed to mitigate the increased flows from 122 acres of developed area downstream of the existing City. The South Detention Basin is located south of the Main Canal and west of the Highway 99. Two storm drains will empty directly into the South Detention Basin. As shown in Table 8-3, 183 cfs from the Main Canal will flow to the South Detention Basin via the inlet weir, and 130 cfs will flow to the South Detention Basin via the two storm drain pipes coming from the east. The South Detention Basin will store 118.1 acre-feet during the 100-year storm. The peak 100-year outflow through the 24-inch outlet pipe is 14 cfs.

6. LATERAL 6 AND DIVERSION TO NORTH DETENTION BASIN

These facilities include the construction of 54-inch storm drain and a twin 54-inch storm drain. Twin storm drains are used to increase capacity and to ensure adequate cover over the pipes. The storm drain system will cross Highway 99 in the existing 6 feet x 5 feet box culvert, cross under the railroad in a twin 54-inch storm drain, and transition into a trapezoidal channel with a bottom width of 6 feet and side slopes of 4H:1V. There will also be a 60-inch storm drain that crosses under the railroad and drains the developed area between Highway 99 and the railroad. This storm drain will drain to the constructed channel, which drains to the North Detention Basin.

7. NORTH DETENTION BASIN AND LUTHER ROAD STORM DRAIN

The North Detention Basin will be located in the Northeast Quadrant of the City just north of the future Garden Glen Development (north of Pennington Road). The basin will drain through an existing trunk storm drain in Luther Road. This existing trunk drain consists of 48-, 54-, and 60-inch diameter pipes that were constructed for the future Garden Glen Development. The trunk drain will be extended with a segment of 42-inch storm drain

The North Detention Basin will detain 142.4 acre-ft during the 100-year design storm. This detention basin will drain through an 18-inch pipe segment that discharges to the new 42-inch trunk drain. Flow from the Garden Glen Development and the discharge from the North Detention Basin will be constricted by a segment of 36-inch storm drain south of Pennington Road. This constriction will back water up through the trunk storm drain and force it into the North Detention Basin. The 100-year peak runoff inflow to the North Detention Basin is 490 cfs, and the 100-year peak channel inflow from the east is 181 cfs. The peak flow out of the basin is 17 cfs. The elevation area data used in the model are shown in Table 8-3.

8. CALTRANS PROPERTY DETENTION BASIN

The Caltrans Property Detention Basin is located on property currently owned by Caltrans and is downstream of the Apricot Street Pump Station. The Caltrans Property Detention Basin will take up 13.7 acres of the 26 acre parcel. The elevation area data used in the model are shown in Table 8-3. Storm flows will enter the Caltrans Property Detention Basin via a 100-foot long inlet weir located on the west side of the basin. A 100-year peak flow over the weir of 200 cfs and 272 cfs of runoff flow from surrounding developed areas will enter Caltrans Property Detention Basin, resulting in a 100-year peak storage of 112.3 ac-ft. The Caltrans Property Detention Basin will be emptied by a 10 cfs pump back to the adjacent channel. The pump station will include a gravity flow outlet (with a flap gate) that drains the upper several feet of the basin. The pumps will drain the lower part of the basin that cannot be drained by gravity.

9. LATERAL 2 IMPROVEMENTS FROM CALTRANS SITE DETENTION BASIN TO PASEO ROAD

The flow in the channel will be constricted downstream of the Caltrans Property Detention Basin with a 12-inch orifice, causing storm water to backup the channel and flow over the weir into the basin. The channel from the Caltrans Property Detention Basin to the restrictive 12-inch orifice will be enlarged to a bottom width 5 feet and side slopes of 3H:1V (horizontal: vertical). Downstream of the restrictive 12-inch culvert, the channel will be quite large (bottom widths of 30-feet to 60-feet) with 5H:1V side slopes. These large channel segments will provide both stormwater conveyance and detention. Flow will be released from this channel/basin through a restrictive 48-inch culvert upstream of Paseo Avenue.

10. LATERAL 2 IMPROVED CHANNEL AND CULVERTS AT TOWNSHIP ROAD

Lateral 2 at Township Road will be replaced with a 72-inch storm drain that will drain future developed areas. This storm drain will discharge to West Detention Basin.

11. WEST DETENTION BASIN

Runoff from the development in the southwest corner of the City will drain through a 72-inch trunk drain to the West Detention Basin. The West Detention Basin is an on-line detention basin with a 100-year peak inflow through the storm drain of 143 cfs and a 100-year peak tributary runoff from adjacent developed areas of 170 cfs. The West Detention Basin will store 52.3 acre-feet during the 100-year storm. The outlet structure is a 5 cfs pump station that drains to Lateral 2. The existing 100-year water surface elevation at Node L02-0130 is 72.5 feet (1.0 foot of flooding). The agricultural land near the development will see a decrease in water levels. The elevation area data for the West Detention Basin are shown in Table 8-3.

COMPARISON WITH EXISTING CONDITIONS

The overall performance of the City's storm drain system and RD 777's channels with Alternative 1 improvements is summarized in Table 8-4 and discussed below. In Table 8-4:

- The nodes with over one-foot of freeboard are not shaded any color.
- The nodes with less than one -foot of freeboard are shaded green.
- The nodes with up to one -foot of flooding are shaded yellow.
- The nodes with one to two feet of flooding are shaded red.
- The nodes with over two feet of flooding depth are shaded purple.
- The nodes where there is an increase in water surface elevations for Alternative 1 over existing conditions are shaded gray.

Overall, the improvements reduce the water levels for both the 10-year and 100-year storms. At some nodes water levels increase, but have freeboard of 1 foot or more, which is acceptable. A few nodes, however, experience increased water levels in an already flooded or near flooded condition. These increased water levels are categorized and are described below:

Increased Water Level and More Than 1 Foot of Freeboard

This category includes nodes where the water levels increases for either the 10-year or 100-year storm but have more than 1 foot of freeboard, which is acceptable.

For the 10-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- L03-0050, L03-0060, L03-0062, L03-0070, L03-0080, L03-0090, L03-0092 – Located along Lateral 3 downstream of the South Detention Basin and downstream of future build out growth areas. The water levels at these nodes increase by 0.1 feet but have 2.7 to 4.7 feet of freeboard, well within the 10-year storm requirement of 1 foot freeboard.
- L04-0064 – Located on Lateral 4 downstream of the South Detention Basin and downstream of future build out growth areas. The water level at this node increases by 0.1 feet but has a freeboard of 1.6 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L04-0070, L04-0080, L04-0088, L04-0092 – Located on Lateral 4 downstream of the South Detention Basin and downstream of future build out growth areas and near Highway 99. The water levels at these nodes increase by 0.1 feet but have 2.1 to 3.7 feet of freeboard, well within the 10-year storm requirement of 1 foot freeboard.

Table 8-4. Node Data and Model Results for Alternative 1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
NBSN	72.5	79.5	--	--	76.0	-3.5	--	--	--	78.4	-1.1	--
SBSN	65.3	75.3	--	--	70.7	-4.6	--	--	--	74.3	-1.0	--
SBSN2	65.2	72.5	--	--	67.8	-4.6	--	--	--	71.2	-1.3	--
EBSN	66.0	80.0	--	--	74.0	-6.0	--	--	--	78.3	-1.7	--
WBSN	63.0	73.5	--	--	69.8	-3.7	--	--	--	72.1	-1.4	--
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.8	55.0	-0.7	0.0
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.7	55.1	-0.7	0.0
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.3	0.0
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.3	0.0
EIC0060	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.3	57.1	-0.3	0.1
EIC0070	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.4	57.1	-0.3	0.1
EIC0075	47.2	57.9	54.8	-3.0	54.8	-3.0	0.0	57.4	-0.4	57.5	-0.4	0.1
EIC0080	48.1	58.5	54.9	-3.6	54.9	-3.6	0.0	57.5	-1.0	57.6	-0.9	0.1
EIC0090	48.2	58.6	54.9	-3.7	54.9	-3.7	0.0	57.5	-1.1	57.6	-1.0	0.1
EIC0100	50.1	57.8	55.6	-2.3	55.6	-2.2	0.0	59.1	1.3	59.2	1.3	0.0
EIC0110	50.2	59.2	55.6	-3.7	55.6	-3.6	0.0	59.1	-0.1	59.2	-0.1	0.0
EIC0120	50.3	63.1	55.9	-7.2	55.8	-7.2	0.0	59.4	-3.6	59.5	-3.6	0.0
EIC0130	50.0	60.8	55.9	-4.9	55.8	-4.9	0.0	59.4	-1.3	59.5	-1.3	0.0
EIC0140	50.0	59.2	56.0	-3.2	56.0	-3.2	0.0	59.6	0.4	59.7	0.4	0.0
EIC0150	49.8	58.6	56.0	-2.6	56.0	-2.7	0.0	59.6	1.0	59.7	1.0	0.0
L01-0090	59.5	70.1	65.7	-4.4	65.4	-4.6	-0.3	67.3	-2.7	67.1	-2.9	-0.2
L01-0100	59.2	69.7	65.8	-4.0	65.5	-4.2	-0.3	67.4	-2.3	67.2	-2.6	-0.2
L01-0110	60.1	68.3	66.3	-2.1	65.9	-2.5	-0.4	67.8	-0.5	67.5	-0.8	-0.3
L01-0120	59.9	68.3	66.3	-2.0	65.9	-2.4	-0.4	67.9	-0.4	67.6	-0.7	-0.3
L01-0170	58.9	69.0	66.3	-2.7	65.9	-3.1	-0.4	67.9	-1.1	67.6	-1.4	-0.3
L01-0180	58.7	67.5	66.6	-0.9	66.1	-1.4	-0.5	68.4	0.9	67.9	0.4	-0.5
L01-0190	60.2	68.6	67.0	-1.6	66.4	-2.2	-0.6	68.7	0.1	68.1	-0.5	-0.5
L01-0200	61.4	69.5	67.2	-2.3	66.5	-3.0	-0.7	68.8	-0.7	68.3	-1.3	-0.6
L01-0210	61.3	69.4	67.4	-2.0	66.7	-2.7	-0.7	69.1	-0.3	68.4	-0.9	-0.7
L01-0220	62.4	71.4	67.9	-3.5	67.1	-4.3	-0.8	69.4	-2.0	68.6	-2.7	-0.7
L01-0230	62.4	69.9	70.7	0.8	68.7	-1.2	-2.1	72.9	3.0	70.7	0.8	-2.2
L01-0240	63.9	70.5	70.9	0.4	69.0	-1.5	-1.9	72.9	2.5	70.8	0.4	-2.1
L01-0250	64.5	71.3	70.9	-0.4	69.0	-2.3	-1.9	73.0	1.6	70.8	-0.5	-2.1
L01-0260	64.6	71.4	72.8	1.4	69.0	-2.4	-3.8	74.6	3.2	70.7	-0.7	-3.8
L01-0270	64.7	71.5	72.8	1.4	69.0	-2.4	-3.8	74.6	3.1	70.7	-0.7	-3.8
L01-0280	64.9	71.6	73.1	1.5	69.0	-2.5	-4.0	74.8	3.2	70.7	-0.8	-4.1
L01-0290	66.4	72.4	73.1	0.6	69.0	-3.4	-4.1	74.8	2.4	70.7	-1.7	-4.1
L01-0300	66.5	73.2	73.1	-0.1	69.0	-4.1	-4.1	74.8	1.6	70.7	-2.4	-4.1
L01-0310	67.9	73.4	73.1	-0.3	69.0	-4.3	-4.1	74.8	1.4	70.7	-2.7	-4.1
L01-0320	68.7	73.5	73.1	-0.4	69.0	-4.5	-4.1	74.8	1.3	70.7	-2.8	-4.1
L01-0330	68.8	74.1	73.1	-1.0	69.0	-5.1	-4.1	74.8	0.7	70.7	-3.4	-4.1
L01-0340	65.7	72.6	73.1	0.5	65.7	-6.9	-7.4	74.8	2.2	70.7	-1.9	-4.1
L02-0010	55.4	63.3	62.0	-1.3	62.1	-1.2	0.1	64.2	0.9	64.2	0.9	0.0
L02-0020	55.5	63.5	62.2	-1.3	62.3	-1.2	0.1	64.4	0.9	64.4	0.9	0.0
L02-0030	55.1	63.7	62.2	-1.4	62.3	-1.3	0.1	64.5	0.8	64.5	0.8	0.0
L02-0032	55.9	64.3	63.1	-1.1	63.1	-1.1	0.0	65.2	0.9	65.1	0.9	-0.1
L02-0040	56.8	65.0	64.2	-0.8	64.1	-0.9	-0.1	66.2	1.2	66.1	1.1	-0.1
L02-0042	57.0	65.3	64.6	-0.7	64.5	-0.8	-0.1	66.5	1.2	66.3	1.1	-0.1
L02-0044	57.1	65.4	64.7	-0.7	64.5	-0.8	-0.1	66.5	1.2	66.4	1.0	-0.1
L02-0050	59.7	70.4	65.5	-4.9	65.3	-5.1	-0.2	67.1	-3.2	67.0	-3.4	-0.2
L02-0060	60.2	66.9	66.7	-0.1	65.3	-1.6	-1.4	68.3	1.4	67.0	0.1	-1.3
L02-0064	60.3	66.2	67.8	1.6	67.1	0.9	-0.7	69.6	3.4	69.1	2.9	-0.5
L02-0070	58.9	65.5	67.8	2.3	67.1	1.6	-0.7	69.6	4.1	69.1	3.7	-0.5
L02-0080	59.3	66.0	68.2	2.2	67.7	1.7	-0.5	70.3	4.3	70.0	4.0	-0.2
L02-0086	59.2	68.9	68.2	-0.7	67.7	-1.2	-0.5	70.3	1.3	70.0	1.1	-0.2
L02-0088	59.4	68.9	68.3	-0.7	67.8	-1.2	-0.5	70.3	1.4	70.1	1.2	-0.2
L02-0090	62.5	68.2	68.3	0.1	67.8	-0.4	-0.5	70.3	2.2	70.1	2.0	-0.2
L02-0095	62.7	68.6	68.3	-0.3	67.8	-0.8	-0.5	70.4	1.8	70.2	1.6	-0.2
L02-0100	62.7	69.6	68.4	-1.2	67.9	-1.7	-0.5	70.5	1.0	70.3	0.7	-0.2
L02-0102	64.2	68.8	68.5	-0.3	68.0	-0.8	-0.5	70.6	1.8	70.3	1.6	-0.2
L02-0104	64.2	69.0	68.9	-0.1	68.2	-0.8	-0.7	71.0	2.1	70.7	1.7	-0.4
L02-0106	64.0	68.5	68.9	0.4	68.2	-0.3	-0.7	71.1	2.5	70.7	2.2	-0.4
L02-0108	64.1	68.6	69.7	1.1	68.7	0.1	-1.0	72.0	3.4	71.3	2.7	-0.6
L02-0110	64.9	69.5	69.7	0.2	68.7	-0.8	-1.0	72.0	2.5	71.3	1.8	-0.6
L02-0120	64.4	71.4	70.1	-1.3	69.0	-2.4	-1.0	72.5	1.1	71.6	0.2	-0.8
L02-0130	66.2	71.5	70.1	-1.4	69.0	-2.5	-1.1	72.5	1.0	71.6	0.1	-0.8
L02-0140	63.2	72.0	70.2	-1.8	69.8	-2.2	-0.4	72.6	0.6	72.1	0.1	-0.6
L02-0150	64.5	73.0	70.2	-2.8	69.8	-3.2	-0.4	72.6	-0.4	72.1	-0.9	-0.6
L02-0160	64.6	73.0	70.4	-2.6	69.8	-3.2	-0.7	73.0	0.0	72.1	-0.9	-0.9
L02-0170	65.8	73.3	70.4	-2.9	69.8	-3.5	-0.7	73.0	-0.3	72.1	-1.2	-0.9
L02-0180	65.9	73.3	73.5	0.2	69.8	-3.5	-3.7	74.5	1.2	72.1	-1.2	-2.4
L02-0190	66.9	71.1	70.2	-0.9	68.8	-2.3	-1.4	72.5	1.4	71.6	0.5	-0.9
L02-0200	66.5	70.9	70.9	0.0	69.0	-1.9	-1.9	72.9	2.1	70.8	0.0	-2.1
L02-0210	64.0	70.5	70.9	0.4	69.0	-1.5	-1.9	72.9	2.5	70.8	0.3	-2.1
L02-0220	63.7	71.1	70.9	-0.2	69.0	-2.1	-1.9	72.9	1.9	70.8	-0.2	-2.1
L02-0230	62.9	70.4	70.9	0.5	69.0	-1.4	-1.9	73.0	2.5	70.8	0.4	-2.1
L02-0237	67.1	75.2	72.7	-2.5	71.5	-3.7	-1.2	73.9	-1.3	72.8	-2.4	-1.1
L02-0238	67.4	75.0	72.7	-2.3	71.5	-3.5	-1.2	73.9	-1.1	72.8	-2.2	-1.1
L02-0239	67.7	75.4	72.7	-2.7	71.5	-3.9	-1.2	73.9	-1.5	73.0	-2.4	-0.9
L02-0240	63.0	69.5	71.1	1.6	69.2	-0.3	-1.9	73.2	3.7	71.0	1.6	-2.2
L02-0243	68.3	75.4	72.7	-2.7	71.5	-3.9	-1.2	73.9	-1.5	72.9	-2.5	-1.0
L02-0244	68.9	75.5	72.7	-2.8	71.5	-4.0	-1.2	73.9	-1.6	73.4	-2.1	-0.5
L02-0246	67.8	75.0	72.7	-2.3	71.7	-3.3	-1.0	73.9	-1.1	73.0	-2.0	-1.0
L02-0247	68.0	75.2	72.7	-2.5	71.7	-3.5	-1.0	73.9	-1.3	73.8	-1.4	-0.1
L02-0250	63.6	72.8	71.1	-1.7	70.4	-2.4	-0.7	73.2	0.4	72.6	-0.2	-0.6
L02-0252	64.5	73.2	72.5	-0.8	70.4	-2.8	-2.0	73.7	0.5	72.6	-0.6	-1.1
L02-0253	64.7	73.9	72.7	-1.2	70.4	-3.4	-2.2	73.8	-0.1	72.6	-1.3	-1.2
L02-0254	66.1	73.9	72.7	-1.2	71.3	-2.6	-1.4	73.8	-0.1	72.8	-1.1	-1.1
L02-0255	66.9	74.2	72.7	-1.5	71.5	-2.7	-1.2	73.9	-0.4	72.8	-1.4	-1.1
L02-0260	67.1	74.7	72.7	-1.9	71.6	-3.0	-1.1	73.9	-0.7	72.9	-1.7	-1.0
L02-0261	66.9	76.0	72.7	-3.3	71.5	-4.5	-1.2	73.9	-2.1	72.8	-3.2	-1.1

Table 8-4. Node Data and Model Results for Alternative 1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0262	67.1	75.0	72.7	-2.3	71.5	-3.5	-1.2	73.9	-1.1	72.8	-2.2	-1.1
L02-0270	67.0	74.2	72.7	-1.5	71.6	-2.6	-1.1	73.9	-0.3	72.9	-1.3	-1.0
L02-0272	66.6	73.8	72.7	-1.1	71.7	-2.1	-1.1	73.9	0.1	72.9	-0.9	-1.0
L02-0273	67.7	75.0	72.7	-2.3	71.7	-3.3	-1.0	73.9	-1.1	73.0	-2.0	-1.0
L02-0275	68.0	78.0	70.8	-7.2	68.1	-9.9	-2.7	73.9	-4.1	72.1	-5.9	-1.8
L02-0277	69.4	76.0	72.8	-3.2	72.2	-3.8	-0.5	75.3	-0.7	75.4	-0.6	0.1
L02-0278	69.3	74.6	72.8	-1.9	72.2	-2.5	-0.6	74.8	0.1	74.9	0.2	0.1
L02-0279	68.3	75.6	72.8	-2.8	72.1	-3.5	-0.7	75.6	0.0	75.8	0.2	0.2
L02-0280	67.9	74.1	72.7	-1.4	71.7	-2.4	-1.0	73.9	-0.2	73.0	-1.1	-1.0
L02-0281	69.0	77.0	72.8	-4.2	72.2	-4.8	-0.6	77.0	0.0	77.0	0.0	0.0
L02-0282	68.4	75.8	72.8	-3.0	72.1	-3.7	-0.6	75.8	0.0	75.8	0.0	0.0
L02-0283	68.9	75.2	72.8	-2.4	72.3	-2.8	-0.4	75.5	0.3	75.5	0.4	0.1
L02-0284	68.3	74.9	72.8	-2.1	71.8	-3.1	-1.0	74.0	-0.9	73.5	-1.4	-0.5
L02-0286	69.4	76.2	72.8	-3.4	72.6	-3.6	-0.2	76.4	0.2	76.4	0.2	0.0
L02-0287	71.0	78.6	72.8	-5.8	72.8	-5.8	0.0	78.5	-0.1	78.6	0.0	0.1
L02-0288	70.4	77.5	72.8	-4.7	72.4	-5.1	-0.4	77.5	0.0	77.6	0.1	0.1
L02-0290	68.7	76.3	72.9	-3.4	72.0	-4.3	-0.9	74.1	-2.2	73.9	-2.4	-0.2
L02-0291	68.9	76.0	73.0	-3.0	72.1	-3.9	-0.9	74.2	-1.8	74.1	-1.9	-0.1
L02-0292	69.0	76.0	73.0	-3.0	72.1	-3.9	-0.9	74.2	-1.8	74.2	-1.8	-0.1
L02-0293	69.9	75.3	73.0	-2.3	72.1	-3.2	-0.9	74.2	-1.1	74.1	-1.2	-0.1
L02-0300	68.7	78.0	73.1	-4.9	72.2	-5.8	-0.9	74.3	-3.7	74.2	-3.8	-0.1
L02-0302	72.8	78.3	75.3	-3.1	72.8	-5.5	-2.5	76.2	-2.1	74.2	-4.2	-2.1
L02-0421	69.4	76.8	75.5	-1.3	75.5	-1.3	0.0	76.5	-0.3	76.5	-0.3	0.0
L02-0422	70.7	76.8	76.8	0.0	76.8	0.0	0.0	77.0	0.2	77.0	0.2	0.0
L02-0424	70.5	76.9	77.2	0.2	77.2	0.2	0.0	77.7	0.8	77.7	0.8	0.0
L02-0425	69.5	76.1	75.5	-0.6	75.5	-0.6	0.0	76.5	0.4	76.5	0.4	0.0
L02-0426	62.0	76.9	75.4	-1.5	75.4	-1.5	0.0	76.4	-0.5	76.4	-0.5	0.0
L02-0427	70.1	76.5	76.4	-0.1	76.5	0.0	0.1	77.1	0.6	77.1	0.6	0.0
L02-0428	72.1	77.0	76.1	-0.9	73.8	-3.1	-2.2	77.1	0.1	76.4	-0.5	-0.6
L02-0430	65.5	75.1	72.9	-2.3	70.7	-4.4	-2.1	73.9	-1.3	74.3	-0.9	0.4
L02-0440	65.9	75.2	73.0	-2.2	70.7	-4.5	-2.3	74.1	-1.2	74.3	-1.0	0.2
L02-0450	66.4	75.4	73.1	-2.3	70.7	-4.6	-2.4	74.2	-1.1	74.3	-1.1	0.0
L02-0460	66.3	75.3	73.2	-2.1	71.9	-3.4	-1.4	74.4	-1.0	74.3	-1.0	-0.1
L02-0461	70.7	76.0	72.9	-3.1	71.4	-4.6	-1.5	74.3	-1.7	74.3	-1.7	-0.1
L02-0462	70.5	75.4	73.0	-2.4	72.3	-3.1	-0.6	75.4	0.0	74.3	-1.1	-1.1
L02-0463	70.1	76.1	72.9	-3.1	72.1	-4.0	-0.9	74.3	-1.7	74.3	-1.8	-0.1
L02-0464	70.7	76.0	72.9	-3.2	71.9	-4.2	-1.0	74.3	-1.7	74.3	-1.8	-0.1
L02-0465	69.9	75.4	73.1	-2.3	72.0	-3.4	-1.1	74.3	-1.1	74.3	-1.1	0.0
L02-0467	69.1	75.4	73.2	-2.2	72.0	-3.4	-1.2	74.4	-1.0	74.3	-1.1	-0.1
L02-0468	69.6	75.2	73.2	-2.0	72.0	-3.1	-1.1	74.3	-0.8	74.3	-0.9	0.0
L02-0470	67.0	75.3	73.3	-2.0	72.1	-3.2	-1.2	74.5	-0.9	74.4	-1.0	-0.1
L02-0471	70.9	75.2	73.3	-1.9	72.5	-2.7	-0.8	74.9	-0.3	74.3	-0.9	-0.6
L02-0472	71.2	75.7	73.3	-2.4	73.1	-2.7	-0.3	75.7	0.0	75.1	-0.6	-0.6
L02-0480.1	67.7	76.9	74.8	-2.0	72.6	-4.2	-2.2	75.7	-1.2	74.4	-2.5	-1.3
L02-0481	68.6	76.3	74.1	-2.2	72.1	-4.1	-2.0	75.0	-1.3	f	#VALUE!	#VALUE!
L02-0481A	68.3	75.8	--	--	72.1	-3.7	--	--	--	74.4	-1.4	--
L02-0481B	68.9	75.0	--	--	72.2	-2.8	--	--	--	74.4	-0.6	--
L02-0482	69.2	77.7	76.4	-1.2	71.7	-6.0	-4.7	77.7	0.1	74.3	-3.4	-3.4
L02-0483	69.1	74.4	74.4	0.0	72.3	-2.1	-2.1	75.0	0.7	74.3	0.0	-0.7
L02-0484	69.6	75.2	74.7	-0.5	72.4	-2.8	-2.3	75.2	0.0	74.3	-0.9	-0.9
L02-0485	70.3	75.2	75.0	-0.2	72.5	-2.7	-2.6	75.4	0.2	74.3	-0.9	-1.1
L02-0485A	70.6	77.2	--	--	72.7	-4.5	--	--	--	74.6	-2.6	--
L02-0485B	71.0	76.5	--	--	73.3	-3.2	--	--	--	76.5	0.0	--
L02-0485C	72.0	77.5	--	--	74.3	-3.2	--	--	--	77.5	0.0	--
L02-0485D	72.4	77.5	--	--	74.5	-3.0	--	--	--	77.8	0.3	--
L02-0485E	71.1	77.3	--	--	73.8	-3.5	--	--	--	76.3	-1.0	--
L02-0490	59.5	76.9	73.4	-3.5	72.3	-4.6	-1.1	74.5	-2.3	73.2	-3.6	-1.3
L02-0500	66.1	75.3	74.8	-0.5	73.7	-1.6	-1.1	75.9	0.6	75.1	-0.2	-0.8
L02-0502	72.5	77.0	74.8	-2.2	73.4	-3.6	-1.4	75.9	-1.1	75.0	-2.0	-0.9
L02-0503	69.0	75.6	74.8	-0.8	73.6	-2.0	-1.2	75.9	0.3	75.1	-0.6	-0.9
L02-0504	69.0	75.4	75.0	-0.4	73.4	-2.0	-1.6	76.1	0.7	75.1	-0.3	-1.0
L02-0505	73.4	76.5	75.0	-1.5	73.5	-2.9	-1.5	76.1	-0.4	75.1	-1.4	-1.0
L02-0506	72.0	77.7	75.1	-2.5	74.1	-3.6	-1.1	76.2	-1.4	75.2	-2.5	-1.0
L02-0507	71.0	77.1	76.5	-0.6	75.1	-2.0	-1.4	76.7	-0.3	76.2	-0.9	-0.5
L02-0510	68.8	77.8	75.9	-1.8	74.8	-3.0	-1.2	77.2	-0.6	76.8	-1.0	-0.4
L02-0511	71.6	76.9	77.0	0.0	75.3	-1.7	-1.7	77.5	0.6	77.0	0.0	-0.6
L02-0512	68.2	75.0	75.0	-0.1	73.8	-1.2	-1.2	76.1	1.1	75.2	0.1	-0.9
L02-0513	73.1	77.8	77.9	0.1	75.1	-2.7	-2.8	78.5	0.7	78.4	0.6	0.0
L02-0514	68.5	75.3	75.1	-0.2	74.1	-1.3	-1.1	76.0	0.7	75.4	0.1	-0.6
L02-0515	68.6	76.4	76.4	0.0	74.3	-2.0	-2.1	76.4	0.1	76.4	0.0	-0.1
L02-0516	69.4	75.9	76.1	0.1	75.4	-0.5	-0.6	77.0	1.0	76.8	0.9	-0.1
L02-0517	71.2	77.4	76.4	-1.0	74.3	-3.1	-2.1	76.4	-0.9	76.0	-1.4	-0.5
L02-0518	69.1	78.7	77.4	-1.2	72.8	-5.9	-4.7	79.1	0.5	75.8	-2.8	-3.3
L02-0518A	68.8	78.0	--	--	72.7	-5.3	--	--	--	75.6	-2.4	--
L02-0520	70.3	78.4	77.6	-0.7	72.9	-5.5	-4.7	79.2	0.8	75.7	-2.6	-3.4
L02-0520A	69.4	78.4	--	--	72.8	-5.6	--	--	--	76.1	-2.3	--
L02-0522	73.6	78.1	78.8	0.6	--	--	--	81.0	2.9	--	--	--
L02-0530	72.0	79.2	79.3	0.1	73.8	-5.4	-5.5	81.0	1.9	75.7	-3.5	-5.3
L02-0538	68.6	76.0	76.3	0.3	75.2	-0.8	-1.1	77.2	1.2	76.5	0.5	-0.7
L02-0538AA	69.9	78.1	--	--	75.9	-2.2	--	--	--	77.3	-0.8	--
L02-0538BB	69.9	78.1	--	--	76.2	-1.9	--	--	--	78.4	0.3	--
L02-0540	70.2	78.1	78.3	0.2	76.3	-1.8	-2.0	78.4	0.3	77.6	-0.5	-0.8
L02-0541	70.7	77.7	78.3	0.6	77.3	-0.4	-1.0	79.0	1.3	78.4	0.7	-0.6
L02-0542	71.2	78.4	78.5	0.1	77.7	-0.7	-0.8	79.2	0.8	78.7	0.4	-0.4
L02-0543	71.5	79.2	79.2	0.0	78.1	-1.1	-1.1	79.4	0.2	79.2	0.0	-0.2
L02-0544	72.0	79.9	79.9	0.1	79.9	0.0	-0.1	80.1	0.3	80.1	0.2	-0.1
L03-0010	63.0	71.6	68.9	-2.7	68.5	-3.0	-0.3	70.8	-0.8	69.8	-1.7	-1.0
L03-0020	63.1	71.6	69.1	-2.6	68.9	-2.7	-0.2	71.6	0.0	71.2	-0.5	-0.4
L03-0030	63.5	72.1	69.1	-2.9	69.0	-3.1	-0.1	71.6	-0.4	71.2	-0.8	-0.4
L03-0040	63.5	72.1	69.4	-2.7	69.4	-2.7	0.0	72.5	0.4	72.4	0.3	-0.1
L03-0050	64.0	72.6	69.4	-3.2	69.5	-3.1	0.0	72.5	-0.1	72.5	-0.1	0.0
L03-0060	64.6	73.2	69.4	-3.8	69.5	-3.7	0.0	72.5	-0.7	72.5	-0.7	0.0

Table 8-4. Node Data and Model Results for Alternative 1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L03-0062	64.7	73.3	69.6	-3.8	69.6	-3.7	0.1	72.7	-0.6	72.6	-0.7	0.0
L03-0070	65.9	74.5	69.7	-4.8	69.8	-4.7	0.1	72.7	-1.8	72.6	-1.9	0.0
L03-0080	66.1	74.7	71.7	-3.0	71.8	-2.9	0.1	74.7	0.0	74.8	0.1	0.0
L03-0090	67.8	76.4	71.9	-4.5	72.0	-4.4	0.1	74.8	-1.6	74.8	-1.6	0.0
L03-0092	67.8	76.4	71.9	-4.5	72.0	-4.4	0.1	74.8	-1.6	74.8	-1.6	0.0
L03-0094	67.9	76.5	79.8	3.3	79.7	3.3	0.0	80.9	4.4	80.9	4.4	0.0
L04-0030	66.9	71.9	71.3	-0.6	70.8	-1.1	-0.5	73.9	2.0	71.7	-0.3	-2.2
L04-0040	67.0	71.6	71.3	-0.3	71.0	-0.6	-0.3	73.9	2.3	71.8	0.2	-2.1
L04-0050	67.8	72.1	71.3	-0.7	71.2	-0.9	-0.1	73.9	1.9	72.0	0.0	-1.9
L04-0060	68.3	71.4	71.4	0.0	71.2	-0.1	-0.1	73.9	2.6	72.1	0.7	-1.8
L04-0062	68.2	73.1	71.4	-1.7	71.3	-1.7	0.0	73.9	0.9	72.2	-0.9	-1.8
L04-0064	68.4	73.3	71.6	-1.7	71.7	-1.6	0.1	74.0	0.7	73.0	-0.3	-1.0
L04-0066	68.0	71.7	71.6	-0.1	71.7	0.0	0.1	74.0	2.3	73.0	1.3	-1.0
L04-0068	67.8	72.0	72.0	0.1	72.2	0.2	0.1	74.2	2.3	73.9	2.0	-0.3
L04-0070	68.0	74.4	72.2	-2.3	72.3	-2.1	0.1	74.2	-0.2	74.0	-0.5	-0.3
L04-0080	68.1	76.0	72.2	-3.8	72.3	-3.7	0.1	74.3	-1.7	74.0	-2.0	-0.3
L04-0088	68.5	75.0	72.4	-2.7	72.5	-2.5	0.1	74.4	-0.6	74.2	-0.8	-0.2
L04-0090	69.4	73.0	72.5	-0.5	72.6	-0.4	0.1	74.5	1.5	74.4	1.5	-0.1
L04-0092	69.5	73.6	72.6	-1.1	72.7	-1.0	0.1	74.5	0.9	74.5	0.8	-0.1
L04-0094	69.5	73.7	73.0	-0.7	73.1	-0.7	0.1	75.1	1.3	75.1	1.4	0.0
L04-0100	69.6	73.8	73.0	-0.8	73.1	-0.8	0.1	75.1	1.2	75.1	1.3	0.0
L05-0010	65.5	73.8	72.0	-1.8	68.4	-5.4	-3.6	75.0	1.2	71.5	-2.3	-3.5
L05-0012	65.6	73.0	72.0	-0.9	--	--	--	75.0	2.0	--	--	--
L05-0014	66.0	74.2	72.0	-2.2	--	--	--	75.0	0.8	--	--	--
L05-0020	66.4	75.9	72.0	-3.8	70.2	-5.6	-1.8	75.0	-0.9	71.2	--	-3.8
L05-0040	66.5	74.0	72.0	-2.0	70.7	-3.3	-1.3	75.0	1.0	71.5	-2.5	-3.4
L05-0050	66.6	74.0	72.7	-1.3	71.4	-2.6	-1.3	75.6	1.6	72.6	-1.4	-3.0
L05-0060	69.3	74.2	72.8	-1.4	71.6	-2.6	-1.2	75.6	1.4	73.1	-1.1	-2.5
L05-0070	69.4	74.5	72.9	-1.6	72.2	-2.3	-0.7	75.7	1.2	73.6	-0.9	-2.0
L05-0080	69.4	74.5	72.9	-1.6	72.3	-2.2	-0.6	75.7	1.1	73.7	-0.8	-2.0
L05-0090	69.6	74.8	73.0	-1.9	72.4	-2.4	-0.5	75.7	0.8	73.8	-1.0	-1.8
L05-0100	69.7	75.1	73.0	-2.1	72.6	-2.6	-0.4	75.7	0.5	74.0	-1.2	-1.7
L05-0110	69.8	75.5	73.1	-2.4	72.7	-2.7	-0.3	75.7	0.2	74.1	-1.3	-1.5
L06-0020	69.0	77.2	73.5	-3.6	73.0	-4.1	-0.5	75.7	-1.5	74.4	-2.7	-1.3
L06-0040	68.5	77.2	73.7	-3.5	73.1	-4.1	-0.6	75.7	-1.5	74.5	-2.7	-1.2
L06-0140	69.6	77.6	73.7	-3.9	73.1	-4.5	-0.6	75.8	-1.8	74.5	-3.1	-1.3
L06-0141	69.4	77.2	73.7	-3.5	73.1	-4.1	-0.6	75.7	-1.5	74.5	-2.7	-1.2
L06-0142	69.7	78.2	73.8	-4.4	73.1	-5.0	-0.7	76.0	-2.2	74.7	-3.5	-1.3
L06-0143	71.3	78.2	73.8	-4.4	73.2	-5.0	-0.6	76.0	-2.2	75.1	-3.1	-0.9
L06-0143NA	72.0	77.6	--	--	73.9	-3.7	--	--	--	77.6	0.0	--
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0	78.4	0.4	78.4	0.4	0.0
L06-0145	72.3	78.3	76.6	-1.7	76.6	-1.7	0.0	77.6	-0.6	77.6	-0.6	0.0
L06-0146	72.8	75.0	75.6	0.6	75.6	0.6	0.0	76.6	1.6	76.6	1.6	0.0
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0	77.0	-2.0	77.0	-2.0	0.0
L06-0148	71.8	77.5	73.7	-3.8	73.3	-4.3	-0.5	75.8	-1.8	74.8	-2.8	-1.0
L06-0149	71.5	77.5	73.7	-3.8	73.2	-4.3	-0.5	75.8	-1.7	74.6	-2.8	-1.1
L06-0150	71.6	77.7	74.2	-3.4	73.2	-4.5	-1.1	76.7	-1.0	75.0	-2.7	-1.6
L06-0150D	72.5	77.0	--	--	73.7	-3.3	--	--	--	75.8	-1.2	--
L06-0151	69.9	77.6	74.0	-3.6	73.2	-4.4	-0.8	76.3	-1.2	75.0	-2.6	-1.4
L06-0151NA	70.5	76.2	--	--	73.6	-2.6	--	--	--	75.7	-0.5	--
L06-0151NB	71.6	76.4	--	--	73.9	-2.5	--	--	--	76.1	-0.3	--
L06-0151NC	72.0	76.5	--	--	74.3	-2.3	--	--	--	76.7	0.2	--
L06-0152	74.0	76.7	76.9	0.2	74.0	-2.7	-2.9	77.3	0.6	75.0	-1.7	-2.3
L06-0200	73.0	79.7	76.6	-3.1	73.2	-6.5	-3.4	78.5	-1.2	75.0	-4.6	-3.5
L06-0220	68.8	79.0	78.3	-0.8	74.0	-5.0	-4.2	80.0	1.0	78.3	-0.7	-1.7
L06-0221	77.0	79.5	78.1	-1.4	77.3	-2.2	-0.8	80.0	0.5	78.2	-1.3	-1.8
L06-0222	77.0	79.5	77.9	-1.6	77.8	-1.7	-0.1	78.8	-0.7	78.2	-1.3	-0.5
L06-0230	69.5	80.5	79.4	-1.1	74.0	-6.4	-5.4	81.5	1.0	79.8	-0.7	-1.7
L06-0240	69.7	80.3	79.5	-0.8	74.3	-6.0	-5.2	81.5	1.2	80.4	0.1	-1.1
L06-0240AA	67.3	80.5	74.7	-5.9	74.8	-5.8	0.1	75.8	-4.7	76.1	-4.4	0.3
L06-0242	69.8	80.8	79.5	-1.3	74.3	-6.5	-5.2	81.6	0.8	80.4	-0.4	-1.1
L06-0245	70.2	80.9	79.5	-1.3	74.4	-6.4	-5.1	81.6	0.7	80.8	0.0	-0.7
L06-0250	70.2	81.4	79.7	-1.7	74.5	-7.0	-5.2	81.7	0.3	80.9	-0.5	-0.9
L06-0260	70.3	79.9	79.7	-0.2	74.5	-5.3	-5.2	81.7	1.9	81.0	1.1	-0.8
L06-0270	70.3	81.3	79.7	-1.6	74.5	-6.8	-5.2	81.8	0.5	81.0	-0.3	-0.8
L06-0280	70.7	82.9	79.8	-3.2	74.7	-8.2	-5.1	81.8	-1.1	82.7	-0.3	0.9
L06-0290	70.7	83.3	79.9	-3.3	74.7	-8.6	-5.2	82.1	-1.2	82.8	-0.5	0.7
L06-0292	71.0	82.8	79.9	-2.8	74.7	-8.1	-5.2	82.1	-0.7	82.8	0.0	0.7
L06-0294	71.0	83.3	80.0	-3.3	74.7	-8.6	-5.2	82.1	-1.2	82.8	-0.5	0.7
L06-0300	71.2	83.2	80.0	-3.2	74.7	-8.5	-5.3	82.1	-1.1	83.3	0.1	1.2
L06-0310	71.3	84.0	85.6	1.6	74.7	-9.2	-10.8	86.9	2.9	84.0	0.0	-2.9
L06-0340	68.3	77.1	74.1	-3.0	73.2	-3.9	-0.9	76.2	-0.9	74.9	-2.2	-1.3
L06-0350	69.1	78.1	74.5	-3.6	73.3	-4.8	-1.1	76.6	-1.5	75.2	-2.9	-1.3
L06-0360	70.0	79.1	74.6	-4.6	73.4	-5.8	-1.2	76.7	-2.4	75.3	-3.8	-1.4
L06-0361	70.0	79.1	74.3	-4.9	73.2	-5.9	-1.1	76.6	-2.5	75.0	-4.1	-1.6
L06-0380	70.9	76.7	75.6	-1.1	73.9	-2.8	-1.8	78.6	1.8	76.5	-0.2	-2.1
L06-0390	73.0	78.8	75.7	-3.1	74.2	-4.6	-1.5	78.6	-0.2	76.5	-2.3	-2.1
L06-0390D	73.5	78.5	--	--	74.9	-3.6	--	--	--	76.6	-1.9	--
L06-0390E	74.0	78.0	--	--	75.2	-2.8	--	--	--	76.8	-1.2	--
L06-0390F	74.0	78.0	--	--	75.0	-3.0	--	--	--	76.6	-1.4	--
L06-0400	72.5	78.2	76.7	-1.5	75.7	-2.5	-1.0	79.7	1.5	77.0	-1.2	-2.7
L06-0430	72.8	81.8	76.9	-4.8	--	--	--	79.8	-2.0	--	--	--
L06-0432	73.5	81.8	77.0	-4.8	77.8	-4.0	0.8	79.9	-1.9	78.9	-2.9	-0.9
L06-0433	71.2	80.4	76.8	-3.6	75.9	-4.5	-0.9	79.8	-0.6	77.2	-3.2	-2.6
L06-0434	72.2	80.5	76.8	-3.7	76.2	-4.3	-0.6	79.8	-0.7	77.5	-3.0	-2.3
L06-0435	72.0	80.2	76.8	-3.4	75.8	-4.4	-1.0	79.8	-0.4	77.0	-3.2	-2.7
L06-0436	73.3	80.4	77.4	-3.0	77.1	-3.3	-0.2	80.2	-0.2	78.9	-1.5	-1.3
L06-0438	73.7	79.5	80.1	0.7	80.2	0.7	0.0	81.0	1.5	81.0	1.6	0.0
L06-0460	73.8	80.5	77.1	-3.4	78.4	-2.0	1.3	79.9	-0.5	79.5	-0.9	-0.4
L06-0480	73.8	80.8	77.1	-3.7	78.5	-2.3	1.4	79.9	-0.9	79.8	-0.9	-0.1
L06-0490	74.1	81.0	77.1	-3.9	78.6	-2.4	1.5	79.9	-1.1	80.3	-0.7	0.4
L06-0492	74.1	81.1	77.6	-3.6	78.6	-2.5	1.0	80.8	-0.3	80.3	-0.8	-0.5

Table 8-4. Node Data and Model Results for Alternative 1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L06-0500	74.6	81.5	77.6	-3.9	78.9	-2.6	1.3	80.8	-0.7	81.0	-0.5	0.2
L06-0502	74.6	81.0	77.7	-3.2	78.9	-2.1	1.1	81.0	0.1	81.0	0.0	-0.1
L06-0510	75.2	82.7	77.9	-4.7	79.3	-3.4	1.3	81.1	-1.6	81.9	-0.8	0.9
L06-0520	75.5	82.8	78.9	-3.9	79.3	-3.5	0.4	81.5	-1.3	82.0	-0.8	0.4
L07-0040	74.4	78.7	75.2	-3.5	75.2	-3.6	-0.1	76.8	-1.9	75.6	-3.2	-1.2
L07-0041	74.4	81.4	75.2	-6.2	75.2	-6.2	0.0	76.8	-4.6	75.6	-5.8	-1.2
L07-0042	73.7	80.2	74.2	-5.9	74.3	-5.9	0.1	76.8	-3.4	75.5	-4.6	-1.3
L07-0043	72.9	80.2	74.1	-6.1	74.4	-5.8	0.3	76.8	-3.4	75.5	-4.7	-1.3
L07-0050	76.2	80.0	76.5	-3.4	--	--	--	76.9	-3.1	--	--	--
L07-0060	74.8	79.6	80.6	1.0	--	--	--	81.9	2.3	--	--	--
L07-0061	73.3	78.3	79.2	0.9	74.7	-3.6	-4.4	79.3	1.0	77.8	-0.5	-1.5
L-070061N	74.0	79.2	--	--	74.8	-4.4	--	--	--	78.3	-0.9	--
L07-0062	76.3	79.6	80.6	1.0	--	--	--	81.9	2.3	--	--	--
L07-0064	76.4	79.1	79.5	0.4	--	--	--	80.4	1.3	--	--	--
L07-0068	72.5	79.8	79.2	-0.6	74.0	-5.8	-5.2	79.3	-0.5	76.4	-3.3	-2.9
L07-0070	76.9	80.0	79.5	-0.5	--	--	--	80.4	0.4	--	--	--
L07-0080	77.3	80.1	80.3	0.3	79.3	-0.8	-1.1	81.4	1.4	80.7	0.7	-0.7
L07-0100	75.0	81.0	79.8	-1.1	79.7	-1.3	-0.1	81.3	0.4	81.0	0.0	-0.3
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1	0.1	80.6	-11.1	80.7	-11.0	0.1
L07-0140	66.9	72.8	80.6	7.8	80.6	7.9	0.1	80.6	7.8	80.7	7.9	0.1
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	64.7	-6.1	-0.3	67.2	-3.5	66.9	-3.9	-0.4
L08-0012	60.5	70.8	64.9	-5.8	64.7	-6.1	-0.3	67.2	-3.5	67.0	-3.8	-0.3
L08-0020	60.9	71.2	64.9	-6.3	64.7	-6.5	-0.3	67.2	-3.9	67.0	-4.2	-0.2
L08-0030	61.0	71.2	64.9	-6.3	64.7	-6.6	-0.3	67.2	-4.0	67.1	-4.2	-0.2
L08-0040	61.4	71.7	64.9	-6.8	64.7	-7.1	-0.3	67.3	-4.5	67.1	-4.6	-0.2
L08-0050	61.6	71.8	64.9	-6.9	64.8	-7.1	-0.1	67.3	-4.5	67.4	-4.5	0.0
L08-0060	62.5	72.8	65.6	-7.2	65.6	-7.2	0.0	67.4	-5.3	67.5	-5.2	0.1
L09-0010	69.4	75.5	73.0	-2.5	72.8	-2.6	-0.2	75.5	0.1	74.0	-1.4	-1.5
L09-0040	73.1	77.3	75.2	-2.1	75.2	-2.1	0.0	75.9	-1.4	76.0	-1.3	0.1
L09-0050	72.9	77.3	75.4	-2.0	75.4	-2.0	0.0	76.1	-1.2	76.2	-1.1	0.1
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0	77.6	-4.6	77.6	-4.6	0.0
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0	85.4	3.3	85.4	3.3	0.0
L11-0020	79.6	85.6	81.1	-4.6	80.9	-4.7	-0.2	84.5	-1.1	84.3	-1.3	-0.2
L11-0030	79.6	85.6	87.1	1.4	87.1	1.4	0.0	88.6	3.0	88.6	2.9	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.4	-2.0	0.0	80.8	0.5	79.7	-0.6	-1.1
L13-0020	77.6	79.9	80.4	0.5	80.4	0.5	0.0	81.1	1.3	81.1	1.3	0.0
L15-0010	71.9	77.2	73.4	-3.7	73.5	-3.7	0.1	75.8	-1.4	74.5	-2.6	-1.2
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0	80.7	3.6	80.7	3.5	0.0
MC0010	50.7	59.9	56.3	-3.6	56.2	-3.6	-0.1	59.9	0.0	59.9	0.1	0.0
MC0020	50.7	59.9	56.3	-3.6	56.3	-3.6	-0.1	59.9	0.0	59.9	0.0	0.0
MC0030	51.1	60.3	56.6	-3.7	56.5	-3.8	-0.1	60.1	-0.2	60.1	-0.2	0.0
MC0040	51.4	59.7	56.7	-3.0	56.6	-3.1	-0.1	60.5	0.8	60.5	0.8	0.0
MC0050	51.5	60.1	56.9	-3.3	56.8	-3.4	-0.1	60.6	0.5	60.6	0.5	0.0
MC0060	51.5	60.1	56.9	-3.3	56.8	-3.4	-0.1	60.7	0.5	60.6	0.5	0.0
MC0070	52.2	64.1	57.1	-7.0	56.9	-7.2	-0.1	60.8	-3.3	60.7	-3.4	0.0
MC0080	52.4	61.1	57.1	-4.1	57.0	-4.2	-0.1	60.8	-0.3	60.8	-0.3	0.0
MC0090	53.3	63.2	58.3	-4.8	58.2	-4.9	-0.1	61.7	-1.5	61.6	-1.5	-0.1
MC0100	53.2	62.2	58.4	-3.9	58.2	-4.0	-0.1	61.7	-0.5	61.6	-0.6	-0.1
MC0110	54.3	63.6	59.9	-3.7	59.8	-3.8	-0.1	63.1	-0.6	63.0	-0.6	-0.1
MC0120	54.4	66.8	60.0	-6.8	59.9	-6.9	-0.1	63.1	-3.6	63.0	-3.7	-0.1
MC0130	54.2	64.0	60.3	-3.7	60.2	-3.8	-0.1	63.4	-0.6	63.3	-0.7	-0.1
MC0140	53.9	64.1	60.3	-3.8	60.2	-3.9	-0.1	63.4	-0.7	63.3	-0.8	-0.1
MC0150	57.2	68.6	62.5	-6.1	62.3	-6.3	-0.2	65.3	-3.3	65.1	-3.5	-0.2
MC0160	57.2	68.7	62.6	-6.2	62.4	-6.4	-0.2	65.3	-3.4	65.1	-3.6	-0.2
MC0170	57.9	69.2	63.0	-6.1	62.8	-6.3	-0.2	65.7	-3.4	65.5	-3.6	-0.2
MC0172	58.1	69.3	63.2	-6.1	63.0	-6.3	-0.2	65.9	-3.5	65.7	-3.7	-0.2
MC0174	58.2	69.3	63.2	-6.1	63.0	-6.3	-0.2	65.9	-3.5	65.7	-3.7	-0.2
MC0176	58.2	69.4	63.2	-6.1	63.0	-6.3	-0.2	65.9	-3.5	65.7	-3.7	-0.2
MC0178	58.2	69.4	63.2	-6.1	63.0	-6.3	-0.2	65.9	-3.5	65.7	-3.7	-0.2
MC0180	58.8	69.7	63.6	-6.1	63.4	-6.3	-0.2	66.2	-3.5	65.9	-3.8	-0.2
MC0190	58.8	69.7	63.6	-6.1	63.4	-6.3	-0.2	66.2	-3.5	66.0	-3.8	-0.3
MC0200	59.3	70.8	64.2	-6.6	64.0	-6.9	-0.3	66.7	-4.2	66.4	-4.5	-0.3
MC0210	58.5	70.2	64.3	-5.9	64.0	-6.2	-0.3	66.7	-3.5	66.4	-3.8	-0.3
MC0220	60.1	70.4	64.9	-5.5	64.7	-5.7	-0.3	67.2	-3.2	66.8	-3.6	-0.4
MC0230	61.4	70.9	66.8	-4.1	66.5	-4.4	-0.3	68.8	-2.1	68.0	-2.9	-0.7
MC0240	61.5	70.9	66.8	-4.1	66.5	-4.4	-0.3	68.9	-2.0	68.1	-2.8	-0.8
MC0250	62.0	71.1	67.7	-3.4	67.4	-3.7	-0.3	69.7	-1.4	68.8	-2.3	-0.9
MC0260	62.9	71.5	68.8	-2.6	68.5	-3.0	-0.3	70.8	-0.7	69.8	-1.7	-1.0
MC0270	62.2	70.5	68.9	-1.6	68.5	-1.9	-0.3	70.9	0.5	69.9	-0.6	-1.1
MC0280	65.4	71.4	69.6	-1.9	69.2	-2.3	-0.4	71.4	0.0	70.2	-1.3	-1.3
MC0282	65.5	71.5	69.7	-1.8	69.2	-2.2	-0.4	71.5	0.0	70.2	-1.3	-1.3
MC0290	65.6	71.5	70.4	-1.1	69.7	-1.8	-0.7	73.5	2.0	70.8	-0.7	-2.7
MC0292	67.1	71.9	71.3	-0.6	70.6	-1.4	-0.8	73.9	2.0	71.1	-0.8	-2.8
MC0296	65.8	71.6	71.6	0.0	70.6	-1.0	-0.9	74.1	2.5	71.1	-0.5	-2.9
MC0298	65.4	71.6	71.6	0.0	70.6	-1.0	-1.0	74.1	2.5	71.1	-0.5	-2.9
MC0300	63.3	73.3	71.6	-1.6	70.6	-2.6	-1.0	74.1	0.8	71.1	-2.1	-3.0
MC0310	63.3	72.5	71.7	-0.8	70.6	-1.8	-1.1	74.3	1.8	71.1	-1.3	-3.1
MC0320	65.4	74.7	71.7	-3.0	70.6	-4.1	-1.1	74.3	-0.5	71.1	-3.6	-3.2
MC0330	65.2	71.6	72.0	0.4	70.7	-0.9	-1.3	75.0	3.4	71.1	-0.5	-3.9
MC0340	65.3	72.5	72.1	-0.4	70.7	-1.8	-1.4	75.0	2.6	71.2	-1.3	-3.8
MC0350	65.3	72.8	72.1	-0.7	70.7	-2.1	-1.4	75.1	2.3	71.3	-1.5	-3.8
MC0360	65.5	75.5	72.2	-3.2	71.0	-4.5	-1.2	75.2	-0.2	71.9	-3.6	-3.3
MC0370	64.9	75.5	72.2	-3.3	71.0	-4.5	-1.2	75.2	-0.3	71.9	-3.6	-3.3
MC0380	65.8	74.7	72.3	-2.4	71.3	-3.4	-1.1	75.3	0.6	72.3	-2.4	-3.0
MC0390	67.1	73.5	72.4	-1.1	71.5	-2.0	-0.9	75.3	1.8	72.6	-1.0	-2.7
MC0400	67.1	74.8	72.4	-2.4	71.5	-3.3	-0.9	75.3	0.5	72.6	-2.2	-2.7
MC0410	68.1	78.7	72.9	-5.8	72.6	-6.1	-0.4	75.5	-3.2	73.8	-4.9	-1.7
MC0420	69.2	77.2	73.0	-4.2	73.0	-4.2	-0.1	75.5	-1.7	74.1	-3.1	-1.4
MC0422	69.2	77.2	73.1	-4.2	73.0	-4.2	0.0	75.6	-1.7	74.2	-3.1	-1.4
MC0430	69.4	77.2	73.4	-3.8	73.4	-3.7	0.1	75.7	-1.5	74.5	-2.7	-1.2
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0	81.4	1.5	81.4	1.5	0.0

Table 8-4. Node Data and Model Results for Alternative 1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0440	69.0	76.0	73.4	-2.6	73.5	-2.5	0.1	75.8	-0.2	74.6	-1.4	-1.3
MC0450	70.4	78.1	73.7	-4.3	73.8	-4.3	0.1	76.0	-2.1	74.8	-3.3	-1.2
MC0451	69.7	77.4	73.6	-3.8	73.6	-3.7	0.1	75.9	-1.5	74.7	-2.7	-1.2
MC0460	71.7	77.3	74.1	-3.3	74.2	-3.2	0.1	76.7	-0.6	75.2	-2.2	-1.5
MC0461	70.4	77.6	74.2	-3.4	74.2	-3.4	0.0	76.7	-0.9	75.2	-2.4	-1.5
MC0462	71.1	77.4	74.2	-3.2	74.5	-3.0	0.2	76.7	-0.7	76.6	-0.9	-0.2
MC0463	71.3	76.7	74.2	-2.5	74.6	-2.1	0.4	76.7	0.0	76.7	0.0	0.0
MC0464	71.7	78.6	74.2	-4.4	74.6	-4.0	0.3	76.8	-1.8	77.4	-1.2	0.6
MC0470	72.2	78.7	74.5	-4.2	74.2	-4.5	-0.3	76.8	-1.9	75.1	-3.6	-1.7
MC0480	71.8	77.5	74.7	-2.8	74.2	-3.3	-0.5	77.3	-0.2	75.1	-2.4	-2.2
MC0490	67.5	78.3	75.6	-2.7	74.0	-4.3	-1.6	77.7	-0.6	78.3	0.0	0.6
MC0500	67.6	78.4	75.8	-2.7	74.0	-4.4	-1.8	78.2	-0.2	78.3	-0.1	0.1
MC0510	69.4	80.2	76.8	-3.5	74.0	-6.2	-2.7	78.7	-1.5	78.6	-1.7	-0.2
MC0520	69.5	81.1	77.1	-4.0	74.0	-7.0	-3.1	79.9	-1.1	78.6	-2.4	-1.3
MC0530	70.1	81.3	77.1	-4.2	74.2	-7.1	-2.9	79.9	-1.4	78.9	-2.4	-1.0
MC0540	70.2	81.4	77.3	-4.1	74.2	-7.2	-3.1	80.7	-0.7	78.9	-2.5	-1.8
MC0545	70.7	81.7	77.6	-4.1	74.4	-7.3	-3.2	80.8	-0.9	79.2	-2.4	-1.6
MC0550	71.4	81.9	77.9	-4.0	74.8	-7.1	-3.0	80.9	-1.0	80.0	-2.0	-0.9
MC0560	71.5	82.0	78.1	-3.9	74.9	-7.1	-3.2	81.4	-0.5	80.0	-1.9	-1.4
MC0570	72.3	82.1	78.3	-3.8	75.3	-6.8	-3.1	81.5	-0.6	80.4	-1.7	-1.1
MC0580	72.3	82.1	78.5	-3.7	75.3	-6.8	-3.2	81.9	-0.2	80.4	-1.7	-1.5
MC0590	74.4	82.9	79.3	-3.6	77.0	-5.9	-2.4	82.2	-0.8	81.5	-1.5	-0.7
MC0600	74.4	83.0	79.5	-3.4	77.0	-5.9	-2.5	82.7	-0.3	81.5	-1.4	-1.2
MC0610	76.0	83.2	79.7	-3.5	78.7	-4.5	-1.0	82.7	-0.5	82.5	-0.7	-0.2
MC0620	76.0	83.9	79.9	-4.0	78.9	-5.0	-1.0	83.3	-0.6	82.7	-1.2	-0.6
MC0630	75.1	83.2	80.0	-3.1	79.4	-3.8	-0.6	83.3	0.2	82.8	-0.4	-0.5
MC0640	75.3	83.3	80.1	-3.2	79.4	-3.9	-0.6	83.4	0.1	82.9	-0.4	-0.5
MC0642	76.2	83.8	80.1	-3.7	79.6	-4.2	-0.5	83.4	-0.4	82.9	-0.9	-0.5
MC0650	77.1	84.3	80.9	-3.4	80.6	-3.7	-0.3	84.5	0.2	84.3	0.0	-0.2
MC0660	76.2	83.7	80.1	-3.6	79.5	-4.2	-0.6	83.3	-0.4	82.8	-0.9	-0.5
MC0662	76.3	83.8	80.6	-3.2	80.4	-3.4	-0.2	84.7	0.9	84.6	0.8	-0.1
MC0670	78.0	84.8	80.9	-3.9	80.8	-4.0	-0.1	84.7	-0.1	84.6	-0.2	-0.1
WIC0005	50.5	56.7	57.0	0.4	57.2	0.5	0.2	59.7	3.0	59.7	3.1	0.1
WIC0010	50.9	60.3	58.7	-1.6	58.9	-1.4	0.2	61.2	0.9	61.3	1.0	0.1
WIC0020	50.9	58.9	58.8	-0.1	58.9	0.1	0.2	61.3	2.5	61.4	2.5	0.1
WIC0030	51.8	59.4	59.4	0.0	59.6	0.2	0.2	61.9	2.5	62.0	2.6	0.1
WIC0032	52.5	60.1	59.9	-0.2	60.1	0.0	0.2	62.4	2.3	62.4	2.4	0.0
WIC0034	54.1	61.4	60.9	-0.5	61.1	-0.3	0.2	63.3	1.9	63.3	1.9	0.0
WIC0040	54.9	62.1	61.3	-0.9	61.4	-0.7	0.2	63.6	1.5	63.6	1.5	0.0

- L06-0240AA – The detention basin located at Stephanie Way and Brianne Way. The water level in this detention basin increases by 0.1 feet but has a freeboard of 5.8 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0432 – Located at Highway 99 and part of the improved storm drain system. The water level at this node increases by 0.8 feet, but has a freeboard of 4.0 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0460, L06-0480, L06-0490, L06-0492, L06-0500, L06-0502, L06-0510, L06-0520 – Located on Lateral 6 and part of improved storm drain system. The water levels at these nodes increase by 0.4 feet to 1.5 feet, but have freeboards of 2.0 feet to 3.5 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L07-0042, L07-0043 – Located along the storm drain on Pennington Road near J Street. The water levels at these nodes increase by 0.1 feet and 0.3 feet, but have freeboards of 5.9 and 5.8 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.1 feet. These nodes are on the river side of the levee.
- L15-0010 – Located at Archer Avenue. The water level at this node increases by 0.1 feet but has freeboard of 3.7 feet, well within the 10-year storm requirement of 1 foot freeboard.
- MC0430, MC0440, MC0450, MC0451, MC0460, MC0462, MC0463, MC0464 – Located along the Main Canal from Archer Avenue to Orchard Way. The water levels at these nodes increase by 0.1 feet to 0.4 feet, but have a freeboard of 2.5 feet to 4.0 feet, well within the 10-year storm requirement of 1 foot freeboard.

For the 100-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- L06-0240AA – The detention basin located at Stephanie Way and Brianne Way. The water level in this detention basin increases by 0.3 feet but has a freeboard of 4.4 feet, well within the 100-year storm requirement of 1 foot freeboard for a detention basin.
- MC0464 – Part of the Orchard Way storm drain system that discharges to the Main Canal. The water level at this node increases by 0.6 feet over existing conditions, but has a freeboard of 1.2 feet.
- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.1 feet. These nodes are on the river side of the levee.
- L08-0060 – Located on Lateral 8 downstream of build out areas. The water level at this node increases by 0.1 feet but has a freeboard of 5.3 feet.
- L09-0050, L09-0040 – On Lateral 9 and tributary to the Main Canal. The water levels at these nodes increase by 0.1 feet, but have a freeboard of 1.1 to 1.3 feet.

Increased Water Level but Within City Storm Drain Criteria

This category includes nodes where water levels increase for 100-year storm, but result in no more than minor flooding of streets where there is an urban storm drain system. Even though water levels increase, the storm drain freeboard criteria for the 10-year storm are met, and some ponding of water in the streets in the 100-year storm is allowed.

For the 100-year storm, these nodes include:

- L02-0277, L02-0278, L02-0279 – Part of the Pennington Ranch storm drain system. The water level in these nodes increase by 0.1 to 0.2 feet bring the flooding water depth up to 0.2 feet during the 100-year storm. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system. Notably, the water level at the downstream nodes, L02-0247, decreases by 0.1 feet from existing conditions.
- L02-0283, L02-0287, L02-0288 – Part of the Pennington Ranch storm drain system. The water level in theses node increase by 0.1 feet bringing the flooded water level up to 0.4 feet. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system and has more than 1 foot of freeboard during the 10-year storm.
- L02-0430, L02-0440 – On Lateral 2 near the Caltrans Property Detention Basin. The water levels at these nodes increase due to the restrictive orifice in Lateral 2. The freeboards are 0.9 feet and 1.0 feet. When new growth occurs in this area, the ground elevation should be raised to ensure 1 foot of freeboard in the channel during the 100 year storm.
- L06-0290, L06-0290, L06-0292, L06-0294, L06-0300 – Located along the Alternative 1 storm drain system on Larkin Road. The water levels in these nodes increase by 0.7 feet to 1.2 feet during the 100-year storm, resulting in a freeboard of at least 0 to 1 foot. Under Alternative 1, these nodes are part of an urban storm drain system, and these freeboards are acceptable for the 100-year storm.
- L06-0490, L06-0500, L06-0510, L06-0520 – Located along the Alternative 1 storm drain system on Lateral 6. The water levels at these nodes increase by 0.2 feet to 0.9 feet, but have a freeboard of 0.5 feet to 0.8 feet, which are acceptable for a 100-year storm.
- MC0490, MC0500 – Located on the Main Canal at the restrictive orifice to divert flow to the East Detention Basin. The water levels increase by up to 0.6 feet, leaving no freeboard in the channel. The developed area at this location would need to be built up to ensure 1 foot of freeboard in the channel during the 100-year storm.

Increased Water Level and Increased Flooding

This category includes nodes where the water levels increase over an existing flooded condition.

- WIC0005, WIC0010, WIC0020, WIC0030 – Located at the downstream end of the West Intercepting Canal just upstream of the East Intercepting Canal. For the 10-year storm, the water level at WIC0005 increases bringing the flooded water depth from 0.4 feet to 0.5 feet. The upstream water levels decrease and the downstream water levels remain the same. This is due to the boundary condition used in the model at the downstream end of the East Intercepting Canal. For the 10-year model and 100-year storm models, a "full channel" water level is used as the boundary condition. Because upstream flooding has been reduced, the downstream boundary condition controls the water level at WIC0005. If a lower water level was used for the 10-year storm model, the water level at WIC0005 would be below the channel top and there would not be increased flooding. For the 100-year storm, the water levels at these nodes increase by 0.1 feet. Even though flow coming from built out areas are reduced, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. These minor increases of water levels would be mitigated with improved channel maintenance.

COST ESTIMATES

The construction and capital costs for each of the drain/channel/basin systems discussed above are presented in Table 8-5. As shown, the estimated total construction cost is $23.6 million and the estimated capital cost is $37.9 million. The following assumptions were made for the preparation of the cost estimate:

- Within the future build out area, the excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks. Outside of the future build out are, excavated dirt will be disposed of offsite.
- All land will be purchased (versus easements) at a cost of $50,000 per acre for land within the City's 2030 General Plan Planning Area and at a cost of $25,000 per acre for land outside the City's Planning Area.

Buildout of the general plan includes development of 3,375 acres. Alternative 1 results in an overall cost of $11,232 per acre.

Table 8-5. Cost Estimate for Alternative 1

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
1. Main Canal Improvement and Diversion Channel to East Basin				
Site Preparation (Clear and Grub)	acre	500	16.0	8,000
Channel Excavation (on-site)	CY	4	89,300	357,200
Landscape and Erosion Control	acre	2,000	16.0	32,000
18-Inch Orifice Plate	each	2,000	1	2,000
60-Inch RCP	feet	330	3,749	1,237,170
72-Inch RCP	feet	360	3,187	1,147,320
Headwalls	each	8,000	2	16,000
Maintenance Holes	each	6,000	17	102,000
Drain Inlets	each	5,000	34	170,000
Aggregate Base Access Road	feet	20	2,953	59,050
Fencing	feet	16	5,905	94,480
Mobilization/demobilization (at 5 percent)				161,260
Construction Contingency (at 20 percent)				645,040
Estimated Construction Cost				4,031,520
Land/Easements (for channel)	acre	50,000	16.0	800,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,612,600
Estimated Capital Cost				6,444,100
2. Larkin Road Storm Drain System and Diversion Pipe to Main Canal				
12-Inch RCP	feet	72	1,140	82,080
72-Inch RCP	feet	360	7,594	2,733,937
Maintenance Holes	each	6,000	19	114,000
Drain Inlets	each	5,000	38	190,000
Mobilization/demobilization (at 5 percent)				156,000
Construction Contingency (at 20 percent)				624,000
Estimated Construction Cost				3,900,020
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,560,000
Estimated Capital Cost				5,460,000
3. East Detention Basin				
Site Preparation (Clear and Grub)	acre	500	7.6	3,792
Basin Excavation	CY	4	129,060	516,239
Landscape and Erosion Control	acre	2,000	6.6	13,200
Rock Scour Protection	CY	100	10.0	1,000
Pump Station (30 cfs)	cfs	33,000	20.0	660,000
36-Inch RCP	cfs	216	2,400.0	518,400
Aggregate Base Access Road	feet	20	2,145	42,895
Fencing	feet	16	2,145	34,316
Mobilization/demobilization (at 5 percent)				89,490
Construction Contingency (at 20 percent)				357,970
Estimated Construction Cost				2,237,300
Land/Easements (for basin)	acre	25,000	7.6	189,600
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				894,900
Estimated Capital Cost				3,321,800
4. Lateral 5 Improvement				
12-Inch RCP	feet	72	480	34,560
42-Inch RCP	feet	252	1,417	357,084
48-Inch RCP	feet	288	247	71,136
60-Inch RCP	feet	330	1,463	482,836
Maintenance Holes	each	6,000	8	48,000
Drain Inlets	each	5,000	16	80,000
Mobilization/demobilization (at 5 percent)				53,680
Construction Contingency (at 20 percent)				214,720
Estimated Construction Cost				1,342,020
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				536,800
Estimated Capital Cost				1,878,800
5. South Detention Basin				
Site Preparation (Clear and Grub)	acre	500	22.7	11,368
Basin Excavation	CY	4	232,800	931,200
Landscape and Erosion Control	acre	2,000	21.0	41,962
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
24-Inch RCP	feet	144	100.0	14,400
24-Inch Flap Gate	each	2,800	1.0	2,800
Headwalls	cfs	8,000	20.0	160,000
Aggregate Base Access Road	feet	20	956	19,120
Fencing	feet	16	956	15,296
Mobilization/demobilization (at 5 percent)				61,110
Construction Contingency (at 20 percent)				244,430
Estimated Construction Cost				1,527,690
Land/Easements (for basin)	acre	50,000	22.7	1,136,800
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				611,100
Estimated Capital Cost				3,275,600

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
6. Lateral 6 Improvements and Diversion to North Detention Basin				
Site Preparation (Clear and Grub)	acre	500	5.9	2,950
Channel Excavation (on-site)	CY	4	22,100	88,400
12-Inch RCP	feet	72	600	43,200
54-Inch RCP	feet	311	4,523	1,404,392
Maintenance Holes	each	6,000	10	60,000
Drain Inlets	each	5,000	20	100,000
Headwalls	each	8,000	2	16,000
Aggregate Base Access Road	feet	20	3,558	71,160
Fencing	feet	16	7,116	113,856
Mobilization/demobilization (at 5 percent)				95,000
Construction Contingency (at 20 percent)				379,990
Estimated Construction Cost				2,374,950
Land/Easements (for channel)	acre	50,000	2.1	105,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				950,000
Estimated Capital Cost				3,430,500
7. North Detention Basin and Storm Drain				
Site Preparation (Clear and Grub)	acre	500	27.2	13,617
Basin Excavation	CY	4	274,666	1,098,664
Landscape and Erosion Control	acre	2,000	25	50,612
Rock Scour Protection	CY	100	10	1,000
12-Inch RCP	feet	72	300	21,600
18-Inch RCP	feet	108	100	10,800
36-Inch RCP	feet	216	72	15,552
42-Inch RCP	feet	252	1,940	488,880
Headwalls	each	8,000	2	16,000
Aggregate Base Access Road	feet	20	4,200	83,993
Fencing	feet	16	4,200	67,195
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				97,400
Construction Contingency (at 20 percent)				389,580
Estimated Construction Cost				2,434,890
Land/Easements (for basin)	acre	50,000	27.2	1,361,700
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				974,000
Estimated Capital Cost				4,770,600
8. Caltrans Property Detention Basin				
Site Preparation (Clear and Grub)	acre	500	15.1	7,555
Basin Excavation	CY	4	204,072	816,289
Landscape and Erosion Control	acre	2,000	13.7	27,382
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
Pump Station (10 cfs)	cfs	46,000	10.0	460,000
Aggregate Base Access Road	feet	20	3,089	61,780
Fencing	feet	16	3,089	49,424
Mobilization/demobilization (at 5 percent)				72,420
Construction Contingency (at 20 percent)				289,690
Estimated Construction Cost				1,810,540
Land/Easements (for basin)	acre	10,000	15.1	151,100
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				724,200
Estimated Capital Cost				2,685,800
9. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road				
Site Preparation (Clear and Grub)	acre	500	22.9	11,450
Channel Excavation (on-site)	CY	4	138,600	554,400
Landscape and Erosion Control	acre	2,000	23	45,800
12-Inch Orifice Plate	each	2,000	1	2,000
48-Inch RCP	feet	288	120	34,560
Headwalls	each	8,000	4	32,000
Aggregate Base Access Road	feet	20	7,713	154,264
Fencing	feet	16	15,426	246,822
Mobilization/demobilization (at 5 percent)				54,060
Construction Contingency (at 20 percent)				216,260
Estimated Construction Cost				1,351,620
Land/Easements (for channel)	acre	50,000	15.0	748,100
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				540,600
Estimated Capital Cost				2,640,300
10. Lateral 2 Improved Channel and Culverts at Township Road				
12-Inch RCP	feet	72	420	30,240
72-Inch RCP	feet	360	2,730	982,800
Maintenance Holes	each	6,000	7	42,000
Drain Inlets	each	5,000	14	70,000
Mobilization/demobilization (at 5 percent)				56,250
Construction Contingency (at 20 percent)				225,010
Estimated Construction Cost				1,406,300
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				562,500
Estimated Capital Cost				1,968,800

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
11. West Detention Basin				
Site Preparation (Clear and Grub)	acre	500	7.6	3,783
Basin Excavation	CY	4	129,060	516,239
Landscape and Erosion Control	acre	2,000	6.6	13,166
Pump Station (5 cfs)	cfs	50,000	5	250,000
48-Inch RCP	feet	288	120	34,560
Headwalls	each	8,000	2	16,000
Aggregate Base Access Road	each	20	2,142	42,840
Fencing	each	16	4,284	68,544
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				47,310
Construction Contingency (at 20 percent)				189,230
Estimated Construction Cost				1,182,670
Land/Easements (for basin)	acre	50,000	7.5	375,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				473,100
Estimated Capital Cost				2,030,800
Total Estimated Construction Cost				23,599,500
Total Land/Easement Cost				4,867,800
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				9,439,800
Total Estimated Capital Cost				37,907,100

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent
Costs are for June 2009 (20 City Average ENRCCI of 8,578).

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99

RIVIERA RD

6 LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN

2 LARKIN ROAD STORM DRAIN SYSTEM

1 MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN

CAMPBELL RD

MAHAUGH RD

CHANNEL SIZE
BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

LUTHER RD

7 NORTH DETENTION BASIN

18" RCP OUTLET

CHANNEL SIZE
BOTTOM WIDTH: 25'
SIDE SLOPE: 4H:1V

COOLEY RD

20 CFS PUMPED TO THE FEATHER RIVER

36" FORCE MAIN

PENNINGTON RD

KOLA ST

GARDEN GLEN DIVISION

30" RESTRICTIVE CULVERT

18" ORIFICE

DEREE RD

3 EAST DETENTION BASIN

APRICOT ST

SINNARD AVE

SHELDON AVE

CHANNEL SIZE
BOTTOM WIDTH: 60'
SIDE SLOPE: 5H:1V

INLET WEIR

TOWNSHIP RD

10 CFS PUMPED DISCHARGE

12" ORIFICE

8 CALTRANS PROPERTY DETENTION BASIN

CHANNEL SIZE
BOTTOM WIDTH: 15'
SIDE SLOPE: 3H:1V

CHANNEL SIZE
BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

4

10 LATERAL 2 IMPROVEMENTS AT TOWNSHIP RD

9 LATERAL 2 IMPROVEMENTS

LATERAL 5 STORM DRAIN

CHANNEL SIZE
BOTTOM WIDTH: 60'
SIDE SLOPE: 5H:1V

PASEO AVE

INLET WEIR

5

SOUTH DETENTION BASIN

24" RCP OUTLET WITH FLAP GATE

11 WEST DETENTION BASIN

5 CFS PUMPED DISCHARGE

99

ARKIN RD

0 750 1500
SCALE IN FEET

LEGEND

- CITY LIMITS
- CHANNEL
- PROPOSED STORAGE
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN
- MODEL LINK
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL

Figure 8-1

City of Live Oak
Master Drainage Study
ALTERNATIVE 1

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 9. ALTERNATIVE 2

Alternative 2 involves improving existing drainage facilities or constructing new facilities to efficiently convey flows downstream of the City to a large regional detention basin. The detention basin will have a 100-year storage capacity of 575 acre-feet (with 1.1 feet of freeboard remaining) and will mitigate for increased flows so that flooding downstream of the basin does not increase. The large channels upstream of the basin will both convey the flow and provide detention storage.

The proposed improvements are shown on Figure 9-1. The improvements are grouped into the following 10 sections and are labeled on Figure 9-1:

1. Main Canal Improvement
2. Larkin Road Storm Drain and Diversion to Main Canal
3. Pennington Road Storm Drain
4. Lateral 5 Storm Drain
5. Lateral 6 North of the Diversion Channel
6. Diversion Channel
7. Lateral 2 Channel Widening
8. Paseo Road Improved Channel and Culverts
9. West Lateral 2 Improved Channel and Culverts at Township Road
10. Detention Basin

The details for the improvement alternatives are shown in Table 9-1. The details include new storm drain or channel inverts, sizes, and materials. Each of the improvements is discussed in the following sections.

1. MAIN CANAL IMPROVEMENT

Improvements would be necessary where the Main Canal (also called Live Oak Slough) flows through growth areas. The channel would be widened and graded to allow for future flow to be conveyed downstream without causing or increasing flooding. Upstream of the existing City area the channel would have a bottom width of 5 feet to 12 feet with side slopes of 4H:1V (Horizontal to Vertical), and with 30-inch to 36-inch RCP crossings at roads. Through the existing developed sections of the City the channel bottom width would be 12 feet with side slopes of 4H:1V. A twin 60-inch culvert would be constructed at Archer Avenue. At Highway 99, the flow would pass through the existing 72-inch by 72-inch box culvert and an additional 48-inch culvert. The upstream and downstream inverts of the 48-inch RCP would match the elevations of the improved channel. Downstream of Highway 99 to the diversion channel into the detention basin, the channel would have a bottom width of 15 feet. Between Highway 99 and the detention basin there would be four sets of twin 72-inch RCP culverts at road crossings.

Table 9-1. Alternative 2 Improvement Details

Link Name	US Node Name	DS Node Name	Type	No. Barrels	US Invert Elevation (ft)	DS Invert Elevation (ft)	Roughness	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Sideslope _H:1V	Right-hand Sideslope _H:1V
1. Main Canal Improvement												
MC0600A	MC0600	MC0590	Circular	1	75.02	74.96	0.015	100	3.0	--	--	--
MC0590A	MC0590	MC0580	Trapezoidal	1	74.96	73.55	0.08	2,015	6.7	5	4	4
MC0580A	MC0580	MC0570	Circular	1	73.55	73.50	0.015	100	2.5	--	--	--
MC0570A	MC0570	MC0560	Trapezoidal	1	73.50	72.97	0.08	759	7.2	5	4	4
MC0560A	MC0560	MC0550	Circular	1	72.97	72.90	0.015	104	2.5	--	--	--
MC0550A	MC0550	MC0545	Trapezoidal	1	72.90	72.40	0.08	721	7.2	5	4	4
MC0545A	MC0545	MC0540	Trapezoidal	1	72.40	72.03	0.08	535	7.6	5	4	4
MC0540A	MC0540	MC0530	Circular	1	72.03	71.98	0.015	100	2.5	--	--	--
MC0530A	MC0530	MC0520	Trapezoidal	1	71.98	71.58	0.08	569	6.8	12	4	4
MC0520A	MC0520	MC0510	Circular	1	71.58	71.48	0.015	136	3.0	--	--	--
MC0510A	MC0510	MC0500	Trapezoidal	1	71.48	70.95	0.08	1,764	6.8	12	4	4
MC0500A	MC0500	MC0490	Circular	1	70.95	70.87	0.015	114	4.0	--	--	--
MC0490A	MC0490	MC0480	Trapezoidal	1	70.87	70.48	0.08	812	6.3	12	4	4
MC0480A	MC0480	MC0470	Circular	1	70.48	70.43	0.015	100	4.5	--	--	--
MC0470A	MC0470	MC0461	Trapezoidal	1	70.43	70.12	0.08	643	6.1	12	4	4
MC0461A	MC0461	MC0460	Trapezoidal	1	70.12	69.93	0.08	389	6.3	12	4	4
MC0460A	MC0460	MC0450	Circular	1	69.93	69.87	0.015	114	5.0	--	--	--
MC0450A	MC0450	MC0451	Trapezoidal	1	69.87	69.54	0.08	690	5.7	12	4	4
MC0451A	MC0451	MC0440	Trapezoidal	1	69.54	69.17	0.08	760	5.9	12	4	4
MC0440A	MC0440	MC0430	Circular	2	69.17	69.12	0.015	120	5.0	--	--	--
MC0430A	MC0430	MC0422	Trapezoidal	1	69.12	67.58	0.08	3,165	6.3	12	4	4
MC0422A	MC0422	MC0420	Circular	2	67.58	67.54	0.015	100	6.0	--	--	--
MC0420A	MC0420	L09-0010	Trapezoidal	1	67.54	67.46	0.08	164	6.8	12	4	4
L09-0010B	L09-0010	MC0410	Circular	1	67.46	67.30	0.015	305	4.0	--	--	--
MC0410A	MC0410	MC0400	Trapezoidal	1	67.30	66.58	0.08	1,490	7.1	15	4	4
MC0400A	MC0400	MC0390	Circular	2	66.58	66.58	0.015	100	6.0	--	--	--
MC0390A	MC0390	MC0380	Trapezoidal	1	66.58	65.82	0.08	2,112	7.4	15	4	4
MC0380A	MC0380	MC0370	Trapezoidal	1	65.82	64.87	0.08	1,560	7.9	15	4	4
MC0370A	MC0370	MC0360	Circular	1	64.87	64.83	0.015	100	5.0	--	--	--
MC0360A	MC0360	MC0350	Trapezoidal	1	64.80	64.26	0.08	1,092	7.7	15	4	4
MC0350A	MC0350	MC0340	Circular	2	64.26	64.20	0.015	153	6.0	--	--	--
MC0340A	MC0340	MC0330	Trapezoidal	1	64.20	64.05	0.08	368	7.8	15	4	4
MC0330A	MC0330	MC0320	Circular	2	64.05	64.02	0.015	100	6.0	--	--	--
MC0320A	MC0320	MC0310	Trapezoidal	1	64.02	63.54	0.08	1,184	7.7	15	4	4
MC0310A	MC0310	MC0300	Circular	2	63.54	63.50	0.015	100	6.0	--	--	--
MC0300A	MC0300	MC0298	Trapezoidal	1	63.50	63.31	0.08	458	7.6	15	4	4
MC0298A	MC0298	MC0296	Trapezoidal	1	63.31	63.27	0.08	92	7.7	15	4	4
MC0296A	MC0296	MC0292	Trapezoidal	1	63.27	62.75	0.08	1,292	7.8	15	4	4
MC0292A	MC0292	MC0290	Trapezoidal	1	62.75	62.28	0.08	1,163	8.0	15	4	4
MC0290A	MC0290	MC0282	Circular	2	62.28	62.24	0.015	100	6.0	--	--	--
MC0282A	MC0282	MC0280	Trapezoidal	1	62.24	62.21	0.08	68	7.8	15	4	4
MC0280A	MC0280	MC0270	Trapezoidal	1	62.21	61.16	0.08	2,595	8.0	15	4	4
MC0270A	MC0270	MC0260	Circular	2	61.16	61.12	0.015	100	6.0	--	--	--
MC0260A	MC0260	MC0250	Trapezoidal	1	61.12	60.56	0.08	1,375	7.5	15	4	4
MC0250A	MC0250	MC0240	Trapezoidal	1	60.56	61.40	0.08	939	6.8	15	4	4
2. Larkin Road Storm Drain System and Diversion to Main Canal												
LO60310A	L06-0310	L06-0300	Circular	1	76.95	76.80	0.015	190	3.0	--	--	--
L06-0300A	L06-0300	L06-0294	Circular	1	76.80	76.41	0.015	488	3.0	--	--	--
L06-0294A	L06-0294	L06-0292	Circular	1	76.41	76.38	0.015	43	3.0	--	--	--
L06-0292A	L06-0292	L06-0290	Circular	1	76.38	75.89	0.015	610	3.0	--	--	--
L06-0290A	L06-0290	L06-0280	Circular	1	75.89	75.86	0.015	40	3.0	--	--	--
LO6-0280A	L06-0280	L06-0270	Circular	1	75.86	75.36	0.015	623	3.0	--	--	--
L06-0270A	L06-0270	L06-0260	Circular	1	75.36	75.31	0.015	62	3.0	--	--	--
L06-0260A	L06-0260	L06-0250	Circular	1	75.31	75.16	0.015	192	3.0	--	--	--
L06-0250A	L06-0250	L06-0245	Circular	1	75.16	75.08	0.015	106	3.0	--	--	--
L06-0245A	L06-0245	L06-0242	Circular	1	75.08	74.44	0.015	796	4.0	--	--	--
L06-0242A	L06-0242	L06-0240	Circular	1	74.44	74.42	0.015	30	4.0	--	--	--
L06-0240A	L06-0240	L06-0230	Circular	1	74.42	74.00	0.015	525	4.0	--	--	--
L06-0230A	L06-0230	L06-0220	Circular	1	74.00	72.00	0.015	1,366	4.0	--	--	--
L06-DIV	L06-0220	MC0500	Circular	1	72.00	70.95	0.015	2,523	5.0	--	--	--
3. Pennington Road Storm Drain												
L07-0070A	L07-0070	L07-0064	Circular	1	72.16	71.50	0.015	659	5.0	--	--	--
L07-0064A	L07-0064	L07-0062	Circular	1	71.50	71.41	0.08	88	5.0	--	--	--
L07-0062A	L07-0062	L07-0060	Circular	1	71.41	71.20	0.08	214	5.0	--	--	--
L07-0060A	L07-0060	L07-0050	Circular	1	71.20	71.08	0.015	120	5.0	--	--	--
L07-0050A	L07-0050	L07-0040	Circular	1	71.08	70.69	0.015	388	5.0	--	--	--
L07-0040A	L07-0040	L07-0041	Circular	1	70.69	70.66	0.015	25	5.0	--	--	--
L07-0041A	L07-0041	L07-0042	Circular	1	70.66	70.34	0.015	315	5.0	--	--	--
L07-0042A	L07-0042	L07-0043	Circular	1	70.34	70.32	0.015	22	5.0	--	--	--
L07-0043S	L07-0043	MC0460	Circular	1	70.32	70.00	0.015	323	5.0	--	--	--
4. Lateral 5 Storm Drain												
L05-0050A	L05-0050	L05-0040	Circular	1	66.62	66.50	0.015	117	5.0	--	--	--
L05-0040A	L05-0040	L05-0020	Circular	1	66.50	66.37	0.015	130	5.0	--	--	--
L05-0020A	L05-0020	L05-0014	Circular	1	66.37	65.96	0.015	411	5.0	--	--	--
L05-0014A	L05-0014	L05-0012	Circular	1	65.96	65.63	0.015	332	5.0	--	--	--
L05-0012A	L05-0012	L05-0010	Circular	1	65.63	65.47	0.015	159	5.0	--	--	--
L05-0010A	L05-0010	MC0330	Circular	1	65.47	64.05	0.015	1,417	5.0	--	--	--
5. Lateral 6 North of Diversion Channel												
L06-0520A	L06-0520	L06-0510	Circular	1	74.00	73.92	0.015	40	5.0	--	--	--
L06-0510A	L06-0510	L06-0502	Circular	1	73.92	72.83	0.015	1,556	5.0	--	--	--
L06-0502A	L06-0502	L06-0500	Circular	1	72.83	72.82	0.015	20	6.0	--	--	--
L06-0500A	L06-0500	L06-0492	Circular	1	72.82	72.02	0.015	1,141	6.0	--	--	--
L06-0492A	L06-0492	L06-0490	Circular	1	72.02	72.00	0.015	30	6.0	--	--	--
L06-0490A	L06-0490	L06-0480	Circular	1	72.00	71.54	0.015	656	6.0	--	--	--
L06-0480A	L06-0480	L06-0460	Circular	1	71.54	71.42	0.015	177	6.0	--	--	--
L06-0460A	L06-0460	L06-0432	Trapezoidal	1	71.42	69.80	0.08	2,308	7.9	6	4	4
L06-0432A	L06-0432	L06-0430	Circular	1	69.8	69.73	0.015	104	6.0	--	--	--
6. Diversion Channel												
L06430A	L06-0430	L02-0530	Trapezoidal	1	69.73	68.05	0.08	2,403	9.3	6	4	4
L02-0530B	L02-0530	L02-0530_1	Circular	1	68.05	68.00	0.015	100	4.0	--	--	--
L020530C	L02-0530_1	L02-0530_2	Trapezoidal	1	68.00	65.78	0.08	4,435	9.7	10	4	4
L02-0530D	L02-0530_2	L02-0530_3	Circular	1	65.78	65.72	0.014	120	2.5	--	--	--
L02-0530E	L02-0530_3	L02-0530_4	Trapezoidal	1	63.79	63.72	0.008	5,825	8.3	15	4	4
L02-0530F	L02-0530_4	L02-0252	Trapezoidal	1	63.75	63.72	0.015	20	8.3	15	4	4

Table 9-1. Alternative 2 Improvement Details

Link Name	US Node Name	DS Node Name	Type	No. Barrels	US Invert Elevation (ft)	DS Invert Elevation (ft)	Roughness	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Sideslope _H:1V	Right-hand Sideslope _H:1V
7. Lateral 2 Channel Widening												
L02-0440A	L02-0440	L02-0430	Trapezoidal	1	66.60	65.88	0.08	801	6.1	6	4	4
L02-0430A	L02-0430	L02-0253	Trapezoidal	1	65.88	64.20	0.08	1,862	7.1	6	4	4
L02-0253A	L02-0253	L02-0252	Trapezoidal	1	64.20	63.72	0.08	532	8.1	6	4	4
L02-0252A	L02-0252	L02-0250	Trapezoidal	1	63.72	63.61	0.08	2,003	8.3	20	4	4
L02-0250B	L02-0250	L02-0250_1	Circular	1	63.61	63.61	0.015	100	5.0	--	--	--
L02-0250A	L02-0250_1	L02-0240	Trapezoidal	1	63.61	62.78	0.08	1,511	6.8	20	4	4
L02-0240A	L02-0240	L02-0230	Circular	2	62.78	62.71	0.015	120	6.0	--	--	--
L02-0230A	L02-0230	L02-0220	Trapezoidal	1	62.71	62.30	0.08	729	6.9	20	4	4
L02-0220A	L02-0220	L02-0210	Trapezoidal	1	62.30	62.21	0.08	162	7.0	30	4	4
L02-0210A	L02-0210	L01-0240	Trapezoidal	1	62.21	62.13	0.08	155	7.1	30	4	4
L01-0240A	L01-0240	L01-0230	Trapezoidal	1	62.13	60.76	0.08	2,459	7.5	30	4	4
L01-0230A	L01-0230	L01-0220	Trapezoidal	1	60.76	60.72	0.08	68	7.9	30	4	4
L01-0220A	L01-0220	L01-0210	Trapezoidal	1	60.72	60.22	0.08	2,688	7.9	30	4	4
L01-0210A	L01-0210	L01-0200	Circular	2	60.22	60.16	0.015	110	6.0	--	--	--
L01-0200A	L01-0200	L01-0190	Trapezoidal	1	60.16	59.51	0.08	1,168	7.5	30	4	4
L01-0190A	L01-0190	L01-0180	Trapezoidal	1	59.51	58.73	0.08	1,405	8.1	12	4	4
8. Paseo Road Improved Channel and Culverts												
L01-1340A	L01-0340	L01-0330	Trapezoidal	1	69.14	68.82	0.08	647	2.4	15	4	4
L01-0330A	L01-0330	L01-0320	Circular	1	68.82	68.69	0.015	100	3.0	--	--	--
L01-0320A	L01-0320	L01-0310	Trapezoidal	1	68.69	67.89	0.08	498	3.1	15	4	4
L01-0310A	L01-0310	L01-0300	Trapezoidal	1	67.89	66.52	0.08	855	4.2	15	4	4
L01-0300A	L01-0300	L01-0290	Circular	1	66.52	66.41	0.015	100	3.0	--	--	--
L01-0290A	L01-0290	L01-0280	Trapezoidal	1	66.41	64.85	0.08	972	5.7	15	4	4
L01-0280A	L01-0280	L01-0270	Circular	1	64.85	64.69	0.015	103	3.0	--	--	--
L01-0270A	L01-0270	L01-0260	Trapezoidal	1	64.69	64.59	0.08	64	5.7	15	4	4
L01-260A	L01-0260	L01-0250	Circular	1	64.59	64.48	0.015	100	3.0	--	--	--
L01-0250A	L01-0250	L02-0230	Trapezoidal	1	64.48	62.88	0.08	1,000	5.9	15	4	4
9. Lateral 2 Improved Channel and Culverts at Township Road												
L02-0180A	L02-0180	L02-0170	Circular	1	67.43	67.37	0.015	100	3.0	--	--	--
L02-0170A	L02-0170	L02-0160	Trapezoidal	1	67.37	66.11	0.08	1,199	3.8	10	4	4
L02-0160A	L02-0160	L02-0150	Circular	1	66.11	66.07	0.015	100	3.0	--	--	--
L02-0150A	L02-0150	L02-0140	Trapezoidal	1	66.07	64.69	0.008	1,311	4.3	10	4	4
L02-0140A	L02-0140	L02-0130	Circular	1	64.69	64.63	0.015	100	4.0	--	--	--
L02-0190A	L02-0130	L02-0190	Trapezoidal	1	64.63	63.45	0.08	1,124	5.5	10	4	4
L02-0200AA	L02-0190	L02-0200	Circular	1	63.45	63.40	0.014	100	4.0	--	--	--
L02-0200A	L02-0200	L01-0240	Trapezoidal	1	63.40	62.13	0.08	1,216	6.5	10	4	4
10. Detention Basin												
A2_inlet1	L01-0190	ALT2_DB	Trapezoidal	1	63.00	62.50	0.08	200	4.3	10	4	4
A2_inlet2	MC0240	ALT2_DB	Trapezoidal	1	61.40	61.00	0.08	1,900	6.0	5	4	4
A2_out	ALT2_DB	L01-0180	Circular	1	60.80	60.00	0.015	100	3.0	--	--	--

2. LARKIN ROAD STORM DRAIN AND DIVERSION TO MAIN CANAL

The existing Larkin Road drainage facilities upstream of the City consist of a small road side ditch and several driveway culverts. Alternative 2 involves the construction of a 36-inch to 48-inch storm drains along Larkin Road. A 60-inch storm drain would be constructed to divert flows to the Main Canal. These new drains would be disconnected from the existing 30-inch storm drain along Larkin Road.

3. PENNINGTON ROAD STORM DRAIN

The area north of Pennington Road and east of the Main Canal will be developed under buildout land use conditions and will need improved drainage facilities. The improvements include a 60-inch storm drain.

4. LATERAL 5 CHANNEL AND CULVERT IMPROVEMENT

A section of Lateral 5 will be in developed areas in the future buildout land use conditions. The improvements include a 60-inch storm drain system.

5. LATERAL 6 NORTH OF THE DIVERSION CHANNEL

The existing Lateral 6 drainage facilities upstream of the existing City area consist of a small road side ditch and several culverts. This area will be developed at buildout of the general plan and will need improved drainage facilities. The improved drainage facilities include 60-inch to 72-inch storm drain. Lateral 6 will be redirected to flow west into the new diversion channel (see below).

6. DIVERSION CHANNEL

The purpose of the diversion channel is to convey buildout flows around the City instead of through it. The diversion channel will begin at the Union Pacific Railroad and will flow west through a 48-in RCP culvert at Luther Road. This section of channel will have a bottom width of 6 feet and side slopes of 4H:1V. Once the channel turns south on the west side of Pennington Ranch, it will have a bottom width of 10 feet and side slopes of 4H:1V and will cross Pennington Road via a 30-inch storm drain. Downstream of Pennington Road, the channel will have a bottom width of 15 feet and side slopes of 4H:1V. This channel will discharge to Lateral 2 south of the Wastewater Treatment Plant (WWTP). South of Pennington Road, new development to the west of the channel will drain into this channel.

7. LATERAL 2 CHANNEL WIDENING

Lateral 2 will be widened to have capacity to convey future flows. Upstream of the WWTP, the channel will have a bottom width of 6 feet and side slopes of 4H:1V. Downstream of its confluence with the diversion channel from the west, the improved Lateral 2 channel will be widened to have a bottom width of 20 feet with side slopes of 4H:1V. Along Lateral 2, Alternative 2 includes two road crossing with 60-inch RCPs, and a road crossing with twin 72-inch RCP culverts. The improvements also include culverts for Lateral 2 channel under the existing irrigation canal.

8. PASEO AVENUE IMPROVED CHANNEL AND CULVERTS

The existing Paseo Avenue drainage facilities consist of a road side ditch and several driveway culverts. Under future buildout land use conditions, the area around Paseo Avenue will be developed and will need an improved drainage system. However, this channel is on the south side of Paseo Avenue and will be outside the City. Consequently, this channel can remain as an open channel rather than be replaced with storm drain pipes. The upstream section will be made up of a trapezoid channel with a bottom width of 15 feet and side slopes of 4H:1V. The culverts will have diameters of 36-inches and will detain storm flow in the wider upstream channel section. The downstream channel section will have a bottom width of 6 feet.

9. LATERAL 2 IMPROVED CHANNEL AND CULVERTS AT TOWNSHIP ROAD

Lateral 2 at Township Road will be re-graded and widened to efficiently convey flows downstream to Lateral 2. The channel will have a bottom width of 10-feet and side slopes of 4H:1V. The culverts will be 36-inch and 48-inch RCPs.

10. DETENTION BASIN

A large regional detention basin will be constructed about 2.5 miles downstream of the City. The stage-area-volume data is shown in Table 9-2. A summary of the inlet and outlet data is shown in Table 9-3. The inlet from Lateral 2 will be a constructed channel with a bottom width of 10 feet and side slopes of 4H:1V with an upstream invert at elevation 63.0 feet. The Lateral 2 invert elevation is at about 59.5 feet (Node L01-0190) where the inlet channel begins. The north inlet channel is 3.5 feet above the invert of Lateral 2. The east inlet, or the diversion channel from the Main Canal, to the detention basin will have a bottom width of 5 feet and side slopes of 4H:1V. The upstream invert of the east inlet is at elevation 61.4 feet, the same elevation as the invert of the Main Canal (Node MC0240). The downstream invert of the east inlet channel is at elevation 61.0. The outlet structure will be a 36-inch RCP with a flap gate with an upstream invert of 60.8 feet and downstream invert of 60.0 feet. The elevation of Lateral 2 at the downstream end of the outlet pipe is 58.73 feet (Node L01-0180).

Table 9-2. Stage - Area - Volume Data for Alternative 2 Detention Basin

Elevation, ft	Depth, ft	Area, ac	Volume, ac-ft
60.8	0	77.3	0
68.0	7.2	82.3	574.5

Note: The basin bottom would be graded to drain to the basin outlet structure.

Table 9-3. Summary of Alternative 2 Inlet and Outlet Data

Structure	Type	US Invert Elevation (ft)	DS Invert Elevation (ft)	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Side slope _H:1V	Right-hand Side slope _H:1V
North Inlet	Trapezoidal	63.0	62.5	200	4.3	10	4	4
East Inlet	Trapezoidal	61.4	61.0	1,900	6.0	5	4	4
Outlet	Circular	60.8	60.0	100	3.0	—	—	—

Performance of the detention basin for the 10-year and 100-year storms is summarized in Table 9-4. During the 100-year storm, the detention basin will store 484.4 acre-feet. During the 100-year storm, the north inlet channel from the Lateral 2 will deliver a peak flow of 311 cfs to the detention basin. During the 100-year storm, the east inlet channel from the Main Canal will deliver a peak flow of 242 cfs to the Alternative 2 detention basin. The peak 100-year outflow is 24.2 cfs.

Table 9-4. Alternative 2 Detention Basin Summary

	10-Year	100-Year
Peak WSE (ft)	64.1	66.9
Freeboard (ft)	3.9	1.1
Peak Storage (ac-ft)	259.4	479.8
Peak Inflow from North Inlet (cfs)	164.4	311.0
Peak Inflow from East Inlet (cfs)	102.3	242.3
Peak Outflow (cfs)	23.2	24.2

COMPARISON WITH EXISTING CONDITIONS

The overall performance of the City's storm drain system and RD 777's channels with Alternative 2 improvements is summarized in Table 9-5.

Table 9-5. Node Data and Model Results for Alternative 2

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
ALT2_DB	60.8	68.0	--	--	64.1	-3.9	--	--	--	66.9	-1.1	--
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.8	54.9	-0.8	0.0
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.7	55.0	-0.7	0.0
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.3	0.0
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.2	0.0
EIC0060	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.3	57.0	-0.4	-0.1
EIC0070	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.4	57.0	-0.4	-0.1
EIC0075	47.2	57.9	54.8	-3.0	54.9	-3.0	0.0	57.4	-0.4	57.3	-0.5	-0.1
EIC0080	48.1	58.5	54.9	-3.6	54.9	-3.6	0.0	57.5	-1.0	57.4	-1.1	-0.1
EIC0090	48.2	58.6	54.9	-3.7	54.9	-3.7	0.0	57.5	-1.1	57.4	-1.2	-0.1
EIC0100	50.1	57.8	55.6	-2.3	55.4	-2.4	-0.1	59.1	1.3	58.9	1.1	-0.2
EIC0110	50.2	59.2	55.6	-3.7	55.4	-3.8	-0.1	59.1	-0.1	58.9	-0.3	-0.2
EIC0120	50.3	63.1	55.9	-7.2	55.7	-7.4	-0.2	59.4	-3.6	59.2	-3.9	-0.3
EIC0130	50.0	60.8	55.9	-4.9	55.7	-5.1	-0.2	59.4	-1.3	59.2	-1.6	-0.3
EIC0140	50.0	59.2	56.0	-3.2	55.8	-3.4	-0.2	59.6	0.4	59.4	0.1	-0.3
EIC0150	49.8	58.6	56.0	-2.6	55.8	-2.9	-0.2	59.6	1.0	59.4	0.7	-0.3
L01-0090	59.5	70.1	65.7	-4.4	65.5	-4.6	-0.2	67.3	-2.7	66.6	-3.5	-0.7
L01-0100	59.2	69.7	65.8	-4.0	65.6	-4.2	-0.2	67.4	-2.3	66.6	-3.1	-0.8
L01-0110	60.1	68.3	66.3	-2.1	66.0	-2.4	-0.3	67.8	-0.5	67.0	-1.4	-0.9
L01-0120	59.9	68.3	66.3	-2.0	66.0	-2.3	-0.3	67.9	-0.4	67.0	-1.3	-0.9
L01-0170	58.9	69.0	66.3	-2.7	66.0	-3.0	-0.3	67.9	-1.1	67.0	-2.0	-0.9
L01-0180	58.7	67.5	66.6	-0.9	66.2	-1.3	-0.4	68.4	0.9	67.2	-0.3	-1.2
L01-0190	59.5	68.6	67.0	-1.6	66.2	-2.4	-0.7	68.7	0.1	67.2	-1.4	-1.5
L01-0200	60.2	69.5	67.2	-2.3	66.5	-3.1	-0.7	68.8	-0.7	67.5	-2.0	-1.3
L01-0210	60.2	69.4	67.4	-2.0	66.7	-2.6	-0.7	69.1	-0.3	68.2	-1.2	-0.9
L01-0220	60.7	71.4	67.9	-3.5	67.2	-4.2	-0.7	69.4	-2.0	68.6	-2.7	-0.7
L01-0230	60.8	69.9	70.7	0.8	67.3	-2.6	-3.4	72.9	3.0	68.7	-1.2	-4.2
L01-0240	62.1	70.5	70.9	0.4	68.0	-2.5	-2.9	72.9	2.5	69.3	-1.2	-3.7
L01-0250	64.5	71.3	70.9	-0.4	68.4	-2.9	-2.5	73.0	1.6	69.6	-1.8	-3.4
L01-0260	64.6	71.4	72.8	1.4	68.6	-2.8	-4.2	74.6	3.2	70.3	-1.1	-4.2
L01-0270	64.7	71.5	72.8	1.4	68.6	-2.8	-4.2	74.6	3.1	70.3	-1.1	-4.2
L01-0280	64.9	71.6	73.1	1.5	69.1	-2.4	-4.0	74.8	3.2	71.3	-0.2	-3.5
L01-0290	66.4	72.4	73.1	0.6	69.3	-3.1	-3.8	74.8	2.4	71.4	-1.1	-3.4
L01-0300	66.5	73.2	73.1	-0.1	69.3	-3.8	-3.8	74.8	1.6	71.4	-1.8	-3.4
L01-0310	67.9	73.4	73.1	-0.3	69.3	-4.1	-3.8	74.8	1.4	71.4	-2.0	-3.4
L01-0320	68.7	73.5	73.1	-0.4	69.3	-4.2	-3.8	74.8	1.3	71.4	-2.1	-3.4
L01-0330	68.8	74.1	73.1	-1.0	69.3	-4.8	-3.8	74.8	0.7	71.4	-2.7	-3.4
L01-0340	69.1	72.6	73.1	0.5	69.3	-3.3	-3.8	74.8	2.2	71.4	-1.3	-3.4
L02-0010	55.4	63.3	62.0	-1.3	62.1	-1.2	0.1	64.2	0.9	63.9	0.6	-0.3
L02-0020	55.5	63.5	62.2	-1.3	62.4	-1.1	0.1	64.4	0.9	64.2	0.7	-0.3
L02-0030	55.1	63.7	62.2	-1.4	62.4	-1.3	0.1	64.5	0.8	64.2	0.5	-0.3
L02-0032	55.9	64.3	63.1	-1.1	63.1	-1.1	0.0	65.2	0.9	64.8	0.5	-0.4
L02-0040	56.8	65.0	64.2	-0.8	64.2	-0.8	-0.1	66.2	1.2	65.7	0.7	-0.5
L02-0042	57.0	65.3	64.6	-0.7	64.5	-0.8	-0.1	66.5	1.2	65.9	0.6	-0.6
L02-0044	57.1	65.4	64.7	-0.7	64.6	-0.8	-0.1	66.5	1.2	66.0	0.6	-0.6
L02-0050	59.7	70.4	65.5	-4.9	65.3	-5.0	-0.1	67.1	-3.2	66.5	-3.9	-0.7
L02-0060	60.2	66.9	66.7	-0.1	65.3	-1.5	-1.4	68.3	1.4	66.5	-0.4	-1.8
L02-0064	60.3	66.2	67.8	1.6	67.1	0.9	-0.7	69.6	3.4	68.9	2.7	-0.7
L02-0070	58.9	65.5	67.8	2.3	67.1	1.7	-0.6	69.6	4.1	68.9	3.5	-0.7
L02-0080	59.3	66.0	68.2	2.2	67.7	1.7	-0.5	70.3	4.3	69.6	3.6	-0.6
L02-0086	59.2	68.9	68.2	-0.7	67.7	-1.3	-0.5	70.3	1.3	69.6	0.7	-0.6
L02-0088	59.4	68.9	68.3	-0.7	67.7	-1.2	-0.6	70.3	1.4	69.7	0.8	-0.6
L02-0090	62.5	68.2	68.3	0.1	67.7	-0.4	-0.6	70.3	2.2	69.7	1.5	-0.6
L02-0095	62.7	68.6	68.3	-0.3	67.7	-0.9	-0.6	70.4	1.8	69.7	1.1	-0.7
L02-0100	62.7	69.6	68.4	-1.2	67.8	-1.8	-0.6	70.5	1.0	69.7	0.1	-0.8
L02-0102	64.2	68.8	68.5	-0.3	67.8	-0.9	-0.7	70.6	1.8	69.7	1.0	-0.8
L02-0104	64.2	69.0	68.9	-0.1	67.9	-1.1	-1.0	71.0	2.1	69.7	0.7	-1.3
L02-0106	64.0	68.5	68.9	0.4	67.9	-0.6	-1.0	71.1	2.5	69.7	1.2	-1.3
L02-0108	64.1	68.6	69.7	1.1	68.1	-0.6	-1.6	72.0	3.4	69.7	1.1	-2.2
L02-0110	64.9	69.5	69.7	0.2	68.1	-1.4	-1.6	72.0	2.5	69.7	0.2	-2.2
L02-0120	64.4	71.4	70.1	-1.3	68.2	-3.2	-1.8	72.5	1.1	69.7	-1.7	-2.7
L02-0130	64.6	71.5	70.1	-1.4	68.1	-3.4	-2.0	72.5	1.0	69.6	-1.9	-2.8
L02-0140	64.7	72.0	70.2	-1.8	68.3	-3.7	-1.9	72.6	0.6	69.7	-2.3	-2.9
L02-0150	66.1	71.2	70.2	-1.0	68.2	-2.9	-2.0	72.6	1.5	69.7	-1.5	-2.9
L02-0160	66.1	71.3	70.4	-0.8	69.2	-2.1	-1.3	73.0	1.7	70.4	-0.8	-2.6
L02-0170	67.4	73.3	70.4	-2.9	70.1	-3.2	-0.4	73.0	-0.3	70.7	-2.6	-2.2
L02-0180	67.4	70.7	73.5	2.8	71.0	0.2	-2.5	74.5	3.8	71.7	1.0	-2.8
L02-0190	63.5	71.1	70.2	-0.9	68.0	-3.1	-2.2	72.5	1.4	69.5	-1.5	-2.9
L02-0200	63.4	70.9	70.9	0.0	68.0	-2.9	-2.9	72.9	2.1	69.3	-1.5	-3.6
L02-0210	62.2	70.5	70.9	0.4	68.0	-2.5	-2.9	72.9	2.5	69.3	-1.2	-3.7
L02-0220	62.3	71.1	70.9	-0.2	68.1	-3.0	-2.8	72.9	1.9	69.3	-1.7	-3.6
L02-0230	62.7	70.4	70.9	0.5	68.4	-2.0	-2.5	73.0	2.5	69.6	-0.9	-3.4
L02-0237	67.1	75.2	72.7	-2.5	71.7	-3.5	-1.0	73.9	-1.3	72.2	-3.0	-1.7
L02-0238	67.4	75.0	72.7	-2.3	71.7	-3.3	-1.0	73.9	-1.1	72.2	-2.8	-1.7
L02-0239	67.7	75.4	72.7	-2.7	71.7	-3.7	-1.0	73.9	-1.5	72.2	-3.2	-1.7
L02-0240	62.8	69.5	71.1	1.6	68.5	-0.9	-2.5	73.2	3.7	69.8	0.3	-3.4
L02-0243	68.3	75.4	72.7	-2.7	71.7	-3.7	-1.0	73.9	-1.5	72.2	-3.2	-1.7
L02-0244	68.9	75.5	72.7	-2.8	71.7	-3.8	-1.0	73.9	-1.6	72.2	-3.3	-1.7
L02-0246	67.8	75.0	72.7	-2.3	71.9	-3.1	-0.8	73.9	-1.1	72.2	-2.8	-1.7
L02-0247	68.0	75.2	72.7	-2.5	72.0	-3.2	-0.8	73.9	-1.3	72.2	-3.0	-1.7
L02-0250	63.6	72.7	71.1	-1.6	70.2	-2.5	-0.9	73.2	0.5	71.9	-0.9	-1.3
L02-0252	63.7	73.2	72.5	-0.8	70.5	-2.7	-2.0	73.7	0.5	72.0	-1.2	-1.7
L02-0253	64.2	73.9	72.7	-1.2	70.5	-3.3	-2.1	73.8	-0.1	72.1	-1.8	-1.7
L02-0254	66.1	73.9	72.7	-1.2	71.1	-2.8	-1.6	73.8	-0.1	72.2	-1.7	-1.7
L02-0255	66.9	74.2	72.7	-1.5	71.7	-2.6	-1.0	73.9	-0.4	72.2	-2.0	-1.7
L02-0260	67.1	74.7	72.7	-1.9	71.9	-2.7	-0.8	73.9	-0.7	72.2	-2.5	-1.7
L02-0261	66.9	76.0	72.7	-3.3	71.7	-4.3	-1.0	73.9	-2.1	72.2	-3.8	-1.7
L02-0262	67.1	75.0	72.7	-2.3	71.7	-3.3	-1.0	73.9	-1.1	72.2	-2.8	-1.7
L02-0270	67.0	74.2	72.7	-1.5	71.9	-2.3	-0.8	73.9	-0.3	72.2	-2.0	-1.7
L02-0272	66.6	73.8	72.7	-1.1	71.9	-1.8	-0.8	73.9	0.1	72.2	-1.6	-1.7
L02-0273	67.7	75.0	72.7	-2.3	71.9	-3.1	-0.8	73.9	-1.1	72.2	-2.8	-1.7
L02-0275	70.0	75.0	70.8	-4.2	70.0	-5.0	-0.7	73.9	-1.1	70.2	-4.8	-3.7
L02-0277	69.4	76.0	72.8	-3.2	72.3	-3.7	-0.5	75.3	-0.7	75.1	-0.9	-0.2
L02-0278	69.3	74.6	72.8	-1.9	72.2	-2.4	-0.6	74.8	0.1	74.7	0.0	-0.1

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0279	68.3	75.6	72.8	-2.8	72.1	-3.5	-0.6	75.6	0.0	74.2	-1.4	-1.4
L02-0280	67.9	74.1	72.7	-1.4	71.9	-2.2	-0.8	73.9	-0.2	72.2	-1.9	-1.7
L02-0281	69.0	77.0	72.8	-4.2	72.2	-4.8	-0.5	77.0	0.0	75.0	-2.0	-2.0
L02-0282	68.4	75.8	72.8	-3.0	72.2	-3.6	-0.6	75.8	0.0	74.6	-1.2	-1.2
L02-0283	68.9	75.2	72.8	-2.4	72.4	-2.8	-0.4	75.5	0.3	75.2	0.0	-0.3
L02-0284	68.3	74.9	72.8	-2.1	71.9	-3.0	-0.9	74.0	-0.9	72.2	-2.7	-1.8
L02-0286	69.4	76.2	72.8	-3.4	72.6	-3.6	-0.2	76.4	0.2	76.2	0.0	-0.1
L02-0287	71.0	78.6	72.8	-5.8	72.9	-5.7	0.1	78.5	-0.1	77.7	-0.9	-0.8
L02-0288	70.4	77.5	72.8	-4.7	72.4	-5.1	-0.4	77.5	0.0	76.1	-1.4	-1.4
L02-0290	68.7	76.3	72.9	-3.4	72.0	-4.3	-1.0	74.1	-2.2	72.2	-4.1	-1.9
L02-0291	68.9	76.0	73.0	-3.0	72.0	-4.0	-1.0	74.2	-1.8	72.2	-3.8	-2.0
L02-0292	69.0	76.0	73.0	-3.0	72.0	-4.0	-1.0	74.2	-1.8	72.2	-3.8	-2.0
L02-0293	69.9	75.3	73.0	-2.3	72.0	-3.3	-1.0	74.2	-1.1	72.2	-3.1	-2.0
L02-0300	68.7	78.0	73.1	-4.9	72.0	-6.0	-1.2	74.3	-3.7	72.2	-5.8	-2.1
L02-0302	72.8	78.3	75.3	-3.1	72.8	-5.5	-2.5	76.2	-2.1	72.8	-5.5	-3.4
L02-0421	69.4	76.8	75.5	-1.3	75.5	-1.3	0.0	76.5	-0.3	76.4	-0.4	-0.1
L02-0422	70.7	76.8	76.8	0.0	76.8	0.0	0.0	77.0	0.2	76.9	0.1	0.0
L02-0424	70.5	76.9	77.2	0.2	77.1	0.2	0.0	77.7	0.8	77.7	0.7	0.0
L02-0425	69.5	76.1	75.5	-0.6	75.5	-0.6	0.0	76.5	0.4	76.4	0.3	-0.1
L02-0426	62.0	76.9	75.4	-1.5	75.4	-1.5	0.0	76.4	-0.5	76.3	-0.6	-0.1
L02-0427	70.1	76.5	76.4	-0.1	76.4	-0.1	0.0	77.1	0.6	77.0	0.5	-0.1
L02-0428	72.1	77.0	76.1	-0.9	75.0	-2.0	-1.1	77.1	0.1	77.0	0.1	0.0
L02-0430	65.9	75.1	72.9	-2.3	70.9	-4.3	-2.0	73.9	-1.3	72.2	-2.9	-1.6
L02-0440	66.6	75.2	73.0	-2.2	71.3	-3.9	-1.7	74.1	-1.2	72.5	-2.8	-1.6
L02-0450	66.4	75.4	73.1	-2.3	71.9	-3.4	-1.2	74.2	-1.1	73.2	-2.2	-1.0
L02-0460	66.3	75.3	73.2	-2.1	72.3	-3.0	-0.9	74.4	-1.0	73.7	-1.7	-0.7
L02-0461	70.7	76.0	72.9	-3.1	71.8	-4.2	-1.1	74.3	-1.7	73.2	-2.8	-1.1
L02-0462	70.5	75.4	73.0	-2.4	72.4	-3.0	-0.6	75.4	0.0	74.3	-1.1	-1.0
L02-0463	70.1	76.1	72.9	-3.1	72.3	-3.7	-0.6	74.3	-1.7	73.6	-2.4	-0.7
L02-0464	70.7	76.0	72.9	-3.2	72.0	-4.0	-0.8	74.3	-1.7	73.2	-2.8	-1.1
L02-0465	69.9	75.4	73.1	-2.3	72.4	-3.0	-0.7	74.3	-1.1	73.7	-1.7	-0.6
L02-0467	69.1	75.4	73.2	-2.2	72.4	-3.0	-0.9	74.4	-1.0	73.7	-1.6	-0.6
L02-0468	69.6	75.2	73.2	-2.0	72.4	-2.8	-0.8	74.3	-0.8	73.7	-1.4	-0.6
L02-0470	67.0	75.3	73.3	-2.0	72.5	-2.9	-0.9	74.5	-0.9	73.8	-1.5	-0.7
L02-0471	70.9	75.2	73.3	-1.9	72.5	-2.7	-0.8	74.9	-0.3	74.7	-0.5	-0.2
L02-0472	71.2	75.7	73.3	-2.4	73.0	-2.7	-0.3	75.7	0.0	75.8	0.1	0.1
L02-0480.1	67.7	76.9	74.8	-2.0	73.8	-3.0	-1.0	75.7	-1.2	75.2	-1.6	-0.4
L02-0481	68.6	76.3	74.1	-2.2	72.5	-3.8	-1.6	75.0	-1.3	74.9	-1.3	0.0
L02-0481A	68.3	75.8	--	--	72.5	-3.3	--	--	--	74.0	-1.8	--
L02-0481B	68.9	75.0	--	--	72.5	-2.5	--	--	--	74.5	-0.5	--
L02-0482	69.2	77.7	76.4	-1.2	72.3	-5.4	-4.2	77.7	0.1	75.8	-1.9	-2.0
L02-0483	69.1	74.4	74.4	0.0	72.5	-1.9	-1.9	75.0	0.7	74.5	0.1	-0.6
L02-0484	69.6	75.2	74.7	-0.5	72.5	-2.7	-2.2	75.2	0.0	75.2	0.0	0.0
L02-0485	70.3	75.2	75.0	-0.2	72.5	-2.7	-2.5	75.4	0.2	75.3	0.1	-0.2
L02-0485A	70.6	77.2	--	--	72.6	-4.6	--	--	--	76.1	-1.1	--
L02-0485B	71.0	76.5	--	--	72.8	-3.7	--	--	--	76.6	0.1	--
L02-0485C	72.0	77.5	--	--	73.5	-4.0	--	--	--	77.5	0.0	--
L02-0485D	72.4	77.5	--	--	73.7	-3.8	--	--	--	77.6	0.1	--
L02-0485E	71.1	77.3	--	--	72.7	-4.6	--	--	--	77.3	0.0	--
L02-0490	59.5	76.9	73.4	-3.5	72.6	-4.2	-0.8	74.5	-2.3	73.9	-2.9	-0.6
L02-0500	66.1	75.3	74.8	-0.5	73.8	-1.5	-1.1	75.9	0.6	75.3	0.0	-0.5
L02-0502	72.5	77.0	74.8	-2.2	73.5	-3.6	-1.3	75.9	-1.1	75.4	-1.6	-0.5
L02-0503	69.0	75.6	74.8	-0.8	73.7	-1.9	-1.1	75.9	0.3	75.4	-0.2	-0.5
L02-0504	69.0	75.4	75.0	-0.4	73.5	-1.9	-1.5	76.1	0.7	75.5	0.1	-0.6
L02-0505	73.4	76.5	75.0	-1.5	73.5	-2.9	-1.5	76.1	-0.4	75.5	-1.0	-0.6
L02-0506	72.0	77.7	75.1	-2.5	74.2	-3.5	-1.0	76.2	-1.4	75.6	-2.1	-0.6
L02-0507	71.0	77.1	76.5	-0.6	75.5	-1.6	-1.0	76.7	-0.3	76.2	-0.9	-0.5
L02-0508	75.4	76.7	0.0	-76.7	0.0	--	0.0	0.0	-76.7	0.0	--	0.0
L02-0509	73.1	77.9	0.0	-77.9	0.0	--	0.0	0.0	-77.9	0.0	--	0.0
L02-0510	68.8	77.8	75.9	-1.8	74.4	-3.3	-1.5	77.2	-0.6	76.4	-1.4	-0.8
L02-0511	71.6	76.9	77.0	0.0	74.7	-2.2	-2.3	77.5	0.6	77.0	0.1	-0.5
L02-0512	68.2	75.0	75.0	-0.1	73.8	-1.2	-1.2	76.1	1.1	75.5	0.4	-0.6
L02-0513	73.1	77.8	77.9	0.1	74.4	-3.5	-3.5	78.5	0.7	77.9	0.1	-0.6
L02-0514	68.5	75.3	75.1	-0.2	74.2	-1.2	-1.0	76.0	0.7	75.7	0.3	-0.4
L02-0515	68.6	76.4	76.4	0.0	74.1	-2.3	-2.3	76.4	0.1	76.2	-0.2	-0.3
L02-0516	69.4	75.9	76.1	0.1	75.6	-0.4	-0.5	77.0	1.0	76.9	1.0	0.0
L02-0517	71.2	77.4	76.4	-1.0	74.1	-3.3	-2.3	76.4	-0.9	76.4	-1.0	-0.1
L02-0518	69.1	78.7	77.4	-1.2	72.0	-6.7	-5.4	79.1	0.5	72.2	-6.4	-6.9
L02-0518A	68.8	78.0	--	--	72.0	-6.0	--	--	--	72.2	-5.8	--
L02-0520	70.3	79.0	77.6	-1.4	72.0	-7.0	-5.6	79.2	0.2	72.2	-6.8	-7.0
L02-0520A	69.4	78.4	--	--	72.0	-6.4	--	--	--	72.2	-6.2	--
L02-0522	70.4	79.2	78.8	-0.4	72.0	-7.2	-6.8	81.0	1.8	72.2	-7.0	-8.8
L02-0530	68.1	79.2	79.3	0.1	75.2	-4.0	-4.1	81.0	1.9	78.2	-1.0	-2.9
L02-0530_1	68.0	79.2	--	--	73.7	-5.5	--	--	--	76.6	-2.6	--
L02-0530_2	65.8	78.0	--	--	73.2	-4.8	--	--	--	76.6	-1.4	--
L02-0530_3	63.8	78.0	--	--	70.5	-7.5	--	--	--	72.1	-6.0	--
L02-0530_4	63.7	73.2	--	--	70.5	-2.7	--	--	--	72.0	-1.2	--
L02-0538	68.6	76.0	76.3	0.3	75.2	-0.8	-1.1	77.2	1.2	76.4	0.4	-0.8
L02-0538AA	69.9	78.1	--	--	75.0	-3.1	--	--	--	78.2	0.1	--
L02-0538BB	69.9	78.1	--	--	76.3	-1.8	--	--	--	78.3	0.2	--
L02-0540	70.2	78.1	78.3	0.2	75.2	-2.9	-3.0	78.4	0.3	78.2	0.1	-0.3
L02-0541	70.7	77.7	78.3	0.6	76.3	-1.4	-2.0	79.0	1.3	78.2	0.5	-0.8
L02-0542	71.2	78.4	78.5	0.1	76.8	-1.6	-1.7	79.2	0.8	78.6	0.3	-0.5
L02-0543	71.5	79.2	79.2	0.0	77.5	-1.7	-1.7	79.4	0.2	79.2	0.0	-0.2
L02-0544	72.0	79.9	79.9	0.1	78.9	-1.0	-1.0	80.1	0.3	80.1	0.3	0.0
L03-0010	63.0	71.6	68.9	-2.7	66.9	-4.7	-2.0	70.8	-0.8	68.7	-2.9	-2.1
L03-0020	63.1	71.6	69.1	-2.6	67.2	-4.5	-1.9	71.6	0.0	70.0	-1.6	-1.6
L03-0030	63.5	72.1	69.1	-2.9	67.6	-4.4	-1.5	71.6	-0.4	70.1	-1.9	-1.5
L03-0040	63.5	72.1	69.4	-2.7	68.3	-3.8	-1.0	72.5	0.4	71.5	-0.6	-1.0
L03-0050	64.0	72.6	69.4	-3.2	68.7	-3.9	-0.7	72.5	-0.1	71.6	-1.0	-0.9
L03-0060	64.6	73.2	69.4	-3.8	68.7	-4.5	-0.7	72.5	-0.7	71.6	-1.6	-0.9
L03-0062	64.7	73.3	69.6	-3.8	68.9	-4.4	-0.7	72.7	-0.6	71.8	-1.6	-0.9
L03-0070	65.9	74.5	69.7	-4.8	69.2	-5.3	-0.5	72.7	-1.8	71.8	-2.7	-0.9
L03-0080	66.1	74.7	71.7	-3.0	71.5	-3.1	-0.2	74.7	0.0	74.2	-0.5	-0.5
L03-0090	67.8	76.4	71.9	-4.5	71.8	-4.6	-0.1	74.8	-1.6	74.2	-2.1	-0.5
L03-0092	67.8	76.4	71.9	-4.5	71.8	-4.6	-0.1	74.8	-1.6	74.3	-2.1	-0.5

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L03-0094	67.9	76.5	79.8	3.3	79.7	3.3	0.0	80.9	4.4	80.9	4.4	0.0
L04-0030	66.9	71.9	71.3	-0.6	69.4	-2.5	-1.9	73.9	2.0	71.2	-0.7	-2.7
L04-0040	67.0	71.6	71.3	-0.3	70.1	-1.5	-1.2	73.9	2.3	71.4	-0.2	-2.5
L04-0050	67.8	72.1	71.3	-0.7	70.7	-1.4	-0.7	73.9	1.9	71.7	-0.4	-2.3
L04-0060	68.3	71.4	71.4	0.0	70.7	-0.7	-0.6	73.9	2.6	71.7	0.4	-2.2
L04-0062	68.2	73.1	71.4	-1.7	70.9	-2.2	-0.5	73.9	0.9	71.8	-1.2	-2.1
L04-0064	68.4	73.3	71.6	-1.7	71.4	-1.9	-0.2	74.0	0.7	72.7	-0.6	-1.3
L04-0066	68.0	71.7	71.6	-0.1	71.4	-0.3	-0.2	74.0	2.3	72.7	1.0	-1.3
L04-0068	67.8	72.0	72.0	0.1	71.9	0.0	-0.1	74.2	2.3	73.6	1.6	-0.6
L04-0070	68.0	74.4	72.2	-2.3	72.1	-2.3	-0.1	74.2	-0.2	73.7	-0.7	-0.6
L04-0080	68.1	76.0	72.2	-3.8	72.2	-3.8	-0.1	74.3	-1.7	73.7	-2.3	-0.5
L04-0088	68.5	75.0	72.4	-2.7	72.3	-2.7	0.0	74.4	-0.6	74.0	-1.0	-0.4
L04-0090	69.4	73.0	72.5	-0.5	72.4	-0.6	0.0	74.5	1.5	74.2	1.2	-0.3
L04-0092	69.5	73.6	72.6	-1.1	72.5	-1.1	0.0	74.5	0.9	74.2	0.6	-0.3
L04-0094	69.5	73.7	73.0	-0.7	73.0	-0.8	0.0	75.1	1.3	75.0	1.3	-0.1
L04-0100	69.6	73.8	73.0	-0.8	73.0	-0.9	0.0	75.1	1.2	75.0	1.1	-0.1
L05-0010	65.5	73.8	72.0	-1.8	70.1	-3.7	-1.9	75.0	1.2	72.6	-1.2	-2.4
L05-0012	65.6	73.0	72.0	-0.9	70.3	-2.6	-1.7	75.0	2.0	72.9	-0.1	-2.1
L05-0014	66.0	74.2	72.0	-2.2	70.6	-3.6	-1.4	75.0	0.8	73.2	-1.0	-1.8
L05-0020	66.4	75.9	72.0	-3.8	70.9	--	-1.1	75.0	-0.9	73.7	--	-1.3
L05-0040	66.5	74.0	72.0	-2.0	71.0	-3.0	-1.0	75.0	1.0	73.8	-0.2	-1.2
L05-0050	66.6	74.0	72.7	-1.3	71.2	-2.8	-1.5	75.6	1.6	74.1	0.0	-1.6
L05-0060	69.3	74.2	72.8	-1.4	71.2	-3.0	-1.5	75.6	1.4	74.1	-0.1	-1.5
L05-0070	69.4	74.5	72.9	-1.6	71.6	-2.8	-1.3	75.7	1.2	74.2	-0.3	-1.4
L05-0080	69.4	74.5	72.9	-1.6	71.7	-2.8	-1.2	75.7	1.1	74.2	-0.3	-1.4
L05-0090	69.6	74.8	73.0	-1.9	72.1	-2.8	-0.9	75.7	0.8	74.3	-0.5	-1.3
L05-0100	69.7	75.1	73.0	-2.1	72.3	-2.8	-0.7	75.7	0.5	74.4	-0.7	-1.3
L05-0110	69.8	75.5	73.1	-2.4	72.6	-2.9	-0.5	75.7	0.2	74.5	-1.0	-1.2
L06-0020	69.0	77.2	73.5	-3.6	73.1	-4.1	-0.5	75.7	-1.5	74.6	-2.6	-1.1
L06-0040	68.5	77.2	73.7	-3.5	73.3	-3.9	-0.4	75.7	-1.5	74.7	-2.5	-1.0
L06-0140	69.6	77.6	73.7	-3.9	73.3	-4.3	-0.4	75.8	-1.8	74.7	-2.9	-1.0
L06-0141	69.4	77.2	73.7	-3.5	73.3	-3.9	-0.4	75.7	-1.5	74.7	-2.5	-1.0
L06-0142	69.7	78.2	73.8	-4.4	73.3	-4.9	-0.5	76.0	-2.2	74.8	-3.3	-1.2
L06-0143	71.3	78.2	73.8	-4.4	73.3	-4.9	-0.5	76.0	-2.2	74.9	-3.3	-1.1
L06-0143NA	72.0	77.6	--	--	73.6	-4.0	--	--	--	77.6	0.0	--
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0	78.4	0.4	78.4	0.4	0.0
L06-0145	72.3	78.3	76.6	-1.7	76.6	-1.7	0.0	77.6	-0.6	77.6	-0.6	0.0
L06-0146	72.8	75.0	75.6	0.6	75.6	0.6	0.0	76.6	1.6	76.6	1.6	0.0
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0	77.0	-2.0	77.0	-2.0	0.0
L06-0148	71.8	77.5	73.7	-3.8	73.4	-4.1	-0.3	75.8	-1.8	74.8	-2.7	-0.9
L06-0149	71.5	77.5	73.7	-3.8	73.3	-4.1	-0.3	75.8	-1.7	74.8	-2.7	-1.0
L06-0150	71.6	77.7	74.2	-3.4	73.3	-4.3	-0.9	76.7	-1.0	75.0	-2.6	-1.6
L06-0150D	72.5	77.0	--	--	73.6	-3.4	--	--	--	75.7	-1.3	--
L06-0151	69.9	77.6	74.0	-3.6	73.3	-4.3	-0.7	76.3	-1.2	75.0	-2.6	-1.4
L06-0151NA	70.5	76.2	--	--	73.3	-2.9	--	--	--	75.6	-0.6	--
L06-0151NB	71.6	76.4	--	--	73.4	-2.9	--	--	--	76.1	-0.2	--
L06-0151NC	72.0	76.5	--	--	73.7	-2.8	--	--	--	76.7	0.2	--
L06-0152	74.0	76.7	76.9	0.2	74.0	-2.7	-2.9	77.3	0.6	75.0	-1.7	-2.3
L06-0200	73.0	79.7	76.6	-3.1	73.3	-6.3	-3.2	78.5	-1.2	75.0	-4.6	-3.4
L06-0220	72.0	79.0	78.3	-0.8	76.4	-2.6	-1.8	80.0	1.0	78.7	-0.3	-1.3
L06-0221	77.0	79.5	78.1	-1.4	77.3	-2.2	-0.8	80.0	0.5	78.7	-0.8	-1.3
L06-0222	77.0	79.5	77.9	-1.6	77.8	-1.7	-0.1	78.8	-0.7	78.3	-1.2	-0.4
L06-0230	74.0	80.5	79.4	-1.1	76.8	-3.7	-2.7	81.5	1.0	79.9	-0.6	-1.6
L06-0240	74.4	80.3	79.5	-0.8	76.9	-3.4	-2.6	81.5	1.2	80.0	-0.3	-1.5
L06-0240AA	67.3	80.5	74.7	-5.9	74.7	-5.9	0.0	75.8	-4.7	75.8	-4.7	0.0
L06-0242	74.4	80.8	79.5	-1.3	76.9	-3.9	-2.6	81.6	0.8	80.1	-0.7	-1.5
L06-0245	75.1	80.9	79.5	-1.3	77.1	-3.8	-2.4	81.6	0.7	80.7	-0.1	-0.8
L06-0250	75.2	81.4	79.7	-1.7	77.2	-4.2	-2.5	81.7	0.3	80.6	-0.8	-1.1
L06-0260	75.3	81.5	79.7	-1.8	77.3	-4.2	-2.4	81.7	0.2	80.8	-0.7	-0.9
L06-0270	75.4	81.3	79.7	-1.6	77.4	-4.0	-2.4	81.8	0.5	81.0	-0.4	-0.8
L06-0280	75.9	82.9	79.8	-3.2	77.8	-5.1	-1.9	81.8	-1.1	82.0	-1.0	0.2
L06-0290	75.9	83.3	79.9	-3.3	77.9	-5.4	-2.0	82.1	-1.2	82.0	-1.2	-0.1
L06-0292	76.4	82.8	79.9	-2.8	78.6	-4.2	-1.3	82.1	-0.7	82.8	0.0	0.7
L06-0294	76.4	83.3	80.0	-3.3	78.6	-4.7	-1.3	82.1	-1.2	82.9	-0.4	0.8
L06-0300	76.8	83.2	80.0	-3.2	79.3	-4.0	-0.7	82.1	-1.1	83.2	0.0	1.1
L06-0310	77.0	84.0	85.6	1.6	79.7	-4.3	-5.9	86.9	2.9	83.7	-0.3	-3.2
L06-0340	68.3	77.1	74.1	-3.0	73.5	-3.6	-0.5	76.2	-0.9	75.2	-1.9	-1.0
L06-0350	69.1	78.1	74.5	-3.6	73.8	-4.3	-0.7	76.6	-1.5	75.6	-2.5	-1.0
L06-0360	70.0	79.1	74.6	-4.6	73.8	-5.3	-0.7	76.7	-2.4	75.7	-3.5	-1.0
L06-0361	70.0	79.1	74.3	-4.9	73.3	-5.8	-0.9	76.6	-2.5	75.1	-4.0	-1.6
L06-0380	70.9	76.7	75.6	-1.1	74.5	-2.2	-1.2	78.6	1.8	77.3	0.6	-1.2
L06-0390	71.7	78.8	75.7	-3.1	74.6	-4.2	-1.1	78.6	-0.2	77.7	-1.1	-0.9
L06-0390D	73.5	78.5	--	--	74.8	-3.7	--	--	--	77.7	-0.8	--
L06-0390E	74.0	78.0	--	--	75.1	-2.9	--	--	--	77.7	-0.3	--
L06-0390F	74.0	78.0	--	--	74.9	-3.1	--	--	--	77.7	-0.3	--
L06-0400	72.5	78.2	76.7	-1.5	75.0	-3.2	-1.8	79.7	1.5	78.2	0.0	-1.6
L06-0430	69.7	81.8	76.9	-4.8	75.5	-6.2	-1.4	79.8	-2.0	78.3	-3.5	-1.5
L06-0432	69.8	81.8	77.0	-4.8	75.6	-6.2	-1.4	79.9	-1.9	78.4	-3.4	-1.5
L06-0433	71.2	80.4	76.8	-3.6	75.6	-4.8	-1.2	79.8	-0.6	78.3	-2.1	-1.5
L06-0434	72.2	80.5	76.8	-3.7	75.8	-4.7	-1.0	79.8	-0.7	78.5	-2.0	-1.4
L06-0435	72.0	80.2	76.8	-3.4	75.2	-5.0	-1.6	79.8	-0.4	78.2	-2.0	-1.5
L06-0436	73.3	80.4	77.4	-3.0	76.7	-3.7	-0.6	80.2	-0.2	78.6	-1.8	-1.6
L06-0438	73.7	79.5	80.1	0.7	80.1	0.6	-0.1	81.0	1.5	81.0	1.5	0.0
L06-0460	71.4	80.5	77.1	-3.4	76.7	-3.7	-0.3	79.9	-0.5	78.7	-1.8	-1.2
L06-0480	71.5	80.8	77.1	-3.7	76.9	-3.9	-0.2	79.9	-0.9	78.8	-2.0	-1.1
L06-0490	72.0	81.0	77.1	-3.9	77.0	-4.0	-0.1	79.9	-1.1	78.9	-2.1	-1.0
L06-0492	72.0	81.1	77.6	-3.6	77.0	-4.1	-0.6	80.8	-0.3	78.9	-2.2	-1.8
L06-0500	72.8	81.5	77.6	-3.9	77.1	-4.4	-0.5	80.8	-0.7	79.1	-2.4	-1.7
L06-0502	72.8	81.0	77.7	-3.2	77.1	-3.9	-0.6	81.0	0.1	79.1	-1.9	-1.9
L06-0510	73.9	82.7	77.9	-4.7	77.5	-5.2	-0.5	81.1	-1.6	79.8	-2.9	-1.2
L06-0520	74.0	82.8	78.9	-3.9	77.5	-5.3	-1.4	81.5	-1.3	79.8	-3.0	-1.7
L07-0040	70.7	78.7	75.2	-3.5	74.8	-3.9	-0.4	76.8	-1.9	76.5	-2.2	-0.3
L07-0041	70.7	81.4	75.2	-6.2	74.8	-6.6	-0.4	76.8	-4.6	76.5	-4.9	-0.3
L07-0042	70.3	80.2	74.2	-5.9	74.8	-5.4	0.5	76.8	-3.4	76.4	-3.8	-0.4
L07-0043	70.3	80.2	74.1	-6.1	74.8	-5.4	0.7	76.8	-3.4	76.4	-3.8	-0.4
L07-0050	71.1	80.0	76.5	-3.4	75.1	-4.9	-1.4	76.9	-3.1	77.5	-2.4	0.7

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L07-0060	71.2	79.6	80.6	1.0	75.3	-4.3	-5.3	81.9	2.3	77.9	-1.7	-4.1
L07-0061	73.3	78.3	79.2	0.9	74.7	-3.6	-4.4	79.3	1.0	77.0	-1.4	-2.3
L-070061N	74.0	79.2	--	--	74.8	-4.4	--	--	--	77.1	-2.1	--
L07-0062	71.4	79.6	80.6	1.0	75.3	-4.3	-5.3	81.9	2.3	78.4	-1.2	-3.5
L07-0064	71.5	79.1	79.5	0.4	75.3	-3.8	-4.2	80.4	1.3	78.4	-0.6	-1.9
L07-0068	72.5	79.8	79.2	-0.6	74.0	-5.7	-5.2	79.3	-0.5	75.6	-4.2	-3.7
L07-0070	72.2	80.0	79.5	-0.5	75.7	-4.3	-3.8	80.4	0.4	78.7	-1.3	-1.6
L07-0080	72.3	80.1	80.3	0.3	75.7	-4.3	-4.6	81.4	1.4	78.8	-1.3	-2.6
L07-0100	75.0	81.0	79.8	-1.1	79.7	-1.3	-0.1	81.3	0.4	81.0	0.1	-0.3
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1	0.0	80.6	-11.1	80.6	-11.1	0.0
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8	0.0	80.6	7.8	80.6	7.8	0.0
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	64.1	-6.7	-0.9	67.2	-3.5	66.2	-4.5	-1.0
L08-0012	60.5	70.8	64.9	-5.8	64.1	-6.7	-0.9	67.2	-3.5	66.3	-4.5	-0.9
L08-0020	60.9	71.2	64.9	-6.3	64.2	-7.0	-0.8	67.2	-3.9	66.3	-4.8	-0.9
L08-0030	61.0	71.2	64.9	-6.3	64.2	-7.0	-0.7	67.2	-4.0	66.4	-4.8	-0.8
L08-0040	61.4	71.7	64.9	-6.8	64.6	-7.2	-0.4	67.3	-4.5	66.5	-5.2	-0.8
L08-0050	61.6	71.8	64.9	-6.9	64.8	-7.1	-0.2	67.3	-4.5	66.9	-4.9	-0.5
L08-0060	62.5	72.8	65.6	-7.2	65.6	-7.2	0.0	67.4	-5.3	67.2	-5.5	-0.2
L09-0010	67.5	75.5	73.0	-2.5	72.6	-2.9	-0.4	75.5	0.1	74.3	-1.2	-1.3
L09-0040	73.1	77.3	75.2	-2.1	75.2	-2.1	0.0	75.9	-1.4	75.9	-1.4	0.0
L09-0050	72.9	77.3	75.4	-2.0	75.4	-2.0	0.0	76.1	-1.2	76.1	-1.2	0.0
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0	77.6	-4.6	77.6	-4.6	0.0
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0	85.4	3.3	85.4	3.3	0.0
L11-0020	79.6	85.6	81.1	-4.6	80.8	-4.8	-0.2	84.5	-1.1	83.8	-1.8	-0.7
L11-0030	79.6	85.6	87.1	1.4	87.1	1.5	0.0	88.6	3.0	88.6	2.9	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.4	-2.0	0.0	80.8	0.5	80.0	-0.4	-0.9
L13-0020	77.6	79.9	80.4	0.5	80.4	0.5	0.0	81.1	1.3	81.1	1.3	0.0
L15-0010	71.9	77.2	73.4	-3.7	73.7	-3.5	0.3	75.8	-1.4	75.0	-2.2	-0.7
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0	80.7	3.6	80.7	3.5	0.0
MC0010	50.7	59.9	56.3	-3.6	56.0	-3.9	-0.3	59.9	0.0	59.6	-0.3	-0.3
MC0020	50.7	59.9	56.3	-3.6	56.0	-3.9	-0.3	59.9	0.0	59.6	-0.3	-0.3
MC0030	51.1	60.3	56.6	-3.7	56.3	-4.0	-0.3	60.1	-0.2	59.8	-0.5	-0.3
MC0040	51.4	59.7	56.7	-3.0	56.3	-3.4	-0.4	60.5	0.8	60.1	0.4	-0.4
MC0050	51.5	60.1	56.9	-3.3	56.5	-3.6	-0.4	60.6	0.5	60.2	0.1	-0.4
MC0060	51.5	60.1	56.9	-3.3	56.5	-3.6	-0.4	60.7	0.5	60.2	0.1	-0.4
MC0070	52.2	64.1	57.1	-7.0	56.7	-7.4	-0.4	60.8	-3.3	60.3	-3.8	-0.4
MC0080	52.4	61.1	57.1	-4.1	56.7	-4.4	-0.4	60.8	-0.3	60.4	-0.8	-0.5
MC0090	53.3	63.2	58.3	-4.8	58.0	-5.1	-0.3	61.7	-1.5	61.2	-2.0	-0.5
MC0100	53.2	62.2	58.4	-3.9	58.0	-4.2	-0.3	61.7	-0.5	61.2	-1.0	-0.5
MC0110	54.3	63.6	59.9	-3.7	59.6	-4.0	-0.3	63.1	-0.6	62.5	-1.1	-0.5
MC0120	54.4	66.8	60.0	-6.8	59.6	-7.1	-0.3	63.1	-3.6	62.6	-4.2	-0.5
MC0130	54.2	64.0	60.3	-3.7	59.8	-4.2	-0.4	63.4	-0.6	62.8	-1.2	-0.6
MC0140	53.9	64.1	60.3	-3.8	59.9	-4.3	-0.4	63.4	-0.7	62.8	-1.3	-0.6
MC0150	57.2	68.6	62.5	-6.1	61.8	-6.8	-0.7	65.3	-3.3	64.6	-4.0	-0.7
MC0160	57.2	68.7	62.6	-6.2	61.8	-6.9	-0.7	65.3	-3.4	64.6	-4.1	-0.7
MC0170	57.9	69.2	63.0	-6.1	62.3	-6.9	-0.8	65.7	-3.4	65.0	-4.2	-0.8
MC0172	58.1	69.3	63.2	-6.1	62.4	-6.9	-0.8	65.9	-3.5	65.1	-4.2	-0.8
MC0174	58.2	69.3	63.2	-6.1	62.4	-6.9	-0.8	65.9	-3.5	65.1	-4.3	-0.8
MC0176	58.2	69.4	63.2	-6.1	62.4	-7.0	-0.8	65.9	-3.5	65.1	-4.3	-0.8
MC0178	58.2	69.4	63.2	-6.1	62.4	-7.0	-0.8	65.9	-3.5	65.1	-4.3	-0.8
MC0180	58.8	69.7	63.6	-6.1	62.8	-7.0	-0.9	66.2	-3.5	65.3	-4.4	-0.8
MC0190	58.8	69.7	63.6	-6.1	62.8	-6.9	-0.9	66.2	-3.5	65.4	-4.4	-0.9
MC0200	59.3	70.8	64.2	-6.6	63.4	-7.5	-0.9	66.7	-4.2	65.7	-5.1	-0.9
MC0210	58.5	70.2	64.3	-5.9	63.4	-6.8	-0.9	66.7	-3.5	65.7	-4.4	-0.9
MC0220	60.1	70.4	64.9	-5.5	64.1	-6.3	-0.9	67.2	-3.2	66.2	-4.2	-1.0
MC0230	61.4	70.9	66.8	-4.1	65.9	-5.0	-0.9	68.8	-2.1	67.5	-3.4	-1.3
MC0240	61.4	70.9	66.8	-4.1	65.9	-5.0	-0.9	68.9	-2.0	67.6	-3.3	-1.4
MC0250	60.6	71.1	67.7	-3.4	66.3	-4.8	-1.4	69.7	-1.4	68.1	-3.1	-1.7
MC0260	61.1	71.5	68.8	-2.6	66.8	-4.7	-2.0	70.8	-0.7	68.7	-2.8	-2.1
MC0270	61.2	70.5	68.9	-1.6	67.4	-3.1	-1.5	70.9	0.5	69.3	-1.2	-1.6
MC0280	62.2	71.4	69.6	-1.9	68.0	-3.4	-1.5	71.4	0.0	70.0	-1.4	-1.4
MC0282	62.2	71.5	69.7	-1.8	68.1	-3.4	-1.6	71.5	0.0	70.1	-1.4	-1.4
MC0290	62.3	71.5	70.4	-1.1	68.4	-3.1	-1.9	73.5	2.0	70.4	-1.1	-3.1
MC0292	62.8	71.9	71.3	-0.6	68.7	-3.2	-2.6	73.9	2.0	70.7	-1.2	-3.2
MC0296	63.3	71.6	71.6	0.0	69.0	-2.6	-2.6	74.1	2.5	71.0	-0.6	-3.1
MC0298	63.3	71.6	71.6	0.0	69.0	-2.5	-2.5	74.1	2.5	71.0	-0.6	-3.1
MC0300	63.5	73.3	71.6	-1.6	69.2	-4.1	-2.5	74.1	0.8	71.1	-2.2	-3.0
MC0310	63.5	72.5	71.7	-0.8	69.5	-3.0	-2.2	74.3	1.8	71.3	-1.1	-2.9
MC0320	64.0	74.7	71.7	-3.0	69.8	-5.0	-2.0	74.3	-0.5	71.6	-3.1	-2.7
MC0330	64.1	71.6	72.0	0.4	70.1	-1.5	-1.9	75.0	3.4	71.9	0.3	-3.1
MC0340	64.2	72.5	72.1	-0.4	70.2	-2.3	-1.9	75.0	2.6	71.9	-0.5	-3.1
MC0350	64.3	72.8	72.1	-0.7	70.5	-2.3	-1.6	75.1	2.3	72.2	-0.7	-3.0
MC0360	64.8	75.5	72.2	-3.2	70.7	-4.7	-1.5	75.2	-0.2	72.3	-3.1	-2.9
MC0370	64.9	75.5	72.2	-3.3	71.0	-4.5	-1.2	75.2	-0.3	73.2	-2.3	-2.1
MC0380	65.8	74.7	72.3	-2.4	71.3	-3.3	-1.0	75.3	0.6	73.4	-1.3	-1.9
MC0390	66.6	73.5	72.4	-1.1	71.9	-1.6	-0.5	75.3	1.8	73.8	0.3	-1.5
MC0400	66.6	74.8	72.4	-2.4	72.0	-2.8	-0.4	75.3	0.5	73.9	-1.0	-1.4
MC0410	67.3	78.7	72.9	-5.8	72.5	-6.1	-0.4	75.5	-3.2	74.2	-4.5	-1.3
MC0420	67.5	77.2	73.0	-4.2	72.6	-4.6	-0.4	75.5	-1.7	74.3	-2.9	-1.3
MC0422	67.6	77.2	73.1	-4.2	72.6	-4.6	-0.4	75.6	-1.7	74.3	-2.9	-1.3
MC0430	69.1	77.2	73.4	-3.8	73.6	-3.6	0.3	75.7	-1.5	75.0	-2.2	-0.8
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0	81.4	1.5	81.4	1.5	0.0
MC0440	69.2	76.0	73.4	-2.6	73.7	-2.3	0.3	75.8	-0.2	75.2	-0.8	-0.7
MC0450	69.9	78.1	73.7	-4.3	74.2	-3.8	0.5	76.0	-2.1	75.5	-2.6	-0.5
MC0451	69.5	77.4	73.6	-3.8	74.0	-3.4	0.4	75.9	-1.5	75.3	-2.0	-0.6
MC0460	69.9	77.3	74.1	-3.3	74.8	-2.6	0.7	76.7	-0.6	76.3	-1.0	-0.3
MC0461	70.1	77.6	74.2	-3.4	74.8	-2.8	0.6	76.7	-0.9	76.4	-1.2	-0.3
MC0462	71.1	77.4	74.2	-3.2	74.8	-2.6	0.6	76.7	-0.7	76.5	-0.9	-0.3
MC0463	71.3	76.7	74.2	-2.5	74.8	-1.9	0.6	76.7	0.0	76.8	0.1	0.1
MC0464	71.7	78.6	74.2	-4.4	74.9	-3.7	0.6	76.8	-1.8	77.4	-1.2	0.6
MC0470	70.4	78.7	74.5	-4.2	74.9	-3.8	0.4	76.8	-1.9	76.4	-2.3	-0.4
MC0480	70.5	77.5	74.7	-2.8	75.2	-2.3	0.5	77.3	-0.2	76.9	-0.6	-0.3
MC0490	70.9	78.3	75.6	-2.7	75.3	-3.0	-0.3	77.7	-0.6	77.0	-1.3	-0.7
MC0500	71.0	78.4	75.8	-2.7	75.8	-2.6	0.0	78.2	-0.2	78.0	-0.5	-0.3
MC0510	71.5	80.2	76.8	-3.5	75.9	-4.3	-0.8	78.7	-1.5	78.0	-2.2	-0.7

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0520	71.6	81.1	77.1	-4.0	76.2	-4.9	-0.9	79.9	-1.1	78.6	-2.5	-1.4
MC0530	72.0	81.3	77.1	-4.2	76.2	-5.1	-0.9	79.9	-1.4	78.6	-2.7	-1.4
MC0540	72.0	81.4	77.3	-4.1	76.8	-4.6	-0.5	80.7	-0.7	79.8	-1.6	-0.9
MC0545	72.4	81.7	77.6	-4.1	76.9	-4.8	-0.7	80.8	-0.9	79.8	-1.8	-1.0
MC0550	72.9	81.9	77.9	-4.0	76.9	-5.0	-1.0	80.9	-1.0	79.8	-2.1	-1.0
MC0560	73.0	82.0	78.1	-3.9	77.3	-4.7	-0.8	81.4	-0.5	80.4	-1.6	-1.0
MC0570	73.5	82.1	78.3	-3.8	77.3	-4.8	-1.0	81.5	-0.6	80.4	-1.7	-1.1
MC0580	73.6	82.1	78.5	-3.7	77.6	-4.5	-0.8	81.9	-0.2	81.0	-1.2	-0.9
MC0590	75.0	82.9	79.3	-3.6	78.0	-4.9	-1.3	82.2	-0.8	81.0	-1.9	-1.2
MC0600	75.0	83.0	79.5	-3.4	78.2	-4.7	-1.3	82.7	-0.3	81.3	-1.6	-1.4
MC0610	75.5	83.2	79.7	-3.5	78.6	-4.6	-1.1	82.7	-0.5	81.3	-1.9	-1.4
MC0620	75.6	83.9	79.9	-4.0	79.0	-5.0	-1.0	83.3	-0.6	81.9	-2.0	-1.4
MC0630	75.1	83.2	80.0	-3.1	79.3	-3.8	-0.7	83.3	0.2	82.0	-1.1	-1.3
MC0640	75.3	83.3	80.1	-3.2	79.4	-3.9	-0.7	83.4	0.1	82.1	-1.2	-1.3
MC0642	76.2	83.8	80.1	-3.7	79.5	-4.3	-0.6	83.4	-0.4	82.1	-1.7	-1.3
MC0650	77.1	84.3	80.9	-3.4	80.6	-3.8	-0.3	84.5	0.2	83.8	-0.5	-0.7
MC0660	76.2	83.7	80.1	-3.6	79.4	-4.3	-0.7	83.3	-0.4	82.0	-1.7	-1.3
MC0662	76.3	83.8	80.6	-3.2	80.3	-3.5	-0.3	84.7	0.9	84.0	0.2	-0.6
MC0670	78.0	84.8	80.9	-3.9	80.7	-4.0	-0.2	84.7	-0.1	84.1	-0.7	-0.6
WIC0005	50.5	56.7	57.0	0.4	57.1	0.5	0.1	59.7	3.0	59.4	2.8	-0.3
WIC0010	50.9	60.3	58.7	-1.6	58.8	-1.5	0.1	61.2	0.9	60.9	0.6	-0.4
WIC0020	50.9	58.9	58.8	-0.1	58.8	0.0	0.1	61.3	2.5	60.9	2.1	-0.4
WIC0030	51.8	59.4	59.4	0.0	59.5	0.1	0.1	61.9	2.5	61.5	2.1	-0.4
WIC0032	52.5	60.1	59.9	-0.2	60.0	0.0	0.1	62.4	2.3	62.0	2.0	-0.3
WIC0034	54.1	61.4	60.9	-0.5	61.1	-0.3	0.2	63.3	1.9	63.0	1.6	-0.3
WIC0040	54.9	62.1	61.3	-0.9	61.5	-0.7	0.2	63.6	1.5	63.3	1.2	-0.3

In Table 9-5:

- The nodes with over 1-foot of freeboard are not shaded any color
- The nodes with less than 1-foot of freeboard are shaded green
- The nodes with up to 1-foot of flooding are shaded yellow
- The nodes with one to two feet of flooding are shaded red
- The nodes with over two feet of flooding depth are shaded purple
- An increase in water level over existing conditions is shaded gray

Overall, the improvements reduce the water levels for both the 10-year and 100-year storms. At some nodes water levels increase, but have freeboard of 1 foot or more, which is acceptable. A few nodes, however, experience increased water levels in an already flooded or near flooded condition. These increased water levels are categorized and are described below:

Increased Water Level and More Than 1 Foot of Freeboard

This category includes nodes where the water levels increases for either the 10-year or 100-year storm but have more than 1 foot of freeboard, which is acceptable.

For the 10-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- L02-0287 – Located at Pennington Road and part of the Pennington Ranch Storm Drain System. The water level at this node increases by 0.1 feet but has a freeboard of 5.7 feet, well within the 10-year storm requirement of 1 foot of freeboard.
- L07-0042, L07-0043 – Located at Pennington Road north of J Street. The water levels at these nodes increase by 0.5 feet and 0.7 feet, respectively, but both have a freeboard of 5.4 feet, well within the 10-year storm requirement of 1 foot of freeboard.
- L15-0010 – Located at Archer Avenue east of the existing City area. The water level at this node increases by 0.3 feet but has a freeboard of 3.5 feet, well within the 10-year storm requirement of 1 foot of freeboard.
- MC0430, MC0440 – Located at Archer Avenue on the Main Canal. The water levels at these nodes increase by 0.3 feet, but have a freeboard of 3.6 feet and 2.3 feet, well within the 10-year storm requirement of 1 foot of freeboard.
- MC0450, MC0451, MC0460, MC0461, MC0462, MC0463, MC0464, MC0470, MC0480, MC0490 – Located along the Main Canal from Cooley Road to Archer Avenue. The water levels at these nodes increase by 0.2 feet to 0.5 feet, respectively, but have a freeboard of 2.1 feet to 4.0 feet, well within the 10-year storm requirement of 1 foot of freeboard.

For the 100-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- L07-0050 – Located on Pennington Road east of Main Canal. The water level at this node increases by 0.7 feet, but has a freeboard of 2.4 feet. This node is also part of one of the proposed storm drain systems for Alternative 2.
- MC0464 – Part of the Orchard Way storm drain system that discharges to the Main Canal. The water level at this node increases by 0.6 feet over existing conditions, but has a freeboard of 1.2 feet.

Increased Water Level but Within City Storm Drain Criteria

This category includes nodes where water levels increase for 100-year storm, but result in no more than minor flooding of streets where there is an urban storm drain system. Even though water levels increase, the storm drain freeboard criteria for the 10-year storm are met, and some ponding of water in the streets in the 100-year storm is allowed.

For the 100-year storm, these nodes include:

- L02-0472 – Upstream node of Albert Street storm drain located south of Apricot Street. The water level in this node increases by 0.1 feet bring the flooding water depth to 0.1 feet during the 100-year storm. This amount of minor flooding is acceptable for a 100-year storm in an urban storm drain system. Notably, the water level at the downstream node, L02-0471, decreases by 0.2 feet from existing conditions.
- L06-0280, L06-0292, L06-0294, L06-0300 – Located along the Alternative 2 storm drain system on Larkin Road. The water levels in these nodes increase by 0.2 feet to 1.1 feet during the 100-year storm, resulting in a freeboard of at least 0 to 1 foot. Under Alternative 2, these nodes are part of an urban storm drain system, and these freeboards are acceptable for the 100-year storm.
- MC0463 – Part of the Orchard Way storm drain system that discharges to the Main Canal. The water level at this node increases by 0.1 feet over existing conditions, resulting in a flood depth of 0.1 foot. This amount of minor flooding is acceptable for a 100-year storm in an urban storm drain system. Notably, the water level at the downstream node, MC0462, decreases by 0.3 feet from existing conditions.

Increased Water Level and Increased Flooding

This category includes nodes where the water levels increase over an existing flooded condition.

- WIC0005 – Located at the downstream end of the West Intercepting Canal, about 0.5 miles upstream from the East Intercepting Canal. For the 10-year storm, the water level at WIC0005 increases bringing the flooded water depth from 0.2 feet to 0.5 feet. The upstream water levels decrease and the downstream water levels remain the same. This is due to the boundary condition used in the model at the downstream end at the East Intercepting Canal. For the 10-year model and 100-year storm models, a “full channel” water level is used as the boundary condition. Because upstream flooding has been reduced, the downstream boundary condition controls the water level at WIC0005. If a lower water level was used for the 10-year storm model, the water level at WIC0005 would be below the channel top and flooding would not increase.

COST ESTIMATES

The construction and capital costs for each of the channel/basin systems discussed above are presented in Table 9-6. As shown, the estimated total construction cost is $37.6 million and the estimated capital cost is $59.2 million. The following assumptions were made for the preparation of the cost estimate:

- Within the future buildout area, the excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks. Outside of the future buildout are, excavated dirt will be disposed offsite.
- All land will be purchased (versus easements) at a cost of $50,000 per acre for land within the City's 2030 General Plan Planning Area and at a cost of $25,000 per acre for land outside the City's Planning Area.
- RCP will be constructed to convey drainage flow where the constructed channel crosses existing irrigation canals; however, an equivalent oval or arch pipe may be used.

Buildout of the general plan includes development of 3,375 acres. Alternative 2 results in an overall cost of $17,546 per acre.

Table 9-6. Cost Estimate for Alternative 2

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
1. Main Canal Improvement				
Site Preparation (Clear and Grub)	acre	500	59.2	29,600
Channel Excavation (on-site)	CY	4	122,800	491,200
Channel Excavation (off-site)	CY	15	74,200	1,113,000
Landscape and Erosion Control	acre	2,000	45.9	91,894
30-Inch RCP	feet	180	304	54,720
36-Inch RCP	feet	216	236	50,976
48-Inch RCP	feet	288	419	120,672
60-Inch RCP	feet	330	754	248,820
72-Inch RCP	feet	360	1,506	542,160
Headwalls	each	8,000	36	288,000
Headwalls at Irrigation Canal	each	16,000	2	32,000
Aggregate Base Access Road	feet	20	28,775	575,497
Fencing	feet	16	57,550	920,795
Mobilization/demobilization (at 5 percent)				227,970
Construction Contingency (at 20 percent)				911,870
Estimated Construction Cost				5,699,170
Land/Easements (for channel)	acre	50,000	30.2	1,510,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				2,279,700
Estimated Capital Cost				9,489,400
2. Larkin Road Storm Drain System and Diversion to Main Canal				
12-Inch RCP	feet	72	1,140	82,080
36-Inch RCP	feet	216	2,354	508,464
48-Inch RCP	feet	288	2,717	782,496
60-Inch RCP	feet	330	2,523	832,679
Maintenance Holes	each	6,000	19	114,000
Drain Inlets	each	5,000	38	190,000
Mobilization/demobilization (at 5 percent)				125,490
Construction Contingency (at 20 percent)				501,940
Estimated Construction Cost				3,137,150
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,254,900
Estimated Capital Cost				4,392,100
3. Pennington Road Storm Drain				
12-Inch RCP	feet	72	300	21,600
60-Inch RCP	feet	330	2,154	710,744
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				40,620
Construction Contingency (at 20 percent)				162,470
Estimated Construction Cost				1,015,430
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				406,200
Estimated Capital Cost				1,421,600
4. Lateral 5 Storm Drain				
12-Inch RCP	feet	72	360.0	25,920
48-Inch RCP	feet	288	2,566	739,008
Maintenance Holes	each	6,000	6	36,000
Drain Inlets	each	5,000	12	60,000
Mobilization/demobilization (at 5 percent)				43,050
Construction Contingency (at 20 percent)				172,190
Estimated Construction Cost				1,076,170
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				430,500
Estimated Capital Cost				1,506,700
5. Lateral 6 North of Diversion Channel				
Site Preparation (Clear and Grub)	acre	500	12	6,050
Channel Excavation (on-site)	CY	4	16,600	66,400
Landscape and Erosion Control	acre	2,000	3.7	7,333
48-Inch RCP	feet	288	2,128	612,864
72-Inch RCP	feet	360	100	36,000
Maintenance Holes	each	6,000	9	54,000
Drain Inlets	each	5,000	18	90,000
Headwalls	each	8,000	2	16,000
Aggregate Base Access Road	feet	20	2,308	46,160
Fencing	feet	16	4,616	73,856
Mobilization/demobilization (at 5 percent)				50,430
Construction Contingency (at 20 percent)				201,730
Estimated Construction Cost				1,260,820
Land/Easements (for channel)	acre	50,000	2.4	122,200
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				504,300
Estimated Capital Cost				1,887,300
6. Diversion Channel				
Site Preparation (Clear and Grub)	acre	500	29.9	14,950
Channel Excavation (on-site)	CY	4	200,100	800,400
Landscape and Erosion Control	acre	2,000	24.1	48,200
30-Inch RCP	feet	180	120	21,600
48-Inch RCP	feet	288	580	167,040
Headwalls	each	8,000	16	128,000
Aggregate Base Access Road	feet	20	24	482
Fencing	feet	16	48	771
Mobilization/demobilization (at 5 percent)				59,070
Construction Contingency (at 20 percent)				236,290
Estimated Construction Cost				1,461,850
Land/Easements (for channel)	acre	50,000	29.9	1,495,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				584,700
Estimated Capital Cost				3,541,600

Table 9-6. Cost Estimate for Alternative 2

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
7. Lateral 2 Channel Widening				
Site Preparation (Clear and Grub)	acre	500	35.7	17,850
Channel Excavation (on-site)	CY	4	67,900	271,600
Channel Excavation (off-site)	CY	15	92,800	1,392,000
Landscape and Erosion Control	acre	2,000	28.6	57,113
60-Inch RCP	feet	330	580	191,400
72-Inch RCP	feet	360	460	165,600
Headwalls	each	8,000	8	64,000
Headwalls at Irrigation Canal	each	16,000	2	32,000
Aggregate Base Access Road	each	20	23,100	462,000
Fencing	each	16	38,858	621,729
Mobilization/demobilization (at 5 percent)				163,760
Construction Contingency (at 20 percent)				655,060
Estimated Construction Cost				4,076,260
Land/Easements (for channel)	acre	50,000	20.4	1,018,900
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,630,500
Estimated Capital Cost				6,725,700
8. Paseo Road Improved Channel and Culverts				
Site Preparation (Clear and Grub)	acre	500	6.6	3,300
Channel Excavation (on-site)	CY	4	17,330	69,320
Landscape and Erosion Control	acre	2,000	4.7	9,451
36-Inch RCP	feet	216	1,500	324,000
Headwalls	each	8,000	8	64,000
Aggregate Base Access Road	feet	20	4,036	80,720
Fencing	feet	16	8,072	129,152
Mobilization/demobilization (at 5 percent)				34,000
Construction Contingency (at 20 percent)				135,990
Estimated Construction Cost				846,630
Land/Easements (for channel)	acre	25,000	3.3	83,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				338,700
Estimated Capital Cost				1,268,800
9. Lateral 2 Improved Channel and Culverts at Township Road				
Site Preparation (Clear and Grub)	acre	500	7.8	3,900
Channel Excavation (on-site)	CY	4	20,270	81,080
Landscape and Erosion Control	acre	2,000	5.6	11,179
36-Inch RCP	feet	216	200	43,200
48-Inch RCP	feet	288	200	57,600
Headwalls	each	8,000	8	64,000
Aggregate Base Access Road	feet	20	4,850	97,000
Fencing	feet	16	9,700	155,200
Mobilization/demobilization (at 5 percent)				25,660
Construction Contingency (at 20 percent)				102,630
Estimated Construction Cost				641,450
Land/Easements (for channel)	acre	50,000	1.0	47,900
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				256,600
Estimated Capital Cost				946,000
10. Detention Basin				
Site Preparation (Clear and Grub)	acre	500	89.0	44,518
Channel Excavation (off-site)	CY	15	13,110.0	196,650
Basin Excavation	CY	15	926,890	13,903,344
Landscape and Erosion Control	acre	2,000	84.6	169,216
36-Inch RCP	feet	216	100	21,600
36-Inch Flap Gate	each	4,900	1	4,900
Headwalls	each	8,000	2	16,000
Aggregate Base Access Road	each	20	7,572	151,436
Fencing	each	16	15,144	242,297
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				737,550
Construction Contingency (at 20 percent)				2,950,190
Estimated Construction Cost				18,438,700
Land/Easements (for channel)	acre	25,000	3.3	82,500
Land/Easements (for Basin)	acre	25,000	85.7	2,143,412
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				7,375,500
Estimated Capital Cost				28,040,100
Total Estimated Construction Cost				37,653,600
Total Land/Easement Cost				6,503,900
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				15,061,400
Total Estimated Capital Cost				59,218,900

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent
Costs are for June 2009 (20 City Average ENRCCI of 8,578).

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RIVIERA RD

UPRR

2 LARKIN ROAD STORM DRAIN

5 LATERAL 6 NORTH OF DIVERSION CHANNEL

1 MAIN CANAL IMPROVEMENT

BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

LUTHER RD

LARKIN RD

CAMPBELL RD

MAHAUGH RD

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 12'
SIDE SLOPE: 4H:1V

6 DIVERSION CHANNEL

COOLEY RD

DIVERSION TO MAIN CANAL

KOLA ST

GARDEN GLEN DIVISION

3 PENNINGTON RD STORM DRAIN

BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

PENNINGTON RD

TOWNSHIP RD

DEREE RD

PENNINGTON RD

TWIN 60"

ARCHER AVE

BOTTOM WIDTH: 15'
SIDE SLOPE: 4H:1V

APRICOT ST

SINNARD AVE

SHELDON AVE

FEATHER RIVER

INLET WEIR

WWTP

48" & EX 72"x72" BOX

7 LATERAL 2 IMPROVEMENT

9 LATERAL 2 IMPROVED CHANNEL AT TOWNSHIP RD

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 20'
SIDE SLOPE: 4H:1V

4 LATERAL 5 IMPROVEMENTS

8 PASEO RD IMPROVEMENTS

TWIN 72"

PASEO AVE

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 6'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 20'
SIDE SLOPE: 4H:1V

99

SIPHON CHANNEL UNDER EXISTING IRRIGATION CANAL

10 DETENTION BASIN
82.0 ACRES
485 AC-FT

1 MAIN CANAL IMPROVEMENT

7 LATERAL 2 IMPROVEMENT

INLET CHANNEL
BOTTOM WIDTH: 10'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH:15'
SIDE SLOPE: 4H:1V

BOTTOM WIDTH: 12'
SIDE SLOPE: 4H:1V

SIPHON CHANNEL UNDER EXISTING IRRIGATION CANAL

INLET CHANNEL
BOTTOM WIDTH: 5'
SIDE SLOPE: 4H:1V

36" OUTLET PIPE WITH FLAPGATE

ALT2_DB

N

0 1000 2000
SCALE IN FEET

LEGEND

- CITY LIMITS
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL
- PROPOSED STORM DRAIN
- (1) IMPROVEMENT IDENTIFICATION

Figure 9-1

City of Live Oak
Master Drainage Study
ALTERNATIVE 2

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 10. ALTERNATIVE 3

Alternative 3 includes diverting flows from the Northeast Quadrant of the City to the Feather River, joint use detention basins, joint use open channels, and installation of large storm drains in the future development areas. Alternative 3 also includes the construction of five detention basins. The modeling of Alternative 3 also includes the improvements presented in Chapter 6 to solve the existing flooding problems.

Under Alternative 3, drainage facilities within build out areas will provide flood protection and recreational uses. For example, detention basins will have side slopes that allow the basin to be used as a park during the dry weather. The channels will be wide with low side slopes and will be densely vegetated. They will also have pedestrian/bike paths adjacent to the channel that will also provide maintenance access.

The proposed improvements are shown on Figure 10-1. The improvements are grouped into the following nine sections as shown on Figure 10-1:

1. Main Canal Improvement and Diversion to East Basin
2. East Detention Basin
3. Lateral 5 Improvement
4. South Detention Basin
5. Lateral 6 Improvements and Diversion to North Detention Basin
6. North Detention Basin and Luther Road Storm Drain
7. Caltrans Property Detention Basin
8. Lateral 2 Improvements from the Apricot Street Pump Station to the Caltrans Site Detention Basin to Paseo Road
9. West Detention Basin

The details for the improvement alternatives are shown in Table 10-1. The details include new storm drain or channel inverts, sizes, and materials. Each of the groups of improvements is discussed in the following sections.

As discussed below, this project includes minor increases in water levels in Lateral 4. These increases would be eliminated with annual maintenance of the channel funded through City drainage fees. Maintenance would include channel vegetation removal and culvert sediment removal.

Table 10-1. Alternative 3 Improvement Details

Link Name	US Node Name	DS Node Name	Type	No. Barrels	US Invert Elevation (ft)	DS Invert Elevation (ft)	Roughness	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Sideslope _H:1V	Right-hand Sideslope _H:1V
1. Main Canal Improvement and Diversion Channel to East Basin												
MC0600A	MC0600	MC0590	Circular	1	75.64	75.60	0.015	84	3.0	--	--	--
MC0590A	MC0590	MC0580	Trapezoidal	1	75.60	74.52	0.1	2,015	5.9	10	6	6
MC0580A	MC0580	MC0570	Circular	1	74.52	74.48	0.015	80	3.0	--	--	--
MC0570A	MC0570	MC0560	Trapezoidal	1	74.48	74.07	0.1	759	6.3	10	6	6
MC0560A	MC0560	MC0550	Circular	1	74.07	74.01	0.015	120	3.0	--	--	--
MC0550A	MC0550	MC0545	Trapezoidal	1	74.01	73.62	0.1	721	6.3	10	6	6
MC0545A	MC0545	MC0540	Trapezoidal	1	73.62	73.33	0.1	535	6.7	10	6	6
MC0540A	MC0540	MC0530	Circular	1	73.33	73.29	0.015	80	3.0	--	--	--
MC0530A	MC0530	MC0520	Trapezoidal	1	73.29	72.99	0.1	569	6.4	10	6	6
MC0520A	MC0520	MC0510	Circular	1	72.99	72.99	0.015	150	3.0	--	--	--
MC0510A	MC0510	MC0500	Trapezoidal	1	72.99	72.30	0.1	1,764	6.1	10	6	6
MC0500A	MC0500	MC0490	Circular	2	72.36	72.30	0.015	120	3.5	--	--	--
MCDIV	MC0490	MC0491	Trapezoidal	1	72.20	72.10	0.1	2,795	6.4	10	6	6
MC0491A	MC0491	EBSN	Circular	1	72.10	72.00	0.015	548	5.0	--	--	--
2. East Detention Basin												
Epump	EBSN	L07-0100	Pump	1	--	--	--	--	--	--	--	--
3. Lateral 5 Storm Drain										--	--	--
L05-0050A	L05-0050	L05-0040	Circular	1	66.62	66.50	0.015	120	4.0	--	--	--
L05-0040A	L05-0040	L05-0020	Circular	1	66.50	66.37	0.015	130	4.0	--	--	--
L05-0020A	L05-0020	L05-0014	Circular	1	66.37	65.95	0.015	411	4.0	--	--	--
L05-0014A	L05-0014	L05-0012	Circular	1	65.95	65.71	0.015	332	5.0	--	--	--
L05-0012A	L05-0012	L05-0010	Circular	1	65.71	65.57	0.015	159	5.0	--	--	--
L05-0010B	L05-0010	SBSN	Circular	1	65.57	65.50	0.015	764	5.0	--	--	--
4. South Detention Basin												
MC0330F	MC0330	MC0320	Circular	1	65.36	65.35	0.015	100	4.5	--	--	--
Cal_Weir	L02-0450	CBSN	Weir	1	--	--	--	--	--	--	--	--
CBSN_out	CBSN	L02-0441	Circular	1	69.30	69.00	0.015	134	2.0	--	--	--
5. Lateral 6 Improvements and Diversion to North Detention Basin												
L06-0520A	L06-0520	L06-0510	Circular	1	73.61	73.59	0.015	40	5.5	--	--	--
L06-0510A	L06-0510	L06-0502	Circular	1	73.59	72.81	0.015	1,556	5.5	--	--	--
L06-0502A	L06-0502	L06-0500	Circular	1	72.81	72.80	0.015	20	6.0	--	--	--
L06-0500A	L06-0500	L06-0492	Circular	1	72.80	72.23	0.015	1,141	6.0	--	--	--
L06-0492A	L06-0492	L06-0490	Circular	1	72.23	72.21	0.015	30	6.0	--	--	--
L06-0490A	L06-0490	L06-0480	Circular	1	72.21	71.88	0.015	656	6.0	--	--	--
L06-0480F	L06-0480	L06-0460	Rectangular	1	71.88	71.78	0.015	177	6.0	--	--	--
L06-0460AF	L06-0460	L06-0462	Rectangular	2	71.78	71.66	0.015	250	6.0	--	--	--
L06-0462A	L06-0462	L06-0463	Trapezoidal	1	71.66	71.64	0.1	785	6.6	10	6	6
L06-0463A	L06-0463	NBSN	Trapezoidal	1	71.64	71.50	0.1	1,300	6.5	10	6	6
L06-0432B	L06-0432	L06-0463	Circular	1	74.50	71.64	0.015	876	4.5	--	--	--
6. North Detention Basin and Storm Drain												
NBSN_out	NBSN	L02-0530	Circular	1	71.50	71.20	0.015	554	2.0	--	--	--
L02-0530A	L02-0530	L02-0523	Circular	1	71.20	70.41	0.015	1,940	3.0	--	--	--
L02-0523A	L02-0523	L02-0522	Circular	1	70.41	70.40	0.015	10	3.0	--	--	--
L020518AA	L02-0518A	L02-0300	Circular	1	68.78	68.73	0.015	72	2.5	--	--	--
7. Caltrans Property Detention Basin												
Cal_Weir	L02-0450	CBSN	Weir	1	--	--	--	--	--	--	--	--
CBSN_out	CBSN	L02-0441	Circular	1	69.30	69.00	0.015	134	2.0	--	--	--
8. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road												
L02-0450UA	L02-0450U	L02-0450	Trapezoidal	1	66.53	66.28	0.100	630	7.1	10	6	6
L02-0450A	L02-0450	L02-0440U	Trapezoidal	1	66.28	65.88	0.100	352	7.4	10	6	6
24orif	L02-0440U	L02-0441	Orifice	1	--	--	--	--	--	--	--	--
L02-0440UA	L02-0441	L02-0440	Circular	1	65.88	65.62	0.015	653	5.0	--	--	--
L02-0440A	L02-0440	L02-0430	Circular	1	65.62	65.30	0.015	801	5.0	--	--	--
L02-0430A	L02-0430	L02-0253	Circular	1	65.30	64.56	0.015	1,862	6.0	--	--	--
L02-0253A	L02-0253	L02-0252	Circular	1	64.56	64.35	0.015	532	6.0	--	--	--
L02-0252A	L02-0252	L02-0250	Circular	1	64.35	63.55	0.015	2,003	6.0	--	--	--
L02-0250A	L02-0250	L02-0240	Circular	1	63.55	62.95	0.015	1,511	6.0	--	--	--
9. West Detention Basin												
WBSN_WEIR	L02-0240	WBSN	Circular	1	--	--	--	--	--	--	--	--
WBSN_OUT	WBSN	L01-0240	Circular	1	64.40	63.89	0.015	200	3.0	--	--	--

MODIFIED HYDROLOGY

To develop Alternative 3, it was necessary to redirect several subsheds to be tributary to different or new model nodes. Presented in Table 10-2 are the subsheds that were redirected and the nodes to which they are tributary, the subshed size, and the impervious percentage for the buildout condition. Subsheds not listed in Table 10-2 are unchanged from Table 7-3.

Table 10-2. Summary of Redirected Subsheds

Subshed	Tributary Node	Area, acres	Percent Impervious
L02-0530	NBSN[(a)]	249.8	58
L02-0522	NBSN	103.3	30
L06-0460	L06-0462	102.1	33
L02-0440	CBSN[(b)]	62.27	26
L06-0430	NBSN	42	26
L02-0310	L02-0510A	49.6	40
L02-0304	L02-0518A	40.5	31
L06-0290	MC0550	50.8	43
L01-0290[(e)]	L02-0240	167.8	30
L02-0253	L02-0450	129.8	42
L02-0240	WBSN[(c)]	37.3	37
L06-0240	MC0510	77.1	41
L06-0230	MC0510	47.3	35
L02-0220	WBSN[(a)]	52.3	21
L06-0220	MC0510	73.75	43
L06-0310	MC0600	68.6	10
L06-0200	MC0510	21.2	62
L02-0180	L02-0250	56.8	56
L02-0160	WBSN	74.7	35
L02-0140	WBSN	35.1	29
L07-0080	EBSN[(d)]	54.1	1
L07-0062	EBSN	14.83	29
L07-0060	MC0491	101	29
MC0464(2)	MC0510	10.2	56

(a) NBSN – North Detention Basin
(b) CBSN – Caltrans Property Detention Basin
(c) WBSN – West Detention Basin
(d) EBSN – East Detention Basin
(e) L01-0290 was divided into developed and undeveloped areas. The build out area is tributary to L02-0240 for Alternative 3.

DETENTION BASIN DATA

The model nodes NBSN, WBSN, CBSN, SBSN, and EBSN refer to the North Detention Basin, West Detention Basin, Caltrans Property Detention Basin, South Detention Basin, and East Detention Basin, respectively. Summaries of the detention basin data are shown in Tables 10-3 and 10-4. Summaries of the detention basin results are also shown in Table 10-3.

1. MAIN CANAL IMPROVEMENT AND DIVERSION TO EAST BASIN

A portion of the Main Canal from the north boundary of the build out area to Metter Road will be improved to provide flood protection, recreation, and wildlife habitat. Native California vegetation will be planted, requiring minimal maintenance. The bottom width of the dual-purpose channel will be 10 feet. The channel will also have side slopes of 6H:1V (horizontal: vertical). There will be pedestrian/bike paths on both sides of the channel which will also provide maintenance access. The build out areas west and east of the Main Canal will drain directly to the improved Main Canal, eliminating the need for a large trunk drain along Larkin Road.

To convey the increased flow to the East Basin, parallel 42-in culverts would be constructed where the Main Canal meets the diversion channel to the East Basin (Model nodes MC0500 to MC0490). The flow continuing south in the Main Canal would be limited by constructing an 18-in low flow orifice in the canal. Excess flows will be diverted east via a dual-purpose channel with a bottom width of 10 feet and side slopes of 6H:1V to the East Detention Basin. The new channel will provide flow conveyance and detention storage.

2. EAST DETENTION BASIN

The runoff from the Northeast Quadrant of the City will be diverted to the Feather River. The East Detention Basin will be designed as a dual-purpose basin, providing both flood protection and recreational uses. The basin sides will be gentle, 10H:1V, eliminating the need for fencing and allowing the basin bottom to function as a park. The basin surface area will be divided into two portions; with a deep section about 3 feet lower than the upper area. The deepest part of the basin will have a depth of 6 feet. The basin will be drained by a 20 cfs pump station that will discharge to the Feather River. The elevation area data used in the model are shown in Table 10-4. The flow would be pumped through a 36-in force main. The 100-year peak runoff inflow to the East Detention Basin is 15 cfs and the 100-year peak inflow from the west via the inlet pipe is 57 cfs. The East Detention Basin will detain 38.2 acre-feet of runoff during the 100-year storm.

3. LATERAL 5 IMPROVEMENT

A section of Lateral 5 will be in developed areas in the future build out land use conditions. Alternative 1 includes the construction of a 48-inch to 60-inch storm drain from east of Highway 99 to the South Detention Basin.

Table 10-3. Detention Basin Summary

	North Detention Basin NBSN		East Detention Basin EBSN		Caltrans Property Detention Basin CBSN		South Detention Basin SBSN		West Detention Basin WBSN	
Inlet Data										
Type	Trapezoidal Channel		Trapezoidal Channel		Side Flow Weir		Side Flow Weir		Inlet Weir	
Weir Length (ft)	-		-		240		50		250	
Weir Spill Crest Elev. (ft)	-		-		70.0		69.5		67.5	
Storm Drain Size (in dia.)	-		60		-		60		-	
Bottom width of Channel (ft)	10.0		-		-		-		-	
Outlet Data[(a)]										
Type	Pipe		Pump Station		Pipe		Pipe		Pipe	
Size	18-inch RCP		20 cfs		24-in RCP		24-in RCP		36-in RCP	
Results Data										
	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year
Peak WSE (ft)	78.1	76.6	78.5	76.6	73.5	71.8	71.2	68.4	69.9	68.2
Peak Storage (ac-ft)	152.4	77.0	19.2	7.2	38.2	14.7	144.5	76.4	205.4	115.0
Runoff to Node (cfs)	420	278	15	10	82	59	-	-	593	458
Channel Inflow (cfs)	305	174	-	-	-	-	-	-	-	-
Weir Inflow (cfs)	-	-	-	-	357	171	248	130	238	159
Pipe Inflow (cfs)	-	-	60		-	-	105	85	-	-
Pipe Outflow (cfs)	16	14	-	-	17	15	9	4	13[(b)]	17

(a) The basin would be graded to drain to the outlet culverts or pump station.
(b) During the 100-year storm, the channel downstream of the outlet pipe is nearly full, causing a backwater condition in the discharge pipe. As a result, the 100-year discharge is less than the 10-year discharge from the West Detention Basin.

Table 10-4. Alternative 3 Detention Basin Elevation/Area/Storage

Caltrans Property Detention Basin (CBSN)			
Elevation	Depth	Area, ac	Stor, af
69.3	0.0	0.0	0.0
69.8	0.5	6.4	1.6
72.3	3.0	7.1	18.5
72.8	3.5	18.2	24.8
75.3	6.0	21.4	74.2
75.3	6.0	25.5	74.2
West Detention Basin (WBSN)			
Elevation	Depth	Area, ac	Stor, af
64.4	0.0	0.0	0.0
64.9	0.5	26.7	6.7
67.4	3.0	30.6	78.3
67.9	3.5	51.9	98.9
70.4	6.0	55.7	233.5
70.9	6.5	56.5	261.6
70.9	6.5	66.9	261.6
East Detention Basin (EBSN)			
Elevation	Depth	Area, ac	Stor, af
74.0	0.0	0.0	0.0
74.5	0.5	2.8	0.7
77.0	3.0	3.5	8.5
77.5	3.5	7.3	11.2
80.0	6.0	8.6	31.0
North Detention Basin (NBSN)			
Elevation	Depth	Area, ac	Stor, af
71.5	0	0.0	0
72.0	0.5	3.6	0.9
73.5	2.0	4.3	6.8
74.0	2.5	23.0	13.6
76.5	5.0	25.9	74.7
77.0	5.5	51.8	94.1
79.5	8.0	55.4	228.1
79.5	8.0	64.3	228.1
South Detention Basin (SBSN)			
Elevation	Depth	Area, ac	Stor, af
65.5	0.0	0.0	0.0
66.0	0.5	23.7	5.9
72.0	6.5	25.4	153.2
72.5	7.0	26.0	166.0
72.5	7.0	28.0	166.0

4. SOUTH DETENTION BASIN

The South Detention Basin will be constructed to mitigate the increased flows from 122 acres of developed area downstream of the existing City. The South Detention Basin is located south of the Paseo Avenue and west of Highway 99. The Lateral 5 storm drain will empty directly into the South Detention Basin. As shown in Table 10-3, 248 cfs from the Main Canal will flow to the South Detention Basin via the inlet weir, and 105 cfs will flow to the South Detention Basin via the storm drain pipe coming from the east. The capacity in the Paseo Road culvert will be increased with a 54-in RCP constructed in parallel with the existing 48-in CMP. The South Detention Basin will store 144.5 acre-feet during the 100-year storm. The peak 100-year outflow through the 24-inch outlet pipe is 9 cfs.

5. LATERAL 6 AND DIVERSION TO NORTH DETENTION BASIN

These facilities include the construction of a 60-inch storm drain and box culverts that convey flow under Highway 99 and the railroad. A 6 feet x 5 feet box culvert will be constructed in parallel to the existing box culvert at Highway 99. The storm drain system will cross Highway 99 in the existing and future 6 feet x 5 feet box culverts, cross under the railroad in twin 6 feet x 5 feet box culverts, and transition into a trapezoidal channel with a bottom width of 10 feet and side slopes of 6H:1V. There will also be a 54-inch storm drain that crosses under the railroad that drains the developed area between Highway 99 and the railroad. This storm drain will drain to the constructed channel, which drains to the North Detention Basin.

6. NORTH DETENTION BASIN AND LUTHER ROAD STORM DRAIN

The North Detention Basin will be located in the Northeast Quadrant of the City north of the future Garden Glen Development (north of Pennington Road). The basin will drain through an existing trunk storm drain in Luther Road. This existing trunk drain consists of 48-, 54-, and 60-inch diameter pipes that were constructed for the future Garden Glen Development. The trunk drain will be extended with a segment of 36-inch storm drain.

The North Detention Basin will detain 152.4 acre-ft during the 100-year design storm. This detention basin will drain through an 18-inch pipe segment that discharges to the new 36-in trunk drain. Flow from the Garden Glen Development and the discharge from the North Detention Basin will be constricted by a segment of 30-inch storm drain south of Pennington Road. This constriction will back water up through the trunk storm drain and force it into the North Detention Basin. The 100-year peak runoff inflow to the North Detention Basin is 420 cfs, and the 100-year peak channel inflow from the east is 305 cfs. The peak flow out of the basin is 16 cfs. The elevation area data used in the model are shown in Table 10-4.

7. CALTRANS PROPERTY DETENTION BASIN

The Caltrans Property Detention Basin is located on property once owned by Caltrans and is downstream of the Apricot Street Pump Station. The Caltrans Property Detention Basin will take 21.4 acres of the 26 acre parcel. The channel to the north and west of the basin will be designed to provide detention storage, with a bottom width of 10 feet and gentle side slopes of 6H:1V. The elevation area data used in the model are shown in Table 10-4. Storm flows will enter the Caltrans Property Detention Basin via a 240-foot long inlet weir located on the north side of the basin. A 100-year peak flow over the weir of 357 cfs and 82 cfs of runoff flow from surrounding developed areas will enter Caltrans Property Detention Basin, resulting in 100-year peak storage of 38.2 ac-ft. The Caltrans Property Detention Basin will be emptied by a 24-inch pipe to the adjacent storm drain system.

8. LATERAL 2 IMPROVEMENTS FROM THE APRICOT STREET PUMP STATION TO THE CALTRANS SITE DETENTION BASIN TO PASEO ROAD

For build out conditions, the water levels upstream of the pump station increase under the existing operation of the Apricot Street pump station. There are two 30 cfs pumps in the Apricot Street pump station. For Alternative 3, the "on" elevation of the second pump was changed from 73.0 feet to 71.5 feet. This minor adjustment in the pump station operations sufficiently lowered the water levels in the upstream storm drains to existing conditions levels.

The flow in the channel will be constricted downstream of the Caltrans Property Detention Basin with a 24-inch orifice, causing storm water to backup the channel and flow over the weir into the basin. Downstream of the restrictive 24-inch culvert to Paseo Avenue, the existing Lateral 2 channel will be replaced with a 60-inch to 72-inch storm drain.

9. WEST DETENTION BASIN

Runoff from the development in the southwest corner of the build out area will drain to the West Detention Basin. The West Detention Basin is an offline detention basin with a 100-year peak inflow over the inlet weir of 238 cfs and a 100-year peak tributary runoff from adjacent developed areas of 593 cfs. The West Detention Basin will store 205.4 acre-feet during the 100-year storm. The outlet consists of a 36-inch RCP culvert that discharges downstream of the Paseo Road culverts. The water levels at agricultural land near the development will decrease. The elevation area data for the West Detention Basin are shown in Table 10-4.

COMPARISON WITH EXISTING CONDITIONS

The overall performance of the City's storm drain system and RD 777's channels with the Alternative 3 improvements is summarized in Table 10-5 and discussed below. In Table 10-5:

- The nodes with over 1-foot of freeboard are not shaded any color.
- The nodes with less than 1-foot of freeboard are shaded green.
- The nodes with up to 1-foot of flooding are shaded yellow.
- The nodes with one to two feet of flooding are shaded red.

- The nodes with over two feet of flooding depth are shaded purple.
- The nodes where there is an increase in water surface elevations for Alternative 3 over existing conditions are shaded gray.

Overall, the improvements reduce the water levels for both the 10-year and 100-year storms. However, at some nodes water levels increase, but have freeboard of 1 foot or more, which is acceptable. Also, few nodes experience increased water levels in an already flooded or near flooded condition. These increased water levels are categorized and are described below:

Increased Water Level and More Than 1 Foot of Freeboard

This category includes nodes where the water levels increases for either the 10-year or 100-year storm but have more than 1 foot of freeboard, which is acceptable.

For the 10-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- EIC0100, EIC0110, EIC0120, EIC0130, EIC0140, EIC0150 – Located on the East Intercepting Canal. The water levels at these nodes increase by 0.2 to 0.3 feet but have a freeboard of 2.0 to 7.0 feet.
- L03-0040, L03-0050, L03-0060, L03-0062, L03-0070, L03-0080, L03-0090, L03-0092 – Located along Lateral 3 downstream of the South Detention Basin and downstream of future build out growth areas. The water levels at these nodes increase by 0.2 feet but have 2.6 to 4.6 feet of freeboard, well within the 10-year storm requirement of 1 foot freeboard.
- L04-0064, L04-0070, L04-0080, L04-0088 – Located on Lateral 4 downstream of the South Detention Basin and downstream of future build out growth areas. The water level at these nodes increase by 0.1 feet to 0.2 feet but have a freeboard of 1.6 to 3.6 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0432 – Located at Highway 99 and part of the improved storm drain system. The water level at this node increases by 0.3 feet, but has a freeboard of 4.5 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0436 – Located on Ramsdell Drive. The water level at this node increases by 1.2 feet but has a freeboard of 1.8 feet, well within the 10-year storm requirement of 1 foot of freeboard.
- L06-0460, L06-0480, L06-0490– Located on Lateral 6 and part of improved storm drain system. The water levels at these nodes increase by 0.2 feet to 0.3 feet, but have freeboards 3.2 feet to 3.6 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L07-0042, L07-0043 – Located along the storm drain on Pennington Road near J Street. The water levels at these nodes increase by 0.1 feet and 0.3 feet, but have freeboards of 5.9 and 5.8 feet, well within the 10-year storm requirement of 1 foot freeboard.

- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.1 feet. These nodes are on the river side of the levee.
- L15-0010 – Located at Archer Avenue. The water level at this node increases by 0.1 feet but has freeboard of 3.7 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L08-0060 – Located on Lateral 8 downstream of future build out areas. The water level at this node increased by 0.1 feet but has a freeboard of 7.1 feet.
- L09-0010, L09-0040, L09-0050 – Located on Lateral 9 that discharges to the Main Canal. The water levels at these nodes increase by 0.1 to 0.3 feet but have freeboards of 1.9 to 2.2 feet.
- L13-0010 – Located on a lateral that discharges to the Main Canal in the north section of future build out areas. The water level at this node increases by 0.2 feet, but has 1.7 feet of freeboard.
- MC0410, MC0420, MC0422, MC0430, MC0440, MC0450, MC0451, MC0460, MC0462, MC0463, MC0464, MC0470, MC0480, MC0490, MC0500, MC0510, MC0520,MC0530, MC0540, MC0545 – Located along the Main Canal and part of the improved channel. The water levels at these nodes increase by 0.1 feet to 0.4 feet, but have a freeboard of 1.6 feet to 5.6 feet, well within the 10-year storm requirement of 1 foot freeboard.

For the 100-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- EIC0120, EIC0130 – Located on the East Intercepting Canal upstream of the West Intercepting Canal. The water levels at these nodes increase by 0.1 feet but have 3.6 feet and 1.3 feet of freeboard.
- L02-0239, L02-0244, L02-0290, L02-0291, L02-0292 – Located in the Pennington Ranch development. The water levels at these nodes increase but have one foot of freeboard or more.
- L02-0300 – Located in the open channel downstream of the Garden Glen Division Development. The water level at this node increased by 0.7 feet, but has a freeboard of 3.1 feet.
- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.1 feet. These nodes are on the river side of the levee.
- L07-0050 – Located Pennington Road and Sinnard Avenue. The water level at this node increases by 0.1 feet, but has a freeboard of 3.0 feet.
- L08-0050, L08-0060 – Located on Lateral 8 downstream of build out areas. The water levels at these nodes increase by 0.1 feet but have a freeboard of 4.4 feet and 5.2 feet, respectively.
- L09-0040, L09-0050 – On Lateral 9 and tributary to the Main Canal. The water levels at these nodes increase by 0.2 feet, but have a freeboard of 1.0 to 1.2 feet.

Increased Water Level but Within City Storm Drain Criteria

This category includes nodes where water levels increase for the 100-year storm, but result in no more than minor flooding of streets where there is an urban storm drain system. Even though water levels increase, the storm drain freeboard criteria for the 10-year storm are met, and some ponding of water in the streets in the 100-year storm is allowed.

For the 100-year storm, these nodes include:

- L02-0278, L02-0279 – Part of the Pennington Ranch storm drain system. The water level in these nodes increase by 0.3 to 0.4 feet bring the flooding water depth up to 0.5 feet during the 100-year storm. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system. Notably, the water level at the downstream nodes, L02-0247, decreases by 0.1 feet from existing conditions.
- L02-0283, L02-0284, L02-0286, L02-0293– Part of the Pennington Ranch storm drain system. The water level in theses node increase by up to 0.7 feet bringing the flooded water level up to 0.6 feet. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system and has more than 1 foot freeboard during the 10-year storm.
- L02-0430, L02-0440 – On Lateral 2 near the Caltrans Property Detention Basin. The water levels at these nodes increase due to the restrictive orifice in Lateral 2. The freeboards are 0.4 feet and 0.5 feet. When new growth occurs in this area, the ground elevation should be raised with dirt from the Caltrans Property Detention Basin to ensure 1 foot of freeboard in the channel during the 100 year storm.
- L02-0502, L02-0506, L02-0510, L02-0517 – Part of the P Street storm drain system. The water level at these node increase by up to 1.4 feet over existing conditions, but have a freeboard of 0.0 feet to 0.9 feet, which is acceptable for a 100-year storm.
- MC0490, MC0500 – Located on the Main Canal at the restrictive orifice to divert flow to the East Detention Basin. The water levels increase by up to 0.9 feet, resulting in 0.3 feet of flooding in the channel. The developed area at this location would need to be built up to ensure 1 foot of freeboard in the channel during the 100-year storm.
- L02-0471- Located on the storm drain along N Street and part of an urban storm drain system. The water level at this node increases by 0.1 feet, but has a freeboard of 02. feet, which is acceptable during a 100-year storm.
- L02-0517 – Located on the storm drain on Fir Street. The water level at this node increases by 1.0 feet, which results in 0 feet of freeboard. Notably the downstream node does not change over existing.

Increased Water Level and Increased Flooding

This category includes nodes where the water levels increase over an existing flooded condition.

- L03-0080 – Located on Lateral 3 downstream of future build out areas and upstream of a CMP culvert. The water level at this nodded increases by 0.1 feet, resulting in a flooding level of 0.1 feet. Even though flow coming from built out areas are reduced and peak water surface elevations are reduced downstream, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. This minor increase in water surface elevation could be mitigated with improved channel maintenance funded by City storm drain fees.
- L04-0066, L04-0068 – Located on Lateral 4 downstream of future build out areas. These nodes increase by 0.1 to 0.2 feet, resulting in up to 0.3 feet of flooding. Even though flow coming from built out areas are reduced and peak water surface elevations are reduced downstream, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. This minor increase in water surface elevation could be mitigated with improved channel maintenance funded by City storm drain fees.
- EIC0040, EIC0050, EIC0060, EIC0070, EIC0075, EIC0080, EIC0090, EIC0100, EIC0110, EIC0140, EIC0150 – Located at the downstream end of the East Intercepting Canal. For the 100-year storm, the water levels at these nodes increase by 0.1 feet. See discussion below.
- WIC0005, WIC0010, WIC0020, WIC0030, WIC0032, WIC0034, WIC0040 – Located at the downstream end of the West Intercepting Canal just upstream of the East Intercepting Canal. For the 10-year storm, the water level at WIC0005 increases bringing the flooded water depth from 0.2 feet to 0.5 feet. The upstream water levels decrease and the downstream water levels remain the same. This is due to the boundary condition used in the model at the downstream end of the East Intercepting Canal. For the 10-year model and 100-year storm models, a "full channel" water level is used as the boundary condition. Because upstream flooding has been reduced, the downstream boundary condition controls the water level at WIC0005. If a lower water level was used for the 10-year storm model, the water level at WIC0005 would be below the channel top and there would not be increased flooding. For the 100-year storm, the water levels at these nodes increase by 0.1 feet. Even though flow coming from built out areas are reduced, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. These minor increases of water levels would be mitigated with improved channel maintenance along the East Intercepting Canal and West Intercepting Canal. Also, raising the bank elevations along these channels would ensure a foot of freeboard or more during the 100-year storm.

Table 10-5. Node Data and Model Results for Alternative 3

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
NBSN	71.5	79.5	--	--	76.6	-2.9	--	--	--	78.1	-1.4	--
CBSN	69.3	75.3	--	--	71.8	-3.5	--	--	--	73.5	-1.8	--
SBSN	65.0	72.5	--	--	68.4	-4.1	--	--	--	71.2	-1.3	--
EBSN	71.0	80.0	--	--	76.6	-3.4	--	--	--	78.5	-1.5	--
WBSN	64.4	70.9	--	--	68.2	-2.7	--	--	--	69.9	-1.0	--
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.8	55.0	-0.7	0.0
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.7	55.1	-0.7	0.0
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.3	0.1
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.4	0.3	0.1
EIC0060	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.3	57.2	-0.3	0.1
EIC0070	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.4	57.2	-0.3	0.1
EIC0075	47.2	57.9	54.8	-3.0	54.9	-3.0	0.0	57.4	-0.4	57.6	-0.3	0.1
EIC0080	48.1	58.5	54.9	-3.6	54.9	-3.6	0.0	57.5	-1.0	57.6	-0.9	0.1
EIC0090	48.2	58.6	54.9	-3.7	54.9	-3.7	0.0	57.5	-1.1	57.6	-1.0	0.1
EIC0100	50.1	57.8	55.6	-2.3	55.8	-2.0	0.3	59.1	1.3	59.2	1.4	0.1
EIC0110	50.2	59.2	55.6	-3.7	55.8	-3.4	0.3	59.1	-0.1	59.2	0.0	0.1
EIC0120	50.3	63.1	55.9	-7.2	56.1	-7.0	0.2	59.4	-3.6	59.5	-3.6	0.1
EIC0130	50.0	60.8	55.9	-4.9	56.1	-4.7	0.2	59.4	-1.3	59.5	-1.3	0.1
EIC0140	50.0	59.2	56.0	-3.2	56.2	-3.0	0.2	59.6	0.4	59.7	0.5	0.1
EIC0150	49.8	58.6	56.0	-2.6	56.2	-2.4	0.2	59.6	1.0	59.7	1.1	0.1
L01-0090	59.5	70.1	65.7	-4.4	65.6	-4.4	-0.1	67.3	-2.7	66.9	-3.1	-0.4
L01-0100	59.2	69.7	65.8	-4.0	65.7	-4.1	-0.1	67.4	-2.3	67.0	-2.8	-0.4
L01-0110	60.1	68.3	66.3	-2.1	66.1	-2.3	-0.2	67.8	-0.5	67.3	-1.0	-0.5
L01-0120	59.9	68.3	66.3	-2.0	66.1	-2.2	-0.2	67.9	-0.4	67.3	-1.0	-0.6
L01-0170	58.9	69.0	66.3	-2.7	66.1	-2.9	-0.2	67.9	-1.1	67.4	-1.6	-0.6
L01-0180	58.7	67.5	66.6	-0.9	66.3	-1.2	-0.3	68.4	0.9	67.6	0.1	-0.8
L01-0190	60.2	68.6	67.0	-1.6	66.5	-2.1	-0.4	68.7	0.1	67.8	-0.9	-0.9
L01-0200	61.4	69.5	67.2	-2.3	66.7	-2.8	-0.5	68.8	-0.7	67.8	-1.7	-1.0
L01-0210	61.3	69.4	67.4	-2.0	66.8	-2.6	-0.6	69.1	-0.3	67.9	-1.4	-1.2
L01-0220	62.4	71.4	67.9	-3.5	67.0	-4.4	-0.9	69.4	-2.0	68.0	-3.3	-1.3
L01-0230	62.4	69.9	70.7	0.8	67.7	-2.2	-3.0	72.9	3.0	69.5	-0.4	-3.4
L01-0240	63.9	70.5	70.9	0.4	68.1	-2.4	-2.8	72.9	2.5	69.7	-0.7	-3.2
L01-0250	65.0	71.3	70.9	-0.4	68.1	-3.2	-2.8	73.0	1.6	69.8	-1.6	-3.2
L01-0260	65.2	71.4	72.8	1.4	70.0	-1.4	-2.8	74.6	3.2	72.0	0.6	-2.6
L01-0270	65.3	71.5	72.8	1.4	70.0	-1.5	-2.8	74.6	3.1	72.0	0.5	-2.6
L01-0280	65.5	71.6	73.1	1.5	70.2	-1.3	-2.9	74.8	3.2	72.3	0.8	-2.5
L01-0290	67.6	72.4	73.1	0.6	70.4	-2.1	-2.7	74.8	2.4	72.3	-0.1	-2.5
L01-0300	67.9	73.2	73.1	-0.1	70.4	-2.8	-2.7	74.8	1.6	72.3	-0.8	-2.5
L01-0310	67.3	73.4	73.1	-0.3	70.4	-3.0	-2.7	74.8	1.4	72.3	-1.0	-2.5
L01-0320	66.9	73.5	73.1	-0.4	70.4	-3.1	-2.7	74.8	1.3	72.3	-1.1	-2.5
L01-0330	67.0	74.1	73.1	-1.0	70.4	-3.7	-2.7	74.8	0.7	72.3	-1.7	-2.5
L01-0340	69.9	72.6	73.1	0.5	70.4	-2.3	-2.7	74.8	2.2	72.3	-0.3	-2.5
L02-0010	55.4	63.3	62.0	-1.3	62.4	-0.9	0.4	64.2	0.9	64.2	1.0	0.0
L02-0020	55.5	63.5	62.2	-1.3	62.7	-0.9	0.4	64.4	0.9	64.5	1.0	0.0
L02-0030	55.1	63.7	62.2	-1.4	62.7	-1.0	0.4	64.5	0.8	64.5	0.8	0.0
L02-0032	55.9	64.3	63.1	-1.1	63.4	-0.8	0.3	65.2	0.9	65.1	0.8	-0.1
L02-0040	56.8	65.0	64.2	-0.8	64.4	-0.6	0.2	66.2	1.2	66.0	1.0	-0.2
L02-0042	57.0	65.3	64.6	-0.7	64.7	-0.6	0.1	66.5	1.2	66.2	1.0	-0.2
L02-0044	57.1	65.4	64.7	-0.7	64.8	-0.6	0.1	66.5	1.2	66.3	0.9	-0.2
L02-0050	59.7	70.4	65.5	-4.9	65.5	-4.9	0.0	67.1	-3.2	66.8	-3.6	-0.3
L02-0060	60.2	66.9	66.7	-0.1	65.5	-1.4	-1.2	68.3	1.4	66.8	0.0	-1.5
L02-0064	60.3	66.2	67.8	1.6	67.3	1.1	-0.5	69.6	3.4	69.1	2.9	-0.5
L02-0070	58.9	65.5	67.8	2.3	67.3	1.8	-0.5	69.6	4.1	69.1	3.6	-0.5
L02-0080	59.3	66.0	68.2	2.2	67.9	1.9	-0.3	70.3	4.3	70.0	4.0	-0.2
L02-0086	59.2	68.9	68.2	-0.7	67.9	-1.0	-0.3	70.3	1.3	70.0	1.1	-0.2
L02-0088	59.4	68.9	68.3	-0.7	68.0	-0.9	-0.3	70.3	1.4	70.1	1.2	-0.2
L02-0090	62.5	68.2	68.3	0.1	68.0	-0.2	-0.3	70.3	2.2	70.1	1.9	-0.2
L02-0095	62.7	68.6	68.3	-0.3	68.0	-0.6	-0.3	70.4	1.8	70.2	1.5	-0.2
L02-0100	62.7	69.6	68.4	-1.2	68.1	-1.4	-0.3	70.5	1.0	70.3	0.7	-0.3
L02-0102	64.2	68.8	68.5	-0.3	68.2	-0.6	-0.3	70.6	1.8	70.3	1.5	-0.3
L02-0104	64.2	69.0	68.9	-0.1	68.4	-0.6	-0.5	71.0	2.1	70.5	1.6	-0.5
L02-0106	64.0	68.5	68.9	0.4	68.4	-0.1	-0.5	71.1	2.5	70.6	2.0	-0.5
L02-0108	64.1	68.6	69.7	1.1	68.9	0.3	-0.8	72.0	3.4	71.1	2.5	-0.9
L02-0110	64.9	69.5	69.7	0.2	68.9	-0.6	-0.8	72.0	2.5	71.1	1.6	-0.9
L02-0120	64.4	71.4	70.1	-1.3	69.1	-2.3	-0.9	72.5	1.1	71.4	0.0	-1.1
L02-0130	66.2	71.5	70.1	-1.4	69.1	-2.4	-1.0	72.5	1.0	71.4	-0.1	-1.1
L02-0140	66.1	72.0	70.2	-1.8	--	--	--	72.6	0.6	--	--	--
L02-0150	66.5	71.2	70.2	-1.0	--	--	--	72.6	1.5	--	--	--
L02-0160	66.0	71.3	70.4	-0.8	--	--	--	73.0	1.7	--	--	--
L02-0170	68.0	73.3	70.4	-2.9	--	--	--	73.0	-0.3	--	--	--
L02-0180	68.3	70.7	73.5	2.8	--	--	--	74.5	3.8	--	--	--
L02-0190	66.9	71.1	70.2	-0.9	68.8	-2.2	-1.3	72.5	1.4	71.3	0.2	-1.2
L02-0200	66.5	70.9	70.9	0.0	68.1	-2.8	-2.8	72.9	2.1	69.7	-1.1	-3.2
L02-0210	64.0	70.5	70.9	0.4	68.1	-2.4	-2.8	72.9	2.5	69.7	-0.7	-3.2
L02-0220	63.7	71.1	70.9	-0.2	68.1	-3.0	-2.8	72.9	1.9	69.7	-1.3	-3.2
L02-0230	62.9	70.4	70.9	0.5	68.1	-2.3	-2.8	73.0	2.5	69.8	-0.6	-3.2
L02-0237	67.1	75.2	72.7	-2.5	72.3	-2.9	-0.4	73.9	-1.3	73.0	-2.2	-0.9
L02-0238	67.4	75.0	72.7	-2.3	72.3	-2.7	-0.4	73.9	-1.1	73.1	-1.9	-0.8
L02-0239	67.7	75.4	72.7	-2.7	72.5	-2.9	-0.3	73.9	-1.5	74.4	-1.0	0.5
L02-0240	63.0	69.5	71.1	1.6	68.2	-1.2	-2.9	73.2	3.7	69.9	0.4	-3.3
L02-0243	68.3	75.4	72.7	-2.7	72.4	-3.0	-0.3	73.9	-1.5	73.8	-1.6	-0.1
L02-0244	68.9	75.5	72.7	-2.8	72.4	-3.1	-0.3	73.9	-1.6	74.5	-1.0	0.6
L02-0246	67.8	75.0	72.7	-2.3	72.4	-2.6	-0.3	73.9	-1.1	73.2	-1.8	-0.8
L02-0247	68.0	75.2	72.7	-2.5	72.5	-2.7	-0.2	73.9	-1.3	73.8	-1.4	-0.1
L02-0250	63.6	72.7	71.1	-1.6	69.3	-3.4	-1.8	73.2	0.5	70.5	-2.2	-2.7
L02-0252	64.4	73.2	72.5	-0.8	71.2	-2.1	-1.3	73.7	0.5	72.5	-0.7	-1.2
L02-0253	64.6	73.9	72.7	-1.2	71.5	-2.4	-1.1	73.8	-0.1	72.8	-1.1	-1.0
L02-0254	66.1	73.9	72.7	-1.2	72.1	-1.8	-0.6	73.8	-0.1	72.8	-1.1	-1.0
L02-0255	66.9	74.2	72.7	-1.5	72.3	-2.0	-0.4	73.9	-0.4	72.9	-1.3	-1.0
L02-0260	67.1	74.7	72.7	-1.9	72.3	-2.4	-0.5	73.9	-0.7	72.9	-1.7	-1.0
L02-0261	66.9	76.0	72.7	-3.3	72.3	-3.7	-0.4	73.9	-2.1	72.9	-3.1	-1.0

Table 10-5. Node Data and Model Results for Alternative 3

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0262	67.1	75.0	72.7	-2.3	72.3	-2.7	-0.4	73.9	-1.1	73.0	-2.1	-0.9
L02-0270	67.0	74.2	72.7	-1.5	72.3	-1.9	-0.4	73.9	-0.3	73.0	-1.3	-1.0
L02-0272	66.6	73.8	72.7	-1.1	72.3	-1.5	-0.4	73.9	0.1	73.0	-0.8	-0.9
L02-0273	67.7	75.0	72.7	-2.3	72.4	-2.6	-0.3	73.9	-1.1	73.1	-1.9	-0.8
L02-0275	68.0	78.0	70.8	-7.2	68.1	-9.9	-2.7	73.9	-4.1	69.7	-8.3	-4.2
L02-0277	69.4	76.0	72.8	-3.2	73.4	-2.6	0.6	75.3	-0.7	75.3	-0.7	0.0
L02-0278	69.3	74.6	72.8	-1.9	73.3	-1.4	0.5	74.8	0.1	75.1	0.5	0.4
L02-0279	68.3	75.6	72.8	-2.8	73.1	-2.5	0.3	75.6	0.0	75.9	0.3	0.3
L02-0280	67.9	74.1	72.7	-1.4	72.4	-1.7	-0.3	73.9	-0.2	73.2	-0.9	-0.8
L02-0281	69.0	77.0	72.8	-4.2	73.7	-3.3	0.9	77.0	0.0	77.0	0.0	0.0
L02-0282	68.4	75.8	72.8	-3.0	73.2	-2.6	0.4	75.8	0.0	75.8	0.0	0.0
L02-0283	68.9	75.2	72.8	-2.4	73.5	-1.7	0.7	75.5	0.3	75.8	0.6	0.3
L02-0284	68.3	74.9	72.8	-2.1	72.7	-2.2	-0.2	74.0	-0.9	74.7	-0.2	0.7
L02-0286	69.4	76.2	72.8	-3.4	74.1	-2.1	1.3	76.4	0.2	76.5	0.3	0.1
L02-0287	71.0	78.6	72.8	-5.8	74.7	-3.9	1.9	78.5	-0.1	78.3	-0.3	-0.2
L02-0288	70.4	77.5	72.8	-4.7	73.9	-3.6	1.1	77.5	0.0	77.5	0.0	0.0
L02-0290	68.7	76.3	72.9	-3.4	73.0	-3.3	0.0	74.1	-2.2	74.7	-1.6	0.6
L02-0291	68.9	76.0	73.0	-3.0	73.1	-2.9	0.1	74.2	-1.8	74.8	-1.2	0.6
L02-0292	69.0	76.0	73.0	-3.0	73.1	-2.9	0.1	74.2	-1.8	74.9	-1.1	0.7
L02-0293	69.9	75.3	73.0	-2.3	73.1	-2.2	0.1	74.2	-1.1	75.0	-0.3	0.8
L02-0300	68.7	78.0	73.1	-4.9	73.3	-4.7	0.2	74.3	-3.7	74.9	-3.1	0.7
L02-0302	72.8	78.3	75.3	-3.1	72.8	-5.5	-2.5	76.2	-2.1	75.0	-3.4	-1.3
L02-0421	69.4	76.8	75.5	-1.3	75.5	-1.2	0.1	76.5	-0.3	76.5	-0.3	0.0
L02-0422	70.7	76.8	76.8	0.0	76.8	0.0	0.0	77.0	0.2	77.0	0.2	0.0
L02-0424	70.5	76.9	77.2	0.2	77.2	0.2	0.0	77.7	0.8	77.7	0.8	0.0
L02-0425	69.5	76.1	75.5	-0.6	75.5	-0.5	0.1	76.5	0.4	76.5	0.5	0.0
L02-0426	62.0	76.9	75.4	-1.5	75.5	-1.5	0.1	76.4	-0.5	76.4	-0.5	0.0
L02-0427	70.1	76.5	76.4	-0.1	76.5	0.0	0.0	77.1	0.6	77.1	0.6	0.0
L02-0428	72.1	77.0	76.1	-0.9	75.8	-1.1	-0.2	77.1	0.1	77.0	0.0	-0.1
L02-0430	65.3	75.1	72.9	-2.3	72.0	-3.2	-0.9	73.9	-1.3	74.7	-0.4	0.8
L02-0440	65.6	75.2	73.0	-2.2	72.4	-2.9	-0.6	74.1	-1.2	74.8	-0.5	0.7
L02-0440U	65.9	74.5	--	--	72.4	-2.1	--	--	--	73.5	-1.0	--
L02-0450	66.3	75.4	73.1	-2.3	72.4	-2.9	-0.7	74.2	-1.1	73.5	-1.8	-0.7
L02-0450U	66.5	75.5	--	--	72.5	-3.0	--	--	--	73.6	-2.0	--
L02-0460	66.3	75.3	73.2	-2.1	72.8	-2.6	-0.5	74.4	-1.0	73.6	-1.7	-0.8
L02-0461	70.7	76.0	72.9	-3.1	72.3	-3.7	-0.6	74.3	-1.7	73.6	-2.4	-0.8
L02-0462	70.5	75.4	73.0	-2.4	72.8	-2.6	-0.1	75.4	0.0	75.2	-0.2	-0.2
L02-0463	70.1	76.1	72.9	-3.1	72.7	-3.4	-0.2	74.3	-1.7	74.0	-2.1	-0.3
L02-0464	70.7	76.0	72.9	-3.2	72.3	-3.7	-0.6	74.3	-1.7	73.6	-2.5	-0.8
L02-0465	69.9	75.4	73.1	-2.3	72.7	-2.6	-0.3	74.3	-1.1	74.1	-1.3	-0.3
L02-0467	69.1	75.4	73.2	-2.2	72.8	-2.6	-0.5	74.4	-1.0	74.0	-1.4	-0.4
L02-0468	69.6	75.2	73.2	-2.0	72.8	-2.4	-0.4	74.3	-0.8	74.1	-1.1	-0.2
L02-0470	67.0	75.3	73.3	-2.0	72.9	-2.4	-0.4	74.5	-0.9	73.7	-1.6	-0.8
L02-0471	70.9	75.2	73.3	-1.9	72.9	-2.3	-0.4	74.9	-0.3	75.0	-0.2	0.1
L02-0472	71.2	75.7	73.3	-2.4	73.2	-2.5	-0.1	75.7	0.0	75.7	0.0	0.0
L02-0480.1	67.7	76.9	74.8	-2.0	74.8	-2.1	0.0	75.7	-1.2	74.4	-2.5	-1.3
L02-0481	68.6	76.3	74.1	-2.2	73.0	-3.2	-1.1	75.0	-1.3	73.9	-2.4	-1.1
L02-0481A	68.3	75.8	--	--	73.0	-2.8	--	--	--	73.8	-2.0	--
L02-0481B	68.9	75.0	--	--	73.1	-1.9	--	--	--	74.2	-0.8	--
L02-0482	69.2	77.7	76.4	-1.2	72.9	-4.8	-3.5	77.7	0.1	75.7	-1.9	-2.0
L02-0483	69.1	74.4	74.4	0.0	73.0	-1.3	-1.3	75.0	0.7	74.1	-0.3	-1.0
L02-0484	69.6	75.2	74.7	-0.5	73.1	-2.1	-1.6	75.2	0.0	74.2	-1.0	-1.0
L02-0485	70.3	75.2	75.0	-0.2	73.6	-1.7	-1.5	75.4	0.2	75.5	0.3	0.0
L02-0485A	70.6	77.2	--	--	73.7	-3.5	--	--	--	76.1	-1.1	--
L02-0485B	71.0	76.5	--	--	74.2	-2.3	--	--	--	76.8	0.3	--
L02-0485C	72.0	77.5	--	--	74.8	-2.7	--	--	--	77.8	0.3	--
L02-0485D	72.4	77.5	--	--	74.9	-2.6	--	--	--	78.1	0.6	--
L02-0485E	71.1	77.3	--	--	73.9	-3.4	--	--	--	77.3	0.0	--
L02-0490	59.5	76.9	73.4	-3.5	72.9	-3.9	-0.5	74.5	-2.3	73.6	-3.2	-0.9
L02-0500	66.1	75.3	74.8	-0.5	74.4	-0.9	-0.4	75.9	0.6	75.4	0.1	-0.5
L02-0502	72.5	77.0	74.8	-2.2	74.4	-2.6	-0.3	75.9	-1.1	75.7	-1.4	-0.3
L02-0503	69.0	75.6	74.8	-0.8	74.8	-0.8	0.0	75.9	0.3	75.8	0.2	-0.1
L02-0504	69.0	75.4	75.0	-0.4	--	--	--	76.1	0.7	--	--	--
L02-0505	73.4	76.5	75.0	-1.5	--	--	--	76.1	-0.4	--	--	--
L02-0506	72.0	77.7	75.1	-2.5	75.0	-2.6	-0.1	76.2	-1.4	77.9	0.2	1.6
L02-0507	71.0	77.1	76.5	-0.6	75.2	-1.9	-1.3	76.7	-0.3	77.2	0.1	0.4
L02-0510	68.8	77.8	75.9	-1.8	75.1	-2.7	-0.9	77.2	-0.6	76.9	-0.8	-0.3
L02-0511	71.6	76.9	77.0	0.0	75.7	-1.2	-1.2	77.5	0.6	77.0	0.1	-0.5
L02-0512	68.2	75.0	75.0	-0.1	74.7	-0.4	-0.3	76.1	1.1	75.7	0.7	-0.4
L02-0513	73.1	77.8	77.9	0.1	75.2	-2.6	-2.6	78.5	0.7	78.5	0.7	0.0
L02-0514	68.5	75.3	75.1	-0.2	74.7	-0.6	-0.4	76.0	0.7	75.7	0.4	-0.3
L02-0515	68.6	76.4	76.4	0.0	74.9	-1.5	-1.5	76.4	0.1	76.4	0.0	0.0
L02-0516	69.4	75.9	76.1	0.1	75.8	-0.1	-0.2	77.0	1.0	76.9	0.9	-0.1
L02-0517	71.2	77.4	76.4	-1.0	75.0	-2.4	-1.4	76.4	-0.9	77.4	0.0	1.0
L02-0518	69.1	78.7	77.4	-1.2	74.6	-4.1	-2.8	79.1	0.5	78.3	-0.3	-0.8
L02-0518A	68.8	78.0	--	--	74.5	-3.5	--	--	--	78.0	0.0	--
L02-0520	70.3	79.0	77.6	-1.4	74.9	-4.1	-2.7	79.2	0.2	79.2	0.2	0.0
L02-0520A	69.4	78.4	--	--	74.6	-3.8	--	--	--	78.4	0.0	--
L02-0522	70.4	79.2	78.8	-0.4	75.0	-4.2	--	81.0	1.8	79.3	0.1	--
L02-0530	71.2	79.2	79.3	0.1	78.2	-1.0	-1.1	81.0	1.9	79.2	0.1	-1.8
L02-0538	68.6	76.0	76.3	0.3	75.5	-0.5	-0.8	77.2	1.2	76.7	0.7	-0.4
L02-0538AA	69.9	78.1	--	--	75.4	-2.7	--	--	--	77.2	-0.9	--
L02-0538BB	69.9	78.1	--	--	75.7	-2.4	--	--	--	78.3	0.2	--
L02-0540	70.2	78.1	78.3	0.2	75.6	-2.5	-2.6	78.4	0.3	77.4	-0.7	-1.0
L02-0541	70.7	77.7	78.3	0.6	77.1	-0.6	-1.2	79.0	1.3	78.2	0.5	-0.7
L02-0542	71.2	78.4	78.5	0.1	77.8	-0.6	-0.7	79.2	0.8	78.7	0.3	-0.5
L02-0543	71.5	79.2	79.2	0.0	78.4	-0.8	-0.8	79.4	0.2	79.2	0.0	-0.2
L02-0544	72.0	79.9	79.9	0.1	80.0	0.1	0.1	80.1	0.3	80.1	0.2	-0.1
L03-0010	63.0	71.6	68.9	-2.7	68.5	-3.1	-0.3	70.8	-0.8	69.7	-1.9	-1.1
L03-0020	63.1	71.6	69.1	-2.6	69.0	-2.7	-0.1	71.6	0.0	71.1	-0.5	-0.5
L03-0030	63.5	72.1	69.1	-2.9	69.1	-3.0	-0.1	71.6	-0.4	71.2	-0.9	-0.5
L03-0040	63.5	72.1	69.4	-2.7	69.5	-2.6	0.1	72.5	0.4	72.4	0.3	-0.1

Table 10-5. Node Data and Model Results for Alternative 3

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L03-0050	64.0	72.6	69.4	-3.2	69.6	-3.0	0.2	72.5	-0.1	72.5	-0.1	0.0
L03-0060	64.6	73.2	69.4	-3.8	69.6	-3.6	0.2	72.5	-0.7	72.5	-0.7	0.0
L03-0062	64.7	73.3	69.6	-3.8	69.8	-3.5	0.2	72.7	-0.6	72.6	-0.7	0.0
L03-0070	65.9	74.5	69.7	-4.8	69.9	-4.6	0.2	72.7	-1.8	72.6	-1.9	0.0
L03-0080	66.1	74.7	71.7	-3.0	71.9	-2.8	0.2	74.7	0.0	74.8	0.1	0.1
L03-0090	67.8	76.4	71.9	-4.5	72.1	-4.3	0.2	74.8	-1.6	74.8	-1.6	0.0
L03-0092	67.8	76.4	71.9	-4.5	72.1	-4.3	0.2	74.8	-1.6	74.8	-1.6	0.0
L03-0094	67.9	76.5	79.8	3.3	79.8	3.3	0.0	80.9	4.4	80.9	4.4	0.0
L04-0030	66.9	71.9	71.3	-0.6	70.7	-1.2	-0.6	73.9	2.0	71.4	-0.5	-2.5
L04-0040	67.0	71.6	71.3	-0.3	70.9	-0.7	-0.4	73.9	2.3	71.6	0.0	-2.3
L04-0050	67.8	72.1	71.3	-0.7	71.2	-0.9	-0.2	73.9	1.9	71.9	-0.2	-2.1
L04-0060	68.3	71.4	71.4	0.0	71.2	-0.2	-0.1	73.9	2.6	71.9	0.6	-2.0
L04-0062	68.2	73.1	71.4	-1.7	71.3	-1.8	-0.1	73.9	0.9	72.0	-1.0	-1.9
L04-0064	68.4	73.3	71.6	-1.7	71.7	-1.6	0.1	74.0	0.7	72.9	-0.4	-1.1
L04-0066	68.0	71.7	71.6	-0.1	71.8	0.0	0.1	74.0	2.3	72.9	1.2	-1.1
L04-0068	67.8	72.0	72.0	0.1	72.2	0.3	0.2	74.2	2.3	73.8	1.9	-0.4
L04-0070	68.0	74.4	72.2	-2.3	72.4	-2.1	0.2	74.2	-0.2	73.9	-0.5	-0.3
L04-0080	68.1	76.0	72.2	-3.8	72.4	-3.6	0.2	74.3	-1.7	74.0	-2.0	-0.3
L04-0088	68.5	75.0	72.4	-2.7	72.5	-2.5	0.2	74.4	-0.6	74.2	-0.8	-0.2
L04-0090	69.4	73.0	72.5	-0.5	72.7	-0.3	0.2	74.5	1.5	74.4	1.4	-0.1
L04-0092	69.5	73.6	72.6	-1.1	72.8	-0.9	0.2	74.5	0.9	74.4	0.8	-0.1
L04-0094	69.5	73.7	73.0	-0.7	73.2	-0.6	0.2	75.1	1.3	75.1	1.4	0.0
L04-0100	69.6	73.8	73.0	-0.8	73.2	-0.7	0.2	75.1	1.2	75.1	1.3	0.0
L05-0010	65.6	73.8	72.0	-1.8	69.8	-4.0	-2.2	75.0	1.2	71.2	-2.6	-3.8
L05-0012	65.7	73.0	72.0	-0.9	69.9	-3.1	--	75.0	2.0	71.2	-1.8	-3.8
L05-0014	66.0	74.2	72.0	-2.2	70.2	-4.1	--	75.0	0.8	71.2	-3.1	-3.8
L05-0020	66.4	75.9	72.0	-3.8	71.2	-4.6	-0.8	75.0	-0.9	72.5	-3.3	-2.5
L05-0040	66.5	74.0	72.0	-2.0	71.5	-2.5	-0.5	75.0	1.0	73.1	-0.9	-1.9
L05-0050	66.6	74.0	72.7	-1.3	72.1	-1.9	-0.6	75.6	1.6	74.0	0.0	-1.6
L05-0060	69.3	74.2	72.8	-1.4	71.7	-2.5	-1.1	75.6	1.4	74.2	0.0	-1.4
L05-0070	69.4	74.5	72.9	-1.6	72.3	-2.2	-0.6	75.7	1.2	74.4	0.0	-1.2
L05-0080	69.4	74.5	72.9	-1.6	72.3	-2.2	-0.6	75.7	1.1	74.5	0.0	-1.2
L05-0090	69.6	74.8	73.0	-1.9	72.5	-2.3	-0.5	75.7	0.8	74.6	-0.3	-1.1
L05-0100	69.7	75.1	73.0	-2.1	72.6	-2.5	-0.4	75.7	0.5	74.6	-0.5	-1.0
L05-0110	69.8	75.5	73.1	-2.4	72.8	-2.7	-0.3	75.7	0.2	74.7	-0.7	-0.9
L06-0020	69.0	77.2	73.5	-3.6	73.5	-3.7	-0.1	75.7	-1.5	74.7	-2.5	-1.0
L06-0040	68.5	77.2	73.7	-3.5	73.5	-3.7	-0.1	75.7	-1.5	74.7	-2.5	-1.0
L06-0140	69.6	77.6	73.7	-3.9	73.5	-4.1	-0.1	75.8	-1.8	74.7	-2.9	-1.0
L06-0141	69.4	77.2	73.7	-3.5	73.5	-3.7	-0.1	75.7	-1.5	74.7	-2.5	-1.0
L06-0142	69.7	78.2	73.8	-4.4	73.6	-4.6	-0.2	76.0	-2.2	74.9	-3.3	-1.1
L06-0143	71.3	78.2	73.8	-4.4	73.6	-4.6	-0.2	76.0	-2.2	75.2	-3.0	-0.8
L06-0143NA	72.0	77.6	--	--	74.0	-3.6	--	--	--	77.6	0.0	--
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0	78.4	0.4	78.4	0.4	0.0
L06-0145	72.3	78.3	76.6	-1.7	76.6	-1.7	0.0	77.6	-0.6	77.6	-0.6	0.0
L06-0146	72.8	75.0	75.6	0.6	75.7	0.7	0.0	76.6	1.6	76.6	1.6	0.0
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0	77.0	-2.0	77.0	-2.0	0.0
L06-0148	71.8	77.5	73.7	-3.8	73.7	-3.9	0.0	75.8	-1.8	75.0	-2.6	-0.8
L06-0149	71.5	77.5	73.7	-3.8	73.6	-3.9	-0.1	75.8	-1.7	74.9	-2.6	-0.9
L06-0150	71.6	77.7	74.2	-3.4	73.6	-4.1	-0.6	76.7	-1.0	75.2	-2.5	-1.5
L06-0150D	72.5	77.0	--	--	73.7	-3.3	--	--	--	76.0	-1.0	--
L06-0151	69.9	77.6	74.0	-3.6	73.6	-4.0	-0.4	76.3	-1.2	75.1	-2.4	-1.2
L06-0151NA	70.5	76.2	--	--	73.8	-2.4	--	--	--	75.8	-0.4	--
L06-0151NB	71.6	76.4	--	--	74.2	-2.2	--	--	--	76.1	-0.2	--
L06-0151NC	72.0	76.5	--	--	74.6	-1.9	--	--	--	76.7	0.2	--
L06-0152	74.0	76.7	76.9	0.2	74.0	-2.7	-2.9	77.3	0.6	75.2	-1.5	-2.1
L06-0200	73.0	79.7	76.6	-3.1	73.7	-5.9	-2.8	78.5	-1.2	75.2	-4.5	-3.3
L06-0220	74.4	79.0	78.3	-0.8	74.9	-4.1	-3.3	80.0	1.0	75.4	-3.6	-4.6
L06-0221	77.0	79.5	78.1	-1.4	77.3	-2.2	-0.8	80.0	0.5	77.3	-2.2	-2.7
L06-0222	77.0	79.5	77.9	-1.6	77.8	-1.7	-0.1	78.8	-0.7	78.2	-1.3	-0.6
L06-0230	75.1	80.5	79.4	-1.1	75.7	-4.8	-3.7	81.5	1.0	75.9	-4.6	-5.6
L06-0240	77.2	80.3	79.5	-0.8	77.5	-2.8	-1.9	81.5	1.2	77.6	-2.7	-3.9
L06-0240AA	67.3	80.5	74.7	-5.9	74.7	-5.9	0.0	75.8	-4.7	75.8	-4.7	0.0
L06-0242	73.4	80.8	79.5	-1.3	--	--	--	81.6	0.8	--	--	--
L06-0245	73.6	80.9	79.5	-1.3	--	--	--	81.6	0.7	--	--	--
L06-0250	73.7	81.4	79.7	-1.7	--	--	--	81.7	0.3	--	--	--
L06-0260	73.8	79.9	79.7	-0.2	--	--	--	81.7	1.9	--	--	--
L06-0270	73.9	81.3	79.7	-1.6	--	--	--	81.8	0.5	--	--	--
L06-0280	74.5	82.9	79.8	-3.2	--	--	--	81.8	-1.1	--	--	--
L06-0290	74.6	83.3	79.9	-3.3	--	--	--	82.1	-1.2	--	--	--
L06-0292	75.4	82.8	79.9	-2.8	--	--	--	82.1	-0.7	--	--	--
L06-0294	75.4	83.3	80.0	-3.3	--	--	--	82.1	-1.2	--	--	--
L06-0300	75.7	83.2	80.0	-3.2	--	--	--	82.1	-1.1	--	--	--
L06-0310	75.9	84.0	85.6	1.6	--	--	--	86.9	2.9	--	--	--
L06-0340	68.3	77.1	74.1	-3.0	73.7	-3.4	-0.4	76.2	-0.9	75.3	-1.8	-0.9
L06-0350	69.1	78.1	74.5	-3.6	73.9	-4.2	-0.5	76.6	-1.5	75.4	-2.7	-1.2
L06-0360	70.0	79.1	74.6	-4.6	74.0	-5.1	-0.6	76.7	-2.4	75.4	-3.8	-1.3
L06-0361	70.0	79.1	74.3	-4.9	73.6	-5.5	-0.6	76.6	-2.5	75.2	-3.9	-1.4
L06-0380	70.9	76.7	75.6	-1.1	74.8	-1.9	-0.8	78.6	1.8	76.3	-0.4	-2.2
L06-0390	71.7	78.8	75.7	-3.1	75.0	-3.8	-0.7	78.6	-0.2	76.5	-2.3	-2.0
L06-0390D	73.5	78.5	--	--	75.1	-3.4	--	--	--	76.6	-1.9	--
L06-0390E	74.0	78.0	--	--	75.2	-2.8	--	--	--	76.9	-1.1	--
L06-0390F	74.0	78.0	--	--	75.1	-2.9	--	--	--	76.6	-1.4	--
L06-0400	72.5	78.2	76.7	-1.5	75.3	-2.9	-1.5	79.7	1.5	76.7	-1.5	-3.0
L06-0430	73.2	81.8	76.9	-4.8	75.6	-6.2	-1.4	79.8	-2.0	76.7	-5.0	--
L06-0432	74.5	81.8	77.0	-4.8	77.3	-4.5	0.3	79.9	-1.9	79.2	-2.6	-0.7
L06-0433	71.2	80.4	76.8	-3.6	75.8	-4.6	-1.0	79.8	-0.6	76.9	-3.5	-2.9
L06-0434	72.2	80.5	76.8	-3.7	76.4	-4.1	-0.4	79.8	-0.7	77.2	-3.3	-2.6
L06-0435	72.0	80.2	76.8	-3.4	75.5	-4.7	-1.3	79.8	-0.4	76.7	-3.5	-3.0
L06-0436	73.3	80.4	77.4	-3.0	78.6	-1.8	1.2	80.2	-0.2	79.1	-1.3	-1.1
L06-0438	73.7	79.5	80.1	0.7	80.2	0.7	0.0	81.0	1.5	81.0	1.5	0.0
L06-0460	71.8	80.5	77.1	-3.4	77.2	-3.2	0.2	79.9	-0.5	78.7	-1.8	-1.2
L06-0480	71.9	80.8	77.1	-3.7	77.3	-3.5	0.2	79.9	-0.9	78.9	-1.9	-1.0

Table 10-5. Node Data and Model Results for Alternative 3

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L06-0490	72.2	81.0	77.1	-3.9	77.4	-3.6	0.3	79.9	-1.1	79.1	-1.9	-0.8
L06-0492	72.2	81.1	77.6	-3.6	77.4	-3.7	-0.2	80.8	-0.3	79.1	-2.0	-1.6
L06-0500	72.8	81.5	77.6	-3.9	77.6	-3.9	0.0	80.8	-0.7	79.5	-2.0	-1.3
L06-0502	72.8	81.0	77.7	-3.2	77.6	-3.4	-0.1	81.0	0.1	79.5	-1.5	-1.5
L06-0510	73.6	82.7	77.9	-4.7	77.8	-4.8	-0.1	81.1	-1.6	80.1	-2.6	-1.0
L06-0520	73.6	82.8	78.9	-3.9	77.9	-4.9	-1.1	81.5	-1.3	80.1	-2.7	-1.4
L07-0040	74.4	78.7	75.2	-3.5	75.2	-3.5	0.0	76.8	-1.9	76.8	-1.9	0.0
L07-0041	74.4	81.4	75.2	-6.2	75.2	-6.2	0.0	76.8	-4.6	76.8	-4.6	0.0
L07-0042	73.7	80.2	74.2	-5.9	74.9	-5.2	0.7	76.8	-3.4	76.8	-3.4	0.0
L07-0043	72.9	80.2	74.1	-6.1	75.2	-4.9	1.1	76.8	-3.4	76.7	-3.5	-0.1
L07-0050	76.2	80.0	76.5	-3.4	76.6	-3.4	0.0	76.9	-3.1	76.9	-3.0	0.1
L07-0060	74.8	79.6	80.6	1.0	76.6	-3.0	-4.0	81.9	2.3	77.0	-2.5	-4.9
L07-0061	73.3	78.3	79.2	0.9	74.8	-3.6	-4.4	79.3	1.0	78.4	0.0	-0.9
L-070061N	74.0	79.2	--	--	74.8	-4.4	--	--	--	78.6	-0.5	--
L07-0062	76.3	79.6	80.6	1.0	76.8	-2.8	-3.8	81.9	2.3	77.2	-2.4	-4.8
L07-0064	76.4	79.1	79.5	0.4	76.6	-2.5	-2.9	80.4	1.3	77.5	-1.6	-2.9
L07-0068	72.5	79.8	79.2	-0.6	74.3	-5.5	-4.9	79.3	-0.5	77.3	-2.5	-2.0
L07-0070	76.9	80.0	79.5	-0.5	77.0	-3.0	-2.5	80.4	0.4	77.6	-2.4	-2.8
L07-0080	77.3	80.1	80.3	0.3	77.5	-2.6	-2.9	81.4	1.4	78.0	-2.0	-3.4
L07-0100	75.0	81.0	79.8	-1.1	79.7	-1.3	-0.1	81.3	0.4	81.1	0.1	-0.3
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1	0.0	80.6	-11.1	80.7	-11.0	0.2
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8	0.0	80.6	7.8	80.7	7.9	0.1
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	64.8	-6.0	-0.2	67.2	-3.5	66.8	-3.9	-0.4
L08-0012	60.5	70.8	64.9	-5.8	64.8	-6.0	-0.2	67.2	-3.5	67.0	-3.8	-0.3
L08-0020	60.9	71.2	64.9	-6.3	64.8	-6.4	-0.2	67.2	-3.9	67.0	-4.2	-0.3
L08-0030	61.0	71.2	64.9	-6.3	64.8	-6.5	-0.2	67.2	-4.0	67.1	-4.2	-0.2
L08-0040	61.4	71.7	64.9	-6.8	64.8	-6.9	-0.1	67.3	-4.5	67.1	-4.6	-0.2
L08-0050	61.6	71.8	64.9	-6.9	64.9	-6.9	0.0	67.3	-4.5	67.4	-4.4	0.1
L08-0060	62.5	72.8	65.6	-7.2	65.6	-7.1	0.1	67.4	-5.3	67.6	-5.2	0.1
L09-0010	69.4	75.5	73.0	-2.5	73.2	-2.2	0.3	75.5	0.1	74.5	-1.0	-1.1
L09-0040	73.1	77.3	75.2	-2.1	75.2	-2.1	0.1	75.9	-1.4	76.1	-1.2	0.2
L09-0050	72.9	77.3	75.4	-2.0	75.4	-1.9	0.1	76.1	-1.2	76.3	-1.0	0.2
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0	77.6	-4.6	77.6	-4.6	0.0
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0	85.4	3.3	85.4	3.3	0.0
L11-0020	79.6	85.6	81.1	-4.6	80.9	-4.7	-0.1	84.5	-1.1	84.0	-1.6	-0.5
L11-0030	79.6	85.6	87.1	1.4	87.1	1.4	0.0	88.6	3.0	88.6	2.9	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.6	-1.7	0.2	80.8	0.5	80.2	-0.2	-0.6
L13-0020	77.6	79.9	80.4	0.5	80.4	0.5	0.0	81.1	1.3	81.2	1.3	0.0
L15-0010	71.9	77.2	73.4	-3.7	73.9	-3.3	0.5	75.8	-1.4	75.1	-2.1	-0.7
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0	80.7	3.6	80.7	3.5	0.0
MC0010	50.7	59.9	56.3	-3.6	56.5	-3.4	0.2	59.9	0.0	60.0	0.1	0.0
MC0020	50.7	59.9	56.3	-3.6	56.5	-3.4	0.2	59.9	0.0	60.0	0.1	0.0
MC0030	51.1	60.3	56.6	-3.7	56.8	-3.5	0.1	60.1	-0.2	60.2	-0.1	0.0
MC0040	51.4	59.7	56.7	-3.0	56.8	-2.9	0.1	60.5	0.8	60.5	0.8	0.0
MC0050	51.5	60.1	56.9	-3.3	57.0	-3.1	0.1	60.6	0.5	60.7	0.5	0.0
MC0060	51.5	60.1	56.9	-3.3	57.0	-3.1	0.1	60.7	0.5	60.7	0.5	0.0
MC0070	52.2	64.1	57.1	-7.0	57.2	-6.9	0.1	60.8	-3.3	60.8	-3.3	0.0
MC0080	52.4	61.1	57.1	-4.1	57.2	-3.9	0.1	60.8	-0.3	60.8	-0.3	0.0
MC0090	53.3	63.2	58.3	-4.8	58.5	-4.7	0.1	61.7	-1.5	61.6	-1.5	0.0
MC0100	53.2	62.2	58.4	-3.9	58.5	-3.7	0.1	61.7	-0.5	61.7	-0.6	0.0
MC0110	54.3	63.6	59.9	-3.7	60.1	-3.5	0.2	63.1	-0.6	63.0	-0.6	0.0
MC0120	54.4	66.8	60.0	-6.8	60.2	-6.6	0.2	63.1	-3.6	63.1	-3.7	0.0
MC0130	54.2	64.0	60.3	-3.7	60.4	-3.6	0.2	63.4	-0.6	63.3	-0.7	-0.1
MC0140	53.9	64.1	60.3	-3.8	60.4	-3.7	0.1	63.4	-0.7	63.3	-0.8	-0.1
MC0150	57.2	68.6	62.5	-6.1	62.5	-6.1	0.0	65.3	-3.3	65.1	-3.5	-0.2
MC0160	57.2	68.7	62.6	-6.2	62.6	-6.1	0.0	65.3	-3.4	65.1	-3.6	-0.2
MC0170	57.9	69.2	63.0	-6.1	63.0	-6.1	0.0	65.7	-3.4	65.6	-3.6	-0.2
MC0172	58.1	69.3	63.2	-6.1	63.2	-6.2	0.0	65.9	-3.5	65.7	-3.7	-0.2
MC0174	58.2	69.3	63.2	-6.1	63.2	-6.2	0.0	65.9	-3.5	65.7	-3.7	-0.2
MC0176	58.2	69.4	63.2	-6.1	63.2	-6.2	0.0	65.9	-3.5	65.7	-3.7	-0.2
MC0178	58.2	69.4	63.2	-6.1	63.2	-6.2	0.0	65.9	-3.5	65.7	-3.7	-0.2
MC0180	58.8	69.7	63.6	-6.1	63.5	-6.2	-0.1	66.2	-3.5	65.9	-3.8	-0.3
MC0190	58.8	69.7	63.6	-6.1	63.6	-6.2	-0.1	66.2	-3.5	66.0	-3.8	-0.3
MC0200	59.3	70.8	64.2	-6.6	64.1	-6.7	-0.1	66.7	-4.2	66.3	-4.5	-0.3
MC0210	58.5	70.2	64.3	-5.9	64.1	-6.1	-0.1	66.7	-3.5	66.3	-3.8	-0.3
MC0220	60.1	70.4	64.9	-5.5	64.8	-5.6	-0.2	67.2	-3.2	66.8	-3.6	-0.4
MC0230	61.4	70.9	66.8	-4.1	66.5	-4.4	-0.3	68.8	-2.1	67.9	-2.9	-0.8
MC0240	61.5	70.9	66.8	-4.1	66.5	-4.4	-0.3	68.9	-2.0	68.0	-2.9	-0.9
MC0250	62.0	71.1	67.7	-3.4	67.4	-3.7	-0.3	69.7	-1.4	68.7	-2.4	-1.0
MC0260	62.9	71.5	68.8	-2.6	68.5	-3.0	-0.3	70.8	-0.7	69.7	-1.8	-1.1
MC0270	62.2	70.5	68.9	-1.6	68.5	-1.9	-0.4	70.9	0.5	69.7	-0.7	-1.2
MC0280	65.4	71.4	69.6	-1.9	69.1	-2.3	-0.5	71.4	0.0	70.0	-1.4	-1.4
MC0282	65.5	71.5	69.7	-1.8	69.2	-2.3	-0.5	71.5	0.0	70.0	-1.4	-1.4
MC0290	65.6	71.5	70.4	-1.1	69.6	-1.9	-0.8	73.5	2.0	70.5	-1.0	-3.0
MC0292	67.1	71.9	71.3	-0.6	70.4	-1.5	-0.9	73.9	2.0	70.8	-1.1	-3.1
MC0296	65.8	71.6	71.6	0.0	70.4	-1.2	-1.2	74.1	2.5	71.0	-0.6	-3.0
MC0298	65.4	71.6	71.6	0.0	70.4	-1.2	-1.2	74.1	2.5	71.0	-0.5	-3.0
MC0300	63.3	73.3	71.6	-1.6	70.4	-2.9	-1.2	74.1	0.8	71.1	-2.2	-3.0
MC0310	63.3	72.5	71.7	-0.8	70.4	-2.0	-1.3	74.3	1.8	71.1	-1.3	-3.1
MC0320	65.4	74.7	71.7	-3.0	70.4	-4.3	-1.3	74.3	-0.5	71.2	-3.6	-3.1
MC0330	65.2	71.6	72.0	0.4	70.6	-1.0	-1.4	75.0	3.4	71.3	-0.3	-3.7
MC0340	65.3	72.5	72.1	-0.4	71.0	-1.4	-1.0	75.0	2.6	72.0	-0.5	-3.0
MC0350	65.3	72.8	72.1	-0.7	71.2	-1.7	-1.0	75.1	2.3	72.3	-0.5	-2.8
MC0360	65.5	75.5	72.2	-3.2	71.5	-3.9	-0.7	75.2	-0.2	72.8	-2.6	-2.4
MC0370	64.9	75.5	72.2	-3.3	71.6	-3.9	-0.7	75.2	-0.3	72.9	-2.6	-2.4
MC0380	65.8	74.7	72.3	-2.4	71.9	-2.8	-0.4	75.3	0.6	73.2	-1.5	-2.1
MC0390	67.1	73.5	72.4	-1.1	72.1	-1.4	-0.3	75.3	1.8	73.4	-0.1	-1.9
MC0400	67.1	74.8	72.4	-2.4	72.2	-2.7	-0.3	75.3	0.5	73.5	-1.4	-1.8
MC0410	68.1	78.7	72.9	-5.8	73.0	-5.6	0.1	75.5	-3.2	74.3	-4.4	-1.2
MC0420	69.2	77.2	73.0	-4.2	73.4	-3.8	0.4	75.5	-1.7	74.6	-2.6	-1.0
MC0422	69.2	77.2	73.1	-4.2	73.4	-3.8	0.4	75.6	-1.7	74.6	-2.6	-0.9

Table 10-5. Node Data and Model Results for Alternative 3

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0430	69.4	77.2	73.4	-3.8	73.9	-3.3	0.5	75.7	-1.5	75.0	-2.2	-0.7
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0	81.4	1.5	81.4	1.5	0.0
MC0440	69.0	76.0	73.4	-2.6	73.9	-2.0	0.5	75.8	-0.2	75.1	-0.8	-0.7
MC0450	70.4	78.1	73.7	-4.3	74.3	-3.8	0.6	76.0	-2.1	75.4	-2.7	-0.6
MC0451	69.7	77.4	73.6	-3.8	74.1	-3.3	0.5	75.9	-1.5	75.3	-2.1	-0.6
MC0460	71.7	77.3	74.1	-3.3	74.8	-2.6	0.7	76.7	-0.6	76.1	-1.3	-0.6
MC0461	70.4	77.6	74.2	-3.4	74.8	-2.8	0.6	76.7	-0.9	76.1	-1.5	-0.6
MC0462	71.1	77.4	74.2	-3.2	74.9	-2.5	0.6	76.7	-0.7	76.2	-1.2	-0.5
MC0463	71.3	76.7	74.2	-2.5	75.0	-1.7	0.7	76.7	0.0	76.7	0.0	0.0
MC0464	71.7	78.6	74.2	-4.4	74.9	-3.7	0.7	76.8	-1.8	76.3	-2.3	-0.5
MC0470	72.2	78.7	74.5	-4.2	74.9	-3.8	0.3	76.8	-1.9	76.1	-2.6	-0.7
MC0480	71.8	77.5	74.7	-2.8	74.9	-2.6	0.2	77.3	-0.2	76.1	-1.4	-1.1
MC0490	72.0	78.3	75.6	-2.7	76.7	-1.6	1.1	77.7	-0.6	78.6	0.3	0.9
MC0500	72.3	78.4	75.8	-2.7	76.8	-1.7	1.0	78.2	-0.2	78.7	0.3	0.5
MC0510	73.0	80.2	76.8	-3.5	77.6	-2.6	0.9	78.7	-1.5	78.8	-1.5	0.0
MC0520	73.0	81.1	77.1	-4.0	77.4	-3.6	0.3	79.9	-1.1	79.6	-1.5	-0.3
MC0530	73.3	81.3	77.1	-4.2	77.4	-3.9	0.3	79.9	-1.4	79.6	-1.7	-0.4
MC0540	73.3	81.4	77.3	-4.1	77.7	-3.7	0.4	80.7	-0.7	80.1	-1.3	-0.6
MC0545	73.6	81.7	77.6	-4.1	77.7	-3.9	0.1	80.8	-0.9	80.2	-1.5	-0.6
MC0550	74.0	81.9	77.9	-4.0	77.8	-4.1	-0.1	80.9	-1.0	80.2	-1.8	-0.7
MC0560	74.1	82.0	78.1	-3.9	78.0	-4.0	-0.1	81.4	-0.5	80.6	-1.4	-0.9
MC0570	74.5	82.1	78.3	-3.8	78.0	-4.1	-0.3	81.5	-0.6	80.6	-1.5	-0.9
MC0580	74.5	82.1	78.5	-3.7	78.2	-4.0	-0.3	81.9	-0.2	80.9	-1.2	-1.0
MC0590	75.6	82.9	79.3	-3.6	78.5	-4.4	-0.9	82.2	-0.8	80.9	-2.0	-1.2
MC0600	75.6	83.0	79.5	-3.4	78.8	-4.2	-0.8	82.7	-0.3	81.5	-1.5	-1.2
MC0610	76.0	83.2	79.7	-3.5	78.9	-4.3	-0.8	82.7	-0.5	81.5	-1.7	-1.2
MC0620	76.0	83.9	79.9	-4.0	79.3	-4.7	-0.7	83.3	-0.6	82.3	-1.6	-1.0
MC0630	75.1	83.2	80.0	-3.1	79.6	-3.6	-0.5	83.3	0.2	82.4	-0.8	-1.0
MC0640	75.3	83.3	80.1	-3.2	79.6	-3.7	-0.5	83.4	0.1	82.5	-0.8	-0.9
MC0642	76.2	83.8	80.1	-3.7	79.7	-4.1	-0.4	83.4	-0.4	82.5	-1.3	-0.9
MC0650	77.1	84.3	80.9	-3.4	80.7	-3.6	-0.2	84.5	0.2	84.0	-0.3	-0.5
MC0660	76.2	83.7	80.1	-3.6	79.6	-4.1	-0.4	83.3	-0.4	82.4	-1.3	-0.9
MC0662	76.3	83.8	80.6	-3.2	80.5	-3.3	-0.2	84.7	0.9	84.3	0.5	-0.4
MC0670	78.0	84.8	80.9	-3.9	80.8	-4.0	-0.1	84.7	-0.1	84.3	-0.5	-0.4
WIC0005	50.5	56.7	57.0	0.4	57.5	0.8	0.4	59.7	3.0	59.8	3.1	0.1
WIC0010	50.9	60.3	58.7	-1.6	59.2	-1.1	0.5	61.2	0.9	61.3	1.0	0.1
WIC0020	50.9	58.9	58.8	-0.1	59.3	0.4	0.5	61.3	2.5	61.4	2.6	0.1
WIC0030	51.8	59.4	59.4	0.0	59.9	0.5	0.5	61.9	2.5	62.0	2.6	0.1
WIC0032	52.5	60.1	59.9	-0.2	60.4	0.3	0.5	62.4	2.3	62.5	2.4	0.1
WIC0034	54.1	61.4	60.9	-0.5	61.4	0.0	0.5	63.3	1.9	63.4	2.0	0.1
WIC0040	54.9	62.1	61.3	-0.9	61.8	-0.4	0.5	63.6	1.5	63.7	1.5	0.1

COST ESTIMATES

The construction and capital costs for each of the drain/channel/basin systems discussed above are presented in Table 10-6. As shown, the estimated total construction cost is $21.8 million and the estimated capital cost is $40.1 million. The following assumptions were made for the preparation of the cost estimate:

- Within the future build out area, the excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks. Outside of the future build out area, excavated dirt will be disposed offsite.
- All land will be purchased (versus easements) at a cost of $50,000 per acre for land within the City's 2030 General Plan Planning Area and at a cost of $25,000 per acre for land outside the City's Planning Area.

Build out of the general plan includes development of 3,375 acres. Alternative 3 results in an overall cost of $11,890 per acre.

Table 10-6. Cost Estimate for Alternative 3

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
1. Main Canal Improvement and Diversion Channel to East Basin				
Site Preparation (Clear and Grub)	acre	500	32.7	16,350
Channel Excavation (on-site)	CY	4	83,100	332,400
Landscape and Erosion Control	acre	10,000	29.7	297,000
18-Inch Orifice Plate	each	2,000	1	2,000
36-Inch RCP	feet	216	514	111,024
42-Inch RCP	feet	252	240	60,480
60-Inch RCP	feet	330	548	180,675
Headwalls	each	8,000	14	112,000
12' Asphalt Access Road	feet	72	18,316	1,318,717
Mobilization/demobilization (at 5 percent)				121,530
Construction Contingency (at 20 percent)				486,130
Estimated Construction Cost				3,038,310
Land/Easements (for channel)	acre	50,000	29.7	1,485,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,215,300
Estimated Capital Cost				5,738,600
2. East Detention Basin				
Site Preparation (Clear and Grub)	acre	500	8.6	4,280
Basin Excavation	CY	4	50,082	200,328
Landscape and Erosion Control	acre	2,000	7.3	14,580
Rock Scour Protection	CY	100	10	1,000
Pump Station (20 cfs)	cfs	39,500	20	790,000
36-Inch RCP	cfs	216	2,400	518,400
12' Asphalt Access Road	feet	72	2,950	212,400
Mobilization/demobilization (at 5 percent)				87,050
Construction Contingency (at 20 percent)				348,200
Estimated Construction Cost				2,176,240
Land/Easements (for basin)	acre	25,000	8.6	214,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				870,500
Estimated Capital Cost				3,260,700
3. Lateral 5 Storm Drain				
12-Inch RCP	feet	72	300	21,600
48-Inch RCP	feet	288	661	190,368
60-Inch RCP	feet	330	1,255	414,150
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				35,310
Construction Contingency (at 20 percent)				141,220
Estimated Construction Cost				882,650
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				353,100
Estimated Capital Cost				1,235,800
4. South Detention Basin				
Site Preparation (Clear and Grub)	acre	500	28.0	14,017
Basin Excavation	CY	4	267,884	1,071,534
Landscape and Erosion Control	acre	2,000	26.0	51,904
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
54-Inch RCP	feet	311	100.0	31,050
24-Inch RCP	feet	144	134.0	19,296
24-Inch Flap Gate	each	2,800	1.0	2,800
Headwalls	each	8,000	4.0	32,000
Aggregate Base Access Road	feet	20	4,640	92,800
Fencing	feet	16	4,640	74,240
Mobilization/demobilization (at 5 percent)				70,780
Construction Contingency (at 20 percent)				283,130
Estimated Construction Cost				1,769,550
Land/Easements (for basin)	acre	25,000	28.0	700,900
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				707,800
Estimated Capital Cost				3,178,300
5. Lateral 6 Improvements and Diversion to North Detention Basin				
Site Preparation (Clear and Grub)	acre	500	6.2	3,100
Channel Excavation (on-site)	CY	4	24,900	99,600
Landscape and Erosion Control	acre	2,000	4.2	8,500
12-Inch RCP	feet	72	540	38,900
54-Inch RCP	feet	311	876	272,100
66-Inch RCP	feet	347	1,596	553,000
72-Inch RCP	feet	360	1,847	664,920
5' x 6' Box RCP	feet	600	677	406,200
Maintenance Holes	each	6,000	9	54,000
Drain Inlets	each	5,000	18	90,000
Headwalls	each	8,000	3	24,000
12' Asphalt Access Road	feet	72	2,085	150,120
Mobilization/demobilization (at 5 percent)				118,220
Construction Contingency (at 20 percent)				472,890
Estimated Construction Cost				2,955,550
Land/Easements (for channel)	acre	50,000	6.2	307,800
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,182,200
Estimated Capital Cost				4,445,600

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
6. North Detention Basin and Storm Drain				
Site Preparation (Clear and Grub)	acre	500	64.3	32,146
Basin Excavation	CY	4	368,174	1,472,694
Landscape and Erosion Control	acre	2,000	55.4	110,720
Rock Scour Protection	CY	100	10	1,000
12-Inch RCP	feet	72	360	25,920
18-Inch RCP	feet	108	554	59,832
30-Inch RCP	feet	180	72	12,960
36-Inch RCP	feet	216	1,940	419,040
Headwalls	each	8,000	2	16,000
12' Asphalt Access Road	feet	72	6,720	483,840
Maintenance Holes	each	6,000	6	36,000
Drain Inlets	each	5,000	12	60,000
Mobilization/demobilization (at 5 percent)				136,510
Construction Contingency (at 20 percent)				546,030
Estimated Construction Cost				3,412,690
Land/Easements (for basin)	acre	50,000	64.3	3,214,600
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,365,100
Estimated Capital Cost				7,992,400
7. Caltrans Property Detention Basin				
Site Preparation (Clear and Grub)	acre	500	25.5	12,774
Basin Excavation	CY	4	119,750	478,999
Landscape and Erosion Control	acre	2,000	21.4	42,700
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
24-Inch RCP	feet	144	134.0	19,296
24-Inch Flap Gate	each	2,800	1.0	2,800
12' Asphalt Access Road	feet	72	4,120	296,640
Mobilization/demobilization (at 5 percent)				43,960
Construction Contingency (at 20 percent)				175,840
Estimated Construction Cost				1,099,010
Land/Easements (for basin)	acre	10,000	26.0	260,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				439,600
Estimated Capital Cost				1,798,600
8. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road				
Site Preparation (Clear and Grub)	acre	500	1.7	865
Channel Excavation (on-site)	CY	4	12,700	50,800
Landscape and Erosion Control	acre	2,000	1.7	3,461
24-Inch Orifice Plate	each	2,000	1	2,000
12-Inch RCP	feet	72	900	64,800
60-Inch RCP	feet	330	1,454	479,945
72-Inch RCP	feet	360	4,397	1,582,924
Headwalls	each	8,000	2	16,000
12' Asphalt Access Road	feet	72	982	70,714
Maintenance Holes	each	6,000	15	90,000
Drain Inlets	each	5,000	30	150,000
Mobilization/demobilization (at 5 percent)				125,580
Construction Contingency (at 20 percent)				502,300
Estimated Construction Cost				3,139,390
Land/Easements (for channel)	acre	50,000	1.7	86,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,255,800
Estimated Capital Cost				4,481,700
9. West Detention Basin				
Site Preparation (Clear and Grub)	acre	500	66.9	33,472
Basin Excavation	CY	4	421,876	1,687,506
Landscape and Erosion Control	acre	2,000	56.5	113,028
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
24-Inch RCP	feet	144	200	28,800
Headwalls	each	8,000	2	16,000
12' Asphalt Access Road	each	72	7,240	521,280
Fencing	each	16	14,480	231,680
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				132,890
Construction Contingency (at 20 percent)				531,550
Estimated Construction Cost				3,322,210
Land/Easements (for basin)	acre	50,000	66.9	3,347,222
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,328,900
Estimated Capital Cost				7,998,300
Total Estimated Construction Cost				21,795,600
Total Land/Easement Cost				9,616,022
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				8,718,200
Total Estimated Capital Cost				40,129,822

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent
Costs are for June 2009 (20 City Average ENRCCI of 8,578).

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99

RIVIERA RD

5 LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN

66"

72"

CHANNEL SIZE
BOTTOM WIDTH: 10'
SIDE SLOPE: 6H:1V

LUTHER RD

6 NORTH DETENTION BASIN

NBSN

5'x6' RCP BOX CULVERTS
USE EX 5'X6' BOX AT HWY 99

54"

18" RCP OUTLET

36"

1 MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN

36"

CAMPBELL RD

MAHAUGH RD

CHANNEL SIZE
BOTTOM WIDTH: 10'
SIDE SLOPE: 6H:1V

COOLEY RD

TWIN 42"

60"

20 CFS PUMPED TO THE FEATHER RIVER

36" FORCE MAIN

EBSN

PENNINGTON RD

KOLA ST GARDEN GLEN DIVISION

30" RESTRICTIVE CULVERT

18" ORIFICE

DEREE RD

2 EAST DETENTION BASIN

ADJUST OPERATION OF APRICOT ST PUMP STATION

APRICOT ST

SINNARD AVE

SHELDON AVE

INLET WEIR

24" OUTLET

7 CALTRANS PROPERTY DETENTION BASIN

SBSN

72"

TOWNSHIP RD

8 LATERAL 2 STORM DRAIN

3 LATERAL 5 STORM DRAIN

INLET WEIR

60"

48"

PASEO AVE

9 WEST DETENTION BASIN

WBSN

54" IN ADDITION TO EXISTING

4 SOUTH DETENTION BASIN

INLET WEIR

24" RCP OUTLET WITH FLAP GATE

24" OUTLET

99

PARKIN RD

0 750 1500
SCALE IN FEET

LEGEND

- CITY LIMITS
- CHANNEL
- PROPOSED STORAGE
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN
- MODEL LINK
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL

Figure 10-1

City of Live Oak
Master Drainage Study
ALTERNATIVE 3

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 11. ALTERNATIVE 4

Alternative 4 includes diverting flows from the Northeast Quadrant of the City to the Feather River, flood control and joint use detention basins, joint use open channels, and installation of large storm drains in the future development areas. Alternative 4 includes the construction of five detention basins. The modeling of Alternative 4 also includes the improvements presented in Chapter 6 to solve the existing flooding problems.

Alternative 4 is similar to Alternative 3, with the exception that the North, West and South Detention Basins will not be joint use basins. The Caltrans Property Detention Basin and the East Detention Basin will provide flood protection and provide recreational uses. For example, these recreational/joint use detention basins will have side slopes that allow the basin to be used as a park during dry weather. The channels will be wide with low side slopes and will be densely vegetated. They will also have pedestrian/bike paths adjacent to the channel that will also provide maintenance access.

The proposed improvements are shown on Figure 11-1. The improvements are grouped into the following 11 sections as shown on Figure 11-1:

1. Main Canal Improvement and Diversion to East Basin
2. East Detention Basin
3. Lateral 5 Improvement
4. South Detention Basin
5. Lateral 6 Improvements and Diversion to North Detention Basin
6. North Detention Basin and Luther Road Storm Drain
7. Caltrans Property Detention Basin
8. Lateral 2 Improvements from the Apricot Street Pump Station to the Caltrans Site Detention Basin to Paseo Road
9. WWTP Storm Drain and Inlet Weir Improvements
10. Lateral 2 Improvements at Township Road
11. West Detention Basin

The details for the improvements are shown in Table 11-1. The details identify new storm drain or channel invert elevations, sizes, and materials. Each of the improvements is discussed in the following sections.

As discussed below, this project includes minor increases in water levels in Lateral 4. These increases would be eliminated with annual maintenance of the channel funded through drainage fees. Maintenance would include channel vegetation removal and culvert sediment removal.

Table 11-1. Alternative 4 Improvement Details

Link Name	US Node Name	DS Node Name	Type	No. Barrels	US Invert Elevation (ft)	DS Invert Elevation (ft)	Roughness	Length (ft)	Diameter or Depth (ft)	Bottom Width (ft)	Left-hand Sideslope _H:1V	Right-hand Sideslope _H:1V
1. Main Canal Improvement and Diversion Channel to East Basin												
MC0600A	MC0600	MC0590	Circular	1	75.64	75.60	0.015	84	3.0	--	--	--
MC0590A	MC0590	MC0580	Trapezoidal	1	75.60	74.52	0.1	2,015	5.9	10	6	6
MC0580A	MC0580	MC0570	Circular	1	74.52	74.48	0.015	80	3.0	--	--	--
MC0570A	MC0570	MC0560	Trapezoidal	1	74.48	74.07	0.1	759	6.3	10	6	6
MC0560A	MC0560	MC0550	Circular	1	74.07	74.01	0.015	120	3.0	--	--	--
MC0550A	MC0550	MC0545	Trapezoidal	1	74.01	73.62	0.1	721	6.4	10	6	6
MC0545A	MC0545	MC0540	Trapezoidal	1	73.62	73.33	0.1	535	6.7	10	6	6
MC0540A	MC0540	MC0530	Circular	1	73.33	73.29	0.015	80	3.0	--	--	--
MC0530A	MC0530	MC0520	Trapezoidal	1	73.29	72.99	0.1	569	6.5	10	6	6
MC0520A	MC0520	MC0510	Circular	1	72.99	72.99	0.015	150	3.0	--	--	--
MC0510A	MC0510	MC0500	Trapezoidal	1	72.99	72.30	0.1	1,764	6.1	10	6	6
MC0500A	MC0500	MC0490	Circular	2	72.36	72.30	0.015	120	3.5	--	--	--
MCDIV	MC0490	MC0491	Trapezoidal	1	72.00	71.50	0.1	2,795	6.9	10	6	6
MC0491A	MC0491	EBSN	Circular	1	71.50	71.00	0.015	548	5.0	--	--	--
2. East Detention Basin												
Epump	EBSN	L07-0100	Pump	1	--	--	--	--	--	--	--	--
3. Lateral 5 Storm Drain										--	--	--
L05-0050A	L05-0050	L05-0040	Circular	1	66.62	66.50	0.015	120	4.0	--	--	--
L05-0040A	L05-0040	L05-0020	Circular	1	66.50	66.37	0.015	130	4.0	--	--	--
L05-0020A	L05-0020	L05-0014	Circular	1	66.37	65.95	0.015	411	4.0	--	--	--
L05-0014A	L05-0014	L05-0012	Circular	1	65.95	65.71	0.015	332	5.0	--	--	--
L05-0012A	L05-0012	L05-0010	Circular	1	65.71	65.57	0.015	159	5.0	--	--	--
L05-0010B	L05-0010	SBSN	Circular	1	65.57	65.50	0.015	764	5.0	--	--	--
4. South Detention Basin												
MC0330F	MC0330	MC0320	Circular	1	65.36	65.35	0.015	100	4.5	--	--	--
Cal_Weir	L02-0450	CBSN	Weir	1	--	--	--	--	--	--	--	--
CBSN_out	CBSN	L02-0441	Circular	2	69.30	69.00	0.015	134	2.0	--	--	--
5. Lateral 6 Improvements and Diversion to North Detention Basin												
L06-0520A	L06-0520	L06-0510	Circular	1	73.61	73.59	0.015	40	4.5	--	--	--
L06-0510A	L06-0510	L06-0502	Circular	1	73.59	72.81	0.015	1,556	5.5	--	--	--
L06-0502A	L06-0502	L06-0500	Circular	1	72.81	72.80	0.015	20	5.5	--	--	--
L06-0500A	L06-0500	L06-0492	Circular	1	72.80	72.23	0.015	1,141	6.0	--	--	--
L06-0492A	L06-0492	L06-0490	Circular	1	72.23	72.21	0.015	30	6.0	--	--	--
L06-0490A	L06-0490	L06-0480	Circular	1	72.21	71.88	0.015	656	6.0	--	--	--
L06-0480F	L06-0480	L06-0460	Rectangular	1	71.88	71.78	0.015	177	6.0	--	--	--
L06-0460AF	L06-0460	L06-0462	Rectangular	2	71.78	71.66	0.015	250	6.0	--	--	--
L06-0462A	L06-0462	L06-0463	Trapezoidal	1	71.66	71.64	0.1	785	6.7	10	6	6
L06-0463A	L06-0463	NBSN	Trapezoidal	1	71.64	71.50	0.1	1,300	6.8	10	6	6
L06-0432B	L06-0432	L06-0463	Circular	1	74.50	71.64	0.015	876	4.5	--	--	--
6. North Detention Basin and Storm Drain												
NBSN_out	NBSN	L02-0530	Circular	1	71.50	71.50	0.015	554	2.0	--	--	--
L02-0530A	L02-0530	L02-0523	Circular	1	71.20	70.41	0.015	1,940	3.0	--	--	--
L02-0523A	L02-0523	L02-0522	Circular	1	70.41	70.40	0.015	10	3.0	--	--	--
L020518AA	L02-0518A	L02-0300	Circular	1	68.78	68.73	0.015	72	2.5	--	--	--
7. Caltrans Property Detention Basin												
Cal_Weir	L02-0450	CBSN	Weir	2	--	--	--	--	--	--	--	--
CBSN_out	CBSN	L02-0441	Circular	2	69.30	69.00	0.015	134	2.0	--	--	--
8. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road												
L02-0450UA	L02-0450U	L02-0450	Trapezoidal	1	66.53	66.28	0.100	630	7.4	10	6	6
L02-0450A	L02-0450	L02-0440U	Trapezoidal	1	66.28	65.88	0.100	352	7.7	10	6	6
24orif	L02-0440U	L02-0441	Orifice	1	--	--	--	--	--	--	--	--
L02-0440UA	L02-0441	L02-0440	Trapezoidal	1	65.88	65.62	0.100	653	7.9	15	6	6
L02-0440A	L02-0440	L02-0430	Trapezoidal	1	65.62	65.30	0.100	801	8.2	15	6	6
L02-0430A	L02-0430	L02-0251	Trapezoidal	1	65.30	64.56	0.100	1,862	8.8	15	6	6
L02-0251A	L02-0251	L02-0253	Circular	1	64.56	64.56	0.015	120	1.5	--	--	--
L02-0253A	L02-0253	L02-0252	Trapezoidal	1	64.56	64.35	0.100	532	7.4	20	6	6
L02-0252A	L02-0252	L02-0250	Trapezoidal	1	64.35	63.55	0.100	2,003	7.9	20	6	6
L02-0250A	L02-0250	L02-0240	Trapezoidal	1	63.55	62.95	0.100	1,511	8.6	20	6	6
L02-0240A	L02-0240	L02-0230	Circular	1	62.95	62.88	0.015	100	4.0	--	--	--
9. WWTP Storm Drain and Inlet Weir Improvements												
L02-0255A	L02-0255	L02-02542	Circular	1	66.70	66.60	0.014	511	3.0	--	--	--
L02-02601A	L02-02601	L02-0255	Circular	1	66.85	66.70	0.015	331	3.0	--	--	--
L02-02542A	L02-02542	L02-0254	Circular	1	66.60	66.12	0.015	1,291	3.0	--	--	--
10. Lateral 2 Improvements at Township Road												
L02-0180A	L02-0180	L02-0170	Circular	2	68.93	68.88	0.015	100	3.5	--	--	--
L02-0170A	L02-0170	L02-0160	Circular	2	68.88	68.28	0.015	1,199	3.5	--	--	--
L02-0160A	L02-0160	L02-0150	Circular	2	68.28	68.22	0.015	120	3.5	--	--	--
L02-0150A	L02-0150	L02-0140	Circular	2	68.22	67.56	0.015	1,311	3.5	--	--	--
L02-0140B	L02-0140	WBSN	Circular	2	67.56	67.50	0.015	120	3.5	--	--	--
11. West Detention Basin												
WBSN_PUMP	WBSN	L02-0130	Pump	1	--	--	--	--	--	--	--	--

MODIFIED HYDROLOGY

To develop Alternative 4, it was necessary to redirect several subsheds to be tributary to different or new model nodes. Presented in Table 11-2 are the subsheds that were redirected and the nodes to which they are tributary, and the subshed size for the buildout condition. Subsheds not listed in Table 11-2 are unchanged from Table 7-3.

Table 11-2. Summary of Redirected Subsheds

Subshed	Tributary Node	Area, acres
L02-0530	NBSN[(a)]	249.8
L02-0522	NBSN	103.3
L06-0460	L06-0462	102.1
L02-0440	CBSN[(b)]	62.3
L06-0430	NBSN	42.0
L02-0310	L02-0510A	49.6
L02-0304	L02-0518A	40.5
L06-0290	MC0550	50.8
L01-0290[(e)]	L02-0240	167.8
L02-0253	L02-0450	129.8
L06-0240	MC0510	77.1
L06-0230	MC0510	47.3
L06-0220	MC0510	73.75
L06-0310	MC0600	68.6
L06-0200	MC0510	21.2
L02-0160	WBSN	37.1
L02-0140	WBSN[(c)]	35.1
L07-0080	EBSN[(d)]	54.1
L07-0062	EBSN	14.83
L07-0060	MC0491	101
MC0464(2)	MC0510	10.2

(a) NBSN – North Detention Basin
(b) CBSN – Caltrans Property Detention Basin
(c) WBSN – West Detention Basin
(d) EBSN – East Detention Basin
(e) L01-0290 was divided into developed and undeveloped areas. The build out area is tributary to L02-0240 for Alternative 4.

DETENTION BASIN DATA

The model nodes NBSN, WBSN, CBSN, SBSN, and EBSN refer to the North Detention Basin, West Detention Basin, Caltrans Property Detention Basin, South Detention Basin, and East Detention Basin, respectively. Summaries of the detention basin data are shown in Tables 11-3 and 11-4. Summaries of the detention basin model results are also shown in Table 11-3.

1. MAIN CANAL IMPROVEMENT AND DIVERSION TO EAST BASIN

A portion of the Main Canal from the north boundary of the build out area to Metter Road will be improved to provide flood protection, recreation, and wildlife habitat. Native California vegetation will be planted, requiring minimal maintenance. The bottom width of the dual-purpose channel will be 10 feet. The channel will also have side slopes of 6H:1V (horizontal: vertical). There will be pedestrian/bike paths on both sides of the channel which will also provide maintenance access. The build out areas west and east of the Main Canal will drain directly to the improved Main Canal, eliminating the need for a large trunk drain along Larkin Road.

To convey the increased flow to the East Basin, parallel 42-in culverts would be constructed where the Main Canal meets the diversion channel to the East Basin (model nodes MC0500 to MC0490). The flow continuing south in the Main Canal would be limited by constructing an 18-in low flow orifice in the canal. Excess flows will be diverted east via a dual-purpose channel with a bottom width of 10 feet and side slopes of 6H:1V to the East Detention Basin. The new channel will provide flow conveyance and detention storage.

2. EAST DETENTION BASIN (JOINT USE BASIN)

The runoff from the Northeast Quadrant of the City will be diverted to the Feather River. The East Detention Basin will be designed as a dual-purpose basin, providing both flood protection and recreational uses. The basin sides will be gentle, 10H:1V, eliminating the need for fencing and allowing the basin bottom to function as a park. The basin surface area will be divided into two portions; with a deep section about 3 feet lower than the upper area. The deepest part of the basin will have a depth of 6 feet. The basin will be drained by a 20 cfs pump station that will discharge to the Feather River. The elevation area data used in the model are shown in Table 11-4. The flow would be pumped through a 36-in force main. The 100-year peak runoff inflow to the East Detention Basin is 15 cfs and the 100-year peak inflow from the west via the inlet pipe is 60 cfs. The East Detention Basin will detain 19.2 acre-feet of runoff during the 100-year storm.

3. LATERAL 5 IMPROVEMENT

A section of Lateral 5 will be in developed areas in the future build out land use conditions. Alternative 1 includes the construction of a 48-inch to 60-inch storm drain from east of Highway 99 to the South Detention Basin.

Table 11-3. Detention Basin Summary

	North Detention Basin NBSN		East Detention Basin EBSN		Caltrans Property Detention Basin CBSN		South Detention Basin SBSN		West Detention Basin WBSN	
Inlet Data										
Type	Trapezoidal Channel		Trapezoidal Channel		Side Flow Weir		Side Flow Weir		Inlet Weir	
Weir Length (ft)	-		-		240		50		-	
Weir Spill Crest Elev. (ft)	-		-		70.0		69		-	
Storm Drain Size (in dia.)	-		60		-		60		Twin 42	
Bottom width of Channel (ft)	10.0		-		-		-		-	
Outlet Data[(a)]										
Type	Pipe		Pump Station		Pipe		Pipe		Pump Station	
Size	18-inch RCP		20 cfs		24-in RCP		24-in RCP		5 cfs	
Results Data										
	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year	100-Year	10-Year
Peak WSE (ft)	78.4	76.0	78.6	76.6	73.8	71.7	71.6	69.1	72.1	70.5
Freeboard (ft)	-1.1	-3.5	-1.4	-3.4	-1.5	-3.6	-0.9	-3.4	-1.4	-3.0
Peak Storage (ac-ft)	153.1	80.2	19.3	7.2	43.3	14.2	154.6	94.2	33.8	21.4
Runoff to Node (cfs)	420	278	15	10	82	59	-	-	134	111
Channel Inflow (cfs)	305	171	-	-	-	-	-	-	-	-
Weir Inflow (cfs)	-	-	-	-	320	144	253	143	-	-
Pipe Inflow (cfs)	-	-	60	36	-	-	105	85	66	50
Pipe Outflow (cfs)	16	13	-	-	16	11	8	6	-	-

(a) The basin would be graded to drain to the outlet culverts or pump station.

Table 11-4. Alternative 4 Detention Basin Elevation/Area/Storage

Caltrans Property Detention Basin (CBSN)			
Elevation	Depth	Area, ac	Storage, af
69.3	0.0	0.0	0.0
69.8	0.5	6.4	1.6
72.3	3.0	7.1	18.5
72.8	3.5	18.2	24.8
75.3	6.0	21.4	74.2
75.3	6.0	25.5	74.2
West Detention Basin (WBSN)			
Elevation	Depth	Area, ac	Stor, af
69.3	0.0	5.1	0.0
75.3	6.0	6.0	33.3
75.3	6.0	6.9	33.3
East Detention Basin (EBSN)			
Elevation	Depth	Area, ac	Stor, af
74.0	0.0	0.0	0.0
74.5	0.5	2.8	0.7
77.0	3.0	3.5	8.5
77.5	3.5	7.3	11.2
80.0	6.0	8.6	31.0
80.0	6.0	12.4	31.0
North Detention Basin (NBSN)			
Elevation	Depth	Area, ac	Stor, af
71.5	0	0.0	0.0
73.4	1.9	2.2	2.1
73.5	2.0	29.8	3.7
79.5	8.0	31.7	188.2
79.5	8.0	33.9	188.2
South Detention Basin (SBSN)			
Elevation	Depth	Area, ac	Stor, af
65.5	0.0	0.0	0.0
66.0	0.5	23.7	5.9
72.0	6.5	25.4	153.2
72.5	7.0	26.0	166.0
72.5	7.0	28.0	166.0

Note: Elevation data show full-site area, which includes the access roads.

4. SOUTH DETENTION BASIN

The South Detention Basin will be constructed to mitigate the increased flows from 122 acres of developed area downstream of the existing City. The South Detention Basin is located south of the Paseo Avenue and west of Highway 99. The Lateral 5 storm drain will empty directly into the South Detention Basin. There will be a 42-inch calvert in the Main Canal that restricts flow continuing down the Main Canal and diverts flow into the South Detention Basin. As shown in Table 11-3, 253 cfs from the Main Canal will flow to the South Detention Basin via the inlet weir, and 105 cfs will flow to the South Detention Basin via the storm drain pipe coming from the east. The capacity in the Paseo Road culvert will be increased with a 54-in RCP constructed in parallel with the existing 48-in CMP. The South Detention Basin will store 154.6 acre-feet during the 100-year storm. The peak 100-year outflow through the 24-inch outlet pipe is 8 cfs.

5. LATERAL 6 AND DIVERSION TO NORTH DETENTION BASIN

These facilities include the construction of a 66-inch and 72-inch storm drains and box culverts that convey flow under Highway 99 and the railroad. A 6 feet x 5 feet box culvert will be constructed in parallel to the existing box culvert at Highway 99. The storm drain system will cross Highway 99 in the existing and future 6 feet x 5 feet box culverts, cross under the railroad in twin 6 feet x 5 feet box culverts, and transition into a trapezoidal channel with a bottom width of 10 feet and side slopes of 6H:1V. There will also be a 54-inch storm drain that crosses under the railroad that drains the developed area between Highway 99 and the railroad. This storm drain will drain to the constructed channel, which drains to the North Detention Basin.

6. NORTH DETENTION BASIN AND LUTHER ROAD STORM DRAIN

The North Detention Basin will be located in the Northeast Quadrant of the City north of the future Garden Glen Development (north of Pennington Road). The basin will drain through an existing trunk storm drain in Luther Road. This existing trunk drain consists of 48-, 54-, and 60-inch diameter pipes that were constructed for the future Garden Glen Development. The trunk drain will be extended with a segment of 36-inch storm drain.

The North Detention Basin will detain 153.1 acre-ft during the 100-year design storm. This detention basin will drain through an 18-inch pipe segment that discharges to the new 36-in trunk drain. Flow from the Garden Glen Development and the discharge from the North Detention Basin will be constricted by a segment of 30-inch storm drain south of Pennington Road. This constriction will back water up through the trunk storm drain and force it into the North Detention Basin. The 100-year peak runoff inflow to the North Detention Basin is 420 cfs, and the 100-year peak channel inflow from the east is 305 cfs. The peak flow out of the basin is 16 cfs. The elevation area data used in the model are shown in Table 11-4.

7. CALTRANS PROPERTY DETENTION BASIN (JOINT USE BASIN)

The Caltrans Property Detention Basin is located on property once owned by Caltrans and is downstream of the Apricot Street Pump Station. The Caltrans Property Detention Basin will take 21.4 acres of the 26 acre parcel. The channel to the north and west of the basin will be designed to provide detention storage, with a bottom width of 10 feet and gentle side slopes of 6H:1V. The elevation area data used in the model are shown in Table 11-4. Storm flows will enter the Caltrans Property Detention Basin via a 240-foot long inlet weir located on the north side of the basin. A 100-year peak flow over the weir of 320 cfs and 82 cfs of runoff flow from surrounding developed areas will enter Caltrans Property Detention Basin, resulting in a 100-year peak storage of 43.3 ac-ft. The Caltrans Property Detention Basin will be emptied by a 24-inch pipe to the adjacent storm drain system.

8. LATERAL 2 IMPROVEMENTS FROM THE APRICOT STREET PUMP STATION TO THE CALTRANS SITE DETENTION BASIN TO PASEO ROAD

For build out conditions, the water levels upstream of the pump station increase under the existing operation of the Apricot Street pump station. There are two 30 cfs pumps in the Apricot Street pump station. For Alternative 4, the "on" elevation of the second pump was changed from 73.0 feet to 71.5 feet. This minor adjustment in the pump station operations sufficiently lowered the water levels in the upstream storm drains to existing conditions levels.

The flow in the channel will be constricted downstream of the Caltrans Property Detention Basin with a 24-inch orifice, causing storm water to backup the channel and flow over the weir into the basin. Downstream of the restrictive 24-inch culvert to Paseo Avenue, the existing Lateral 2 channel will be improved to provide flood protection, recreation, and wildlife habitat. Native California vegetation will be planted, requiring minimal maintenance. The side-slopes will be gentle at 6H:1V. There will be pedestrian/bike paths on both sides of the channel which will also provide maintenance access. The channel bottom width will range from 10 to 20 feet, with restrictive culverts at the southeast corner of the WWTP property and at Paseo Road. Alternative 4 lowers the water level at Paseo Road, but does not eliminate flooding. Nearby development should be graded to ensure adequate freeboard.

9. WWTP STORM DRAIN AND INLET WEIR IMPROVEMENTS

The channel north and east of the WWTP property will be replaced with a 36-inch storm drain, and will discharge to the improved channel at the southeast corner of the WWTP property. Under Alternative 4, the 30-feet wide inlet weir to the Pennington Ranch Detention Basin was lowered from 72.2 feet to 71.0 feet. The inlet weir to the WWTP was set at a width of 30-feet and with a crest elevation of 70.0 feet. The ultimate Pennington Ranch configuration is based on the *Pennington Ranch Drainage Report* (February 2009). The WWTP Detention Basin configuration is based on plans provided by the City. The parameters and the results of the Pennington Ranch and WWTP Detention Basins are shown in Table 11-5.

Table 11-5. Pennington Ranch and WWTP Detention Basin Parameters and Results

	Pennington Ranch Detention Basin		WWTP Detention Basin	
Invert Elev. (ft)	70.0		68.0	
Area at Invert Elev. (acres)	7.0		5.4	
Top Elev. (ft)	75.0		75.0	
Area at Top Elev. (acres)	7.7		6.0	
Weir Crest Elev. (ft)	71.0		70.0	
Weir Length (ft)	30.0		30.0	
	10-Year	100-Year	10-Year	100-Year
Peak Water Surface Elev. (ft)	68.8	72.9	71.2	72.9
Peak Storage (ac-ft)	5.3	36.2	20.2	30.4
Peak Weir Inflow (cfs)	36	105	146	210

10. LATERAL 2 IMPROVEMENTS AT TOWNSHIP ROAD

Lateral 2 at Township Road will be replaced with a twin 42-inch storm drain that will drain future developed areas. This storm drain will discharge to West Detention Basin.

11. WEST DETENTION BASIN

Runoff from the development in the southwest corner of the City will drain through a twin 42-inch trunk drain to the West Detention Basin. The West Detention Basin is an on-line detention basin with a 100-year peak inflow through the storm drain of 66 cfs and a 100-year peak tributary runoff from adjacent developed areas of 134 cfs. The West Detention Basin will store 33.8 acre-feet during the 100-year storm. The outlet structure is a 5 cfs pump station that drains to Lateral 2. The existing 100-year water surface elevation at Node L02-0130 is 72.5 feet (1.0 foot of flooding). The agricultural land near the development will see a decrease in water levels. The elevation area data for the West Detention Basin are shown in Table 11-4.

COMPARISON WITH EXISTING CONDITIONS

The overall performance of the City's storm drain system and RD 777's channels with the Alternative 4 improvements is summarized in Table 11-6 and discussed below. In Table 11-6:

- The nodes with over one foot of freeboard are not shaded any color.
- The nodes with less than one foot of freeboard are shaded green.
- The nodes with up to one foot of flooding are shaded yellow.
- The nodes with one to two feet of flooding are shaded red.
- The nodes with over two feet of flooding depth are shaded purple.
- The nodes where there is an increase in water surface elevations for Alternative 3 over existing conditions are shaded gray.

Table 11-6. Node Data and Model Results for Alternative 4

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
NBSN	71.5	79.5	--	--	76.0	-3.5	--	--	--	78.4	-1.1	--
CBSN	69.3	75.3	--	--	71.7	-3.6	--	--	--	73.8	-1.5	--
SBSN	65.0	72.5	--	--	69.1	-3.4	--	--	--	71.6	-0.9	--
EBSN	71.0	80.0	--	--	76.6	-3.4	--	--	--	78.6	-1.4	--
WBSN	67.5	73.5	--	--	70.5	-3.0	--	--	--	72.1	-1.4	--
WWTP_DB	67.0	75.0			71.2			--	--	72.9	-2.1	--
EIC0010	43.9	55.3	54.8	-0.5	54.8	-0.5	0.0	54.8	-0.5	54.8	-0.5	0.0
EIC0020	44.4	55.7	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.8	55.1	-0.6	0.1
EIC0030	44.8	55.8	54.8	-0.9	54.8	-0.9	0.0	55.0	-0.7	55.2	-0.6	0.1
EIC0040	44.9	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.5	0.4	0.2
EIC0050	45.0	56.1	54.8	-1.3	54.8	-1.3	0.0	56.4	0.3	56.6	0.4	0.2
EIC0060	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.3	57.4	0.0	0.3
EIC0070	46.6	57.4	54.8	-2.6	54.8	-2.6	0.0	57.1	-0.4	57.4	-0.1	0.3
EIC0075	47.2	57.9	54.8	-3.0	54.8	-3.0	0.0	57.4	-0.4	57.8	-0.1	0.4
EIC0080	48.1	58.5	54.9	-3.6	54.9	-3.6	0.0	57.5	-1.0	57.9	-0.6	0.3
EIC0090	48.2	58.6	54.9	-3.7	54.9	-3.7	0.0	57.5	-1.1	57.9	-0.7	0.3
EIC0100	50.1	57.8	55.6	-2.3	55.8	-2.0	0.3	59.1	1.3	59.3	1.5	0.2
EIC0110	50.2	59.2	55.6	-3.7	55.8	-3.4	0.3	59.1	-0.1	59.3	0.1	0.2
EIC0120	50.3	63.1	55.9	-7.2	56.1	-7.0	0.2	59.4	-3.6	59.6	-3.5	0.1
EIC0130	50.0	60.8	55.9	-4.9	56.1	-4.7	0.2	59.4	-1.3	59.6	-1.2	0.1
EIC0140	50.0	59.2	56.0	-3.2	56.2	-3.0	0.2	59.6	0.4	59.8	0.5	0.1
EIC0150	49.8	58.6	56.0	-2.6	56.2	-2.4	0.2	59.6	1.0	59.8	1.1	0.1
L01-0090	59.5	70.1	65.7	-4.4	64.6	-5.5	-1.1	67.3	-2.7	65.9	-4.1	-1.4
L01-0100	59.2	69.7	65.8	-4.0	64.7	-5.0	-1.0	67.4	-2.3	66.1	-3.7	-1.3
L01-0110	60.1	68.3	66.3	-2.1	65.6	-2.7	-0.6	67.8	-0.5	66.9	-1.4	-0.9
L01-0120	59.9	68.3	66.3	-2.0	65.7	-2.6	-0.6	67.9	-0.4	67.0	-1.3	-0.9
L01-0170	58.9	69.0	66.3	-2.7	65.7	-3.3	-0.6	67.9	-1.1	67.0	-2.0	-0.9
L01-0180	58.7	67.5	66.6	-0.9	66.0	-1.5	-0.6	68.4	0.9	67.5	0.0	-0.9
L01-0190	60.2	68.6	67.0	-1.6	66.5	-2.2	-0.5	68.7	0.1	67.9	-0.7	-0.8
L01-0200	61.4	69.5	67.2	-2.3	66.7	-2.8	-0.5	68.8	-0.7	68.1	-1.4	-0.7
L01-0210	61.3	69.4	67.4	-2.0	66.9	-2.5	-0.5	69.1	-0.3	68.4	-1.0	-0.7
L01-0220	62.4	71.4	67.9	-3.5	67.3	-4.0	-0.6	69.4	-2.0	68.7	-2.7	-0.7
L01-0230	62.4	69.9	70.7	0.8	69.0	-0.9	-1.7	72.9	3.0	71.2	1.3	-1.6
L01-0240	63.9	70.5	70.9	0.4	69.3	-1.2	-1.6	72.9	2.5	71.3	0.9	-1.6
L01-0250	65.0	71.3	70.9	-0.4	69.3	-2.0	-1.6	73.0	1.6	71.3	0.0	-1.6
L01-0260	65.2	71.4	72.8	1.4	70.0	-1.4	-2.8	74.6	3.2	72.8	1.4	-1.8
L01-0270	65.3	71.5	72.8	1.4	70.0	-1.4	-2.8	74.6	3.1	72.8	1.3	-1.8
L01-0280	65.5	71.6	73.1	1.5	70.1	-1.4	-2.9	74.8	3.2	73.0	1.4	-1.8
L01-0290	67.6	72.4	73.1	0.6	70.2	-2.2	-2.9	74.8	2.4	73.0	0.5	-1.8
L01-0300	67.9	73.2	73.1	-0.1	70.2	-3.0	-2.9	74.8	1.6	73.0	-0.2	-1.8
L01-0310	67.3	73.4	73.1	-0.3	70.2	-3.2	-2.9	74.8	1.4	73.0	-0.4	-1.8
L01-0320	66.9	73.5	73.1	-0.4	70.2	-3.3	-2.9	74.8	1.3	73.0	-0.5	-1.8
L01-0330	67.0	74.1	73.1	-1.0	70.2	-3.9	-2.9	74.8	0.7	73.0	-1.1	-1.8
L01-0340	69.9	72.6	73.1	0.5	70.2	-2.4	-2.9	74.8	2.2	73.0	0.3	-1.8
L02-0010	55.4	63.3	62.0	-1.3	62.0	-1.2	0.1	64.2	0.9	63.8	0.5	-0.4
L02-0020	55.5	63.5	62.2	-1.3	62.1	-1.4	-0.1	64.4	0.9	63.9	0.4	-0.6
L02-0030	55.1	63.7	62.2	-1.4	62.2	-1.5	-0.1	64.5	0.8	63.9	0.3	-0.5
L02-0032	55.9	64.3	63.1	-1.1	62.6	-1.6	-0.5	65.2	0.9	64.3	0.1	-0.9
L02-0040	56.8	65.0	64.2	-0.8	63.3	-1.8	-1.0	66.2	1.2	64.9	-0.1	-1.3
L02-0042	57.0	65.3	64.6	-0.7	63.5	-1.8	-1.1	66.5	1.2	65.0	-0.2	-1.4
L02-0044	57.1	65.4	64.7	-0.7	63.5	-1.9	-1.2	66.5	1.2	65.1	-0.3	-1.5
L02-0050	59.7	70.4	65.5	-4.9	64.1	-6.3	-1.4	67.1	-3.2	65.5	-4.9	-1.7
L02-0060	60.2	66.9	66.7	-0.1	65.7	-1.1	-1.0	68.3	1.4	67.3	0.4	-1.0
L02-0064	60.3	66.2	67.8	1.6	67.3	1.1	-0.4	69.6	3.4	69.3	3.1	-0.3
L02-0070	58.9	65.5	67.8	2.3	67.3	1.9	-0.4	69.6	4.1	69.3	3.8	-0.3
L02-0080	59.3	66.0	68.2	2.2	67.9	1.9	-0.3	70.3	4.3	70.1	4.1	-0.2
L02-0086	59.2	68.9	68.2	-0.7	67.9	-1.0	-0.3	70.3	1.3	70.1	1.2	-0.2
L02-0088	59.4	68.9	68.3	-0.7	68.0	-1.0	-0.3	70.3	1.4	70.2	1.3	-0.1
L02-0090	62.5	68.2	68.3	0.1	68.0	-0.2	-0.3	70.3	2.2	70.2	2.0	-0.1
L02-0095	62.7	68.6	68.3	-0.3	68.0	-0.6	-0.3	70.4	1.8	70.3	1.6	-0.1
L02-0100	62.7	69.6	68.4	-1.2	68.1	-1.5	-0.3	70.5	1.0	70.4	0.8	-0.1
L02-0102	64.2	68.8	68.5	-0.3	68.2	-0.6	-0.3	70.6	1.8	70.4	1.7	-0.2
L02-0104	64.2	69.0	68.9	-0.1	68.4	-0.6	-0.5	71.0	2.1	70.8	1.8	-0.3
L02-0106	64.0	68.5	68.9	0.4	68.4	-0.1	-0.5	71.1	2.5	70.8	2.3	-0.3
L02-0108	64.1	68.6	69.7	1.1	68.9	0.3	-0.7	72.0	3.4	71.5	2.9	-0.5
L02-0110	64.9	69.5	69.7	0.2	69.0	-0.5	-0.7	72.0	2.5	71.5	2.0	-0.5
L02-0120	64.4	71.4	70.1	-1.3	69.2	-2.2	-0.9	72.5	1.1	71.9	0.5	-0.6
L02-0130	66.2	71.5	70.1	-1.4	69.2	-2.3	-0.9	72.5	1.0	71.9	0.4	-0.6
L02-0140	67.6	73.5	70.2	-3.3	70.5	-3.0	--	72.6	-0.9	72.1	-1.4	--
L02-0150	68.2	73.5	70.2	-3.3	71.1	-2.4	--	72.6	-0.9	72.1	-1.4	--
L02-0160	68.3	73.5	70.4	-3.1	71.2	-2.3	--	73.0	-0.5	72.2	-1.3	--
L02-0170	68.9	73.5	70.4	-3.1	72.5	-1.0	--	73.0	-0.5	74.0	0.5	--
L02-0180	68.9	73.9	73.5	-0.3	72.6	-1.2	--	74.5	0.6	74.1	0.3	--
L02-0190	66.9	71.1	70.2	-0.9	69.2	-1.9	-1.0	72.5	1.4	71.8	0.8	-0.6
L02-0200	66.5	70.9	70.9	0.0	69.3	-1.6	-1.6	72.9	2.1	71.3	0.5	-1.6
L02-0210	64.0	70.5	70.9	0.4	69.3	-1.2	-1.6	72.9	2.5	71.3	0.8	-1.6
L02-0220	63.7	71.1	70.9	-0.2	69.3	-1.7	-1.6	72.9	1.9	71.3	0.3	-1.6
L02-0230	62.9	70.4	70.9	0.5	69.3	-1.1	-1.6	73.0	2.5	71.3	0.9	-1.6
L02-0237	67.1	75.2	72.7	-2.5	72.2	-3.0	-0.5	73.9	-1.3	73.3	-1.9	-0.6
L02-0238	67.4	75.0	72.7	-2.3	72.2	-2.8	-0.5	73.9	-1.1	73.7	-1.3	-0.2
L02-0239	67.7	75.4	72.7	-2.7	72.5	-2.9	-0.2	73.9	-1.5	74.6	-0.8	0.8
L02-0240	63.0	69.5	71.1	1.6	69.7	0.2	-1.4	73.2	3.7	71.8	2.3	-1.4
L02-0243	68.3	75.4	72.7	-2.7	72.4	-3.0	-0.3	73.9	-1.5	75.0	-0.4	1.1
L02-0244	68.9	75.5	72.7	-2.8	72.5	-3.0	-0.2	73.9	-1.6	75.6	0.1	1.7
L02-0246	67.8	75.0	72.7	-2.3	71.8	-3.2	-1.0	73.9	-1.1	72.9	-2.1	-1.1
L02-0247	68.0	75.2	72.7	-2.5	72.0	-3.2	-0.7	73.9	-1.3	73.4	-1.8	-0.5
L02-0250	63.6	72.7	71.1	-1.6	69.7	-3.0	-1.4	73.2	0.5	71.8	-1.0	-1.4
L02-0252	64.4	73.2	72.5	-0.8	69.7	-3.5	-2.7	73.7	0.5	71.8	-1.5	-2.0
L02-0253	64.6	73.9	72.7	-1.2	69.7	-4.1	-2.9	73.8	-0.1	71.8	-2.1	-2.0
L02-0254	66.1	73.9	72.7	-1.2	69.8	-4.1	-2.9	73.8	-0.1	71.8	-2.1	-2.1
L02-0255	66.7	74.2	72.7	-1.5	72.1	-2.2	-0.6	73.9	-0.4	73.2	-1.0	-0.7
L02-0260	67.1	74.7	72.7	-1.9	71.5	-3.1	-1.2	73.9	-0.7	72.9	-1.8	-1.1

Table 11-6. Node Data and Model Results for Alternative 4

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L02-0261	66.9	76.0	72.7	-3.3	72.1	-3.9	-0.6	73.9	-2.1	73.2	-2.8	-0.6
L02-02601	66.9	77.0	--	--	71.3	-5.7	--	--	--	72.9	-4.1	--
L02-0262	67.1	75.0	72.7	-2.3	72.2	-2.8	-0.5	73.9	-1.1	73.3	-1.7	-0.6
L02-0270	67.0	74.2	72.7	-1.5	71.6	-2.7	-1.2	73.9	-0.3	72.9	-1.4	-1.1
L02-0272	66.6	73.8	72.7	-1.1	71.6	-2.2	-1.1	73.9	0.1	72.9	-0.9	-1.1
L02-0273	67.7	75.0	72.7	-2.3	71.8	-3.2	-1.0	73.9	-1.1	72.9	-2.1	-1.1
L02-0275	68.0	75.0	70.8	-4.2	68.7	-6.3	-2.1	73.9	-1.1	72.9	-2.1	-1.0
L02-0277	69.4	76.0	72.8	-3.2	73.0	-3.0	0.2	75.3	-0.7	75.4	-0.6	0.1
L02-0278	69.3	74.6	72.8	-1.9	72.8	-1.8	0.1	74.8	0.1	74.9	0.2	0.1
L02-0279	68.3	75.6	72.8	-2.8	72.7	-2.9	-0.1	75.6	0.0	76.1	0.5	0.5
L02-0280	67.9	74.1	72.7	-1.4	71.8	-2.3	-1.0	73.9	-0.2	72.9	-1.2	-1.1
L02-0281	69.0	77.0	72.8	-4.2	73.0	-4.0	0.2	77.0	0.0	77.0	0.0	0.0
L02-0282	68.4	75.8	72.8	-3.0	72.8	-3.0	0.0	75.8	0.0	75.8	0.0	0.0
L02-0283	68.9	75.2	72.8	-2.4	73.0	-2.1	0.3	75.5	0.3	75.6	0.4	0.1
L02-0284	68.3	74.9	72.8	-2.1	72.1	-2.8	-0.8	74.0	-0.9	73.2	-1.7	-0.8
L02-0286	69.4	76.2	72.8	-3.4	73.5	-2.7	0.7	76.4	0.2	76.4	0.2	0.0
L02-0287	71.0	78.6	72.8	-5.8	74.1	-4.5	1.3	78.5	-0.1	78.5	-0.1	0.0
L02-0288	70.4	77.5	72.8	-4.7	73.4	-4.0	0.6	77.5	0.0	77.5	0.0	0.0
L02-0290	68.7	76.3	72.9	-3.4	72.4	-3.9	-0.6	74.1	-2.2	74.0	-2.3	-0.1
L02-0291	68.9	76.0	73.0	-3.0	72.5	-3.5	-0.5	74.2	-1.8	74.3	-1.7	0.1
L02-0292	69.0	76.0	73.0	-3.0	72.5	-3.5	-0.5	74.2	-1.8	74.5	-1.5	0.3
L02-0293	69.9	75.3	73.0	-2.3	72.5	-2.8	-0.5	74.2	-1.1	74.4	-0.9	0.2
L02-0300	68.7	78.0	73.1	-4.9	72.9	-5.1	-0.2	74.3	-3.7	74.6	-3.4	0.3
L02-0302	72.8	78.3	75.3	-3.1	72.8	-5.5	-2.5	76.2	-2.1	74.5	-3.8	-1.7
L02-0421	69.4	76.8	75.5	-1.3	75.5	-1.2	0.1	76.5	-0.3	76.5	-0.3	0.0
L02-0422	70.7	76.8	76.8	0.0	76.8	0.0	0.0	77.0	0.2	77.0	0.2	0.0
L02-0424	70.5	76.9	77.2	0.2	77.2	0.3	0.1	77.7	0.8	77.7	0.8	0.0
L02-0425	69.5	76.1	75.5	-0.6	75.5	-0.5	0.1	76.5	0.4	76.5	0.5	0.0
L02-0426	62.0	76.9	75.4	-1.5	75.5	-1.5	0.1	76.4	-0.5	76.4	-0.5	0.0
L02-0427	70.1	76.5	76.4	-0.1	76.5	0.0	0.1	77.1	0.6	77.1	0.6	0.0
L02-0428	72.1	77.0	76.1	-0.9	75.3	-1.7	-0.8	77.1	0.1	77.0	0.0	-0.1
L02-0430	65.3	75.1	72.9	-2.3	71.8	-3.4	-1.1	73.9	-1.3	73.7	-1.5	-0.2
L02-0440	65.6	75.2	73.0	-2.2	71.8	-3.5	-1.3	74.1	-1.2	73.7	-1.6	-0.4
L02-0440U	65.9	74.5	--	--	72.4	-2.2	--	--	--	73.8	-0.7	--
L02-0450	66.3	75.4	73.1	-2.3	72.4	-3.0	-0.7	74.2	-1.1	73.8	-1.6	-0.4
L02-0450U	66.5	75.5	--	--	72.4	-3.1	--	--	--	73.8	-1.7	--
L02-0460	66.3	75.3	73.2	-2.1	72.7	-2.7	-0.6	74.4	-1.0	73.8	-1.5	-0.5
L02-0461	70.7	76.0	72.9	-3.1	72.2	-3.8	-0.6	74.3	-1.7	73.8	-2.2	-0.6
L02-0462	70.5	75.4	73.0	-2.4	72.8	-2.6	-0.2	75.4	0.0	75.2	-0.2	-0.2
L02-0463	70.1	76.1	72.9	-3.1	72.7	-3.4	-0.3	74.3	-1.7	74.1	-2.0	-0.3
L02-0464	70.7	76.0	72.9	-3.2	72.3	-3.8	-0.6	74.3	-1.7	73.8	-2.2	-0.6
L02-0465	69.9	75.4	73.1	-2.3	72.7	-2.7	-0.4	74.3	-1.1	74.1	-1.3	-0.2
L02-0467	69.1	75.4	73.2	-2.2	72.7	-2.7	-0.5	74.4	-1.0	74.1	-1.3	-0.3
L02-0468	69.6	75.2	73.2	-2.0	72.7	-2.5	-0.5	74.3	-0.8	74.1	-1.0	-0.2
L02-0470	67.0	75.3	73.3	-2.0	72.8	-2.5	-0.5	74.5	-0.9	73.9	-1.4	-0.6
L02-0471	70.9	75.2	73.3	-1.9	72.8	-2.4	-0.5	74.9	-0.3	75.1	-0.2	0.2
L02-0472	71.2	75.7	73.3	-2.4	73.1	-2.6	-0.2	75.7	0.0	75.8	0.1	0.0
L02-0480.1	67.7	76.9	74.8	-2.0	75.1	-1.7	0.3	75.7	-1.2	77.0	0.1	1.3
L02-0481	68.6	76.3	74.1	-2.2	73.0	-3.3	-1.1	75.0	-1.3	73.9	-2.3	-1.0
L02-0481A	68.3	75.8	--	--	72.9	-2.9	--	--	--	73.9	-1.9	--
L02-0481B	68.9	75.0	--	--	73.0	-2.0	--	--	--	74.1	-0.9	--
L02-0482	69.2	77.7	76.4	-1.2	72.9	-4.8	-3.6	77.7	0.1	75.7	-2.0	-2.1
L02-0483	69.1	74.4	74.4	0.0	73.0	-1.4	-1.4	75.0	0.7	74.0	-0.3	-1.0
L02-0484	69.6	75.2	74.7	-0.5	73.0	-2.2	-1.7	75.2	0.0	74.2	-1.0	-1.0
L02-0485	70.3	75.2	75.0	-0.2	73.5	-1.8	-1.6	75.4	0.2	75.5	0.2	0.0
L02-0485A	70.6	77.2	--	--	73.6	-3.6	--	--	--	76.0	-1.2	--
L02-0485B	71.0	76.5	--	--	74.0	-2.5	--	--	--	76.8	0.3	--
L02-0485C	72.0	77.5	--	--	74.6	-2.9	--	--	--	77.9	0.4	--
L02-0485D	72.4	77.5	--	--	74.8	-2.7	--	--	--	78.1	0.6	--
L02-0485E	71.1	77.3	--	--	73.9	-3.4	--	--	--	77.3	0.0	--
L02-0490	59.5	76.9	73.4	-3.5	72.8	-4.0	-0.5	74.5	-2.3	73.6	-3.2	-0.9
L02-0500	66.1	75.3	74.8	-0.5	74.4	-0.9	-0.4	75.9	0.6	75.4	0.1	-0.5
L02-0502	72.5	77.0	74.8	-2.2	74.5	-2.6	-0.3	75.9	-1.1	75.6	-1.5	-0.3
L02-0503	69.0	75.6	74.8	-0.8	74.8	-0.8	0.0	75.9	0.3	75.8	0.2	-0.1
L02-0504	69.0	75.4	75.0	-0.4	--	--	--	76.1	0.7	--	--	--
L02-0505	73.4	76.5	75.0	-1.5	--	--	--	76.1	-0.4	--	--	--
L02-0506	72.0	77.7	75.1	-2.5	75.3	-2.4	0.1	76.2	-1.4	77.7	0.0	1.4
L02-0507	71.0	77.1	76.5	-0.6	75.5	-1.5	-1.0	76.7	-0.3	77.1	0.1	0.4
L02-0510	68.8	77.8	75.9	-1.8	75.2	-2.6	-0.7	77.2	-0.6	77.5	-0.2	0.3
L02-0511	71.6	76.9	77.0	0.0	76.3	-0.6	-0.7	77.5	0.6	77.0	0.0	-0.6
L02-0512	68.2	75.0	75.0	-0.1	74.7	-0.4	-0.3	76.1	1.1	75.7	0.7	-0.4
L02-0513	73.1	77.8	77.9	0.1	75.1	-2.7	-2.8	78.5	0.7	78.6	0.7	0.0
L02-0514	68.5	75.3	75.1	-0.2	74.7	-0.6	-0.4	76.0	0.7	75.7	0.4	-0.3
L02-0515	68.6	76.4	76.4	0.0	74.9	-1.4	-1.4	76.4	0.1	76.4	0.0	0.0
L02-0516	69.4	75.9	76.1	0.1	76.0	0.0	-0.1	77.0	1.0	76.9	0.9	-0.1
L02-0517	71.2	77.4	76.4	-1.0	75.0	-2.3	-1.3	76.4	-0.9	77.4	0.0	0.9
L02-0518	69.1	78.7	77.4	-1.2	73.8	-4.8	-3.6	79.1	0.5	78.2	-0.4	-0.9
L02-0518A	68.8	78.0	--	--	73.8	-4.2	--	--	--	78.0	0.0	--
L02-0520	70.3	79.0	77.6	-1.4	73.9	-5.0	-3.7	79.2	0.2	79.2	0.2	0.0
L02-0520A	69.4	78.4	--	--	73.9	-4.5	--	--	--	78.4	0.0	--
L02-0522	70.4	79.2	78.8	-0.4	74.0	-5.2	--	81.0	1.8	79.3	0.1	--
L02-0530	71.2	79.2	79.3	0.1	74.3	-4.9	-5.0	81.0	1.9	79.4	0.2	-1.7
L02-0538	68.6	76.0	76.3	0.3	75.6	-0.4	-0.7	77.2	1.2	76.7	0.7	-0.4
L02-0538AA	69.9	78.1	--	--	75.3	-2.8	--	--	--	77.1	-1.0	--
L02-0538BB	69.9	78.1	--	--	75.8	-2.3	--	--	--	78.3	0.2	--
L02-0540	70.2	78.1	78.3	0.2	75.5	-2.6	-2.8	78.4	0.3	77.3	-0.8	-1.1
L02-0541	70.7	77.7	78.3	0.6	77.0	-0.7	-1.3	79.0	1.3	78.2	0.5	-0.8
L02-0542	71.2	78.4	78.5	0.1	77.7	-0.7	-0.8	79.2	0.8	78.7	0.3	-0.5
L02-0543	71.5	79.2	79.2	0.0	78.4	-0.8	-0.8	79.4	0.2	79.2	0.0	-0.2
L02-0544	72.0	79.9	79.9	0.1	79.9	0.0	0.0	80.1	0.3	80.1	0.3	0.0
L03-0010	63.0	71.6	68.9	-2.7	68.2	-3.3	-0.6	70.8	-0.8	69.5	-2.1	-1.3
L03-0020	63.1	71.6	69.1	-2.6	68.7	-2.9	-0.4	71.6	0.0	70.9	-0.7	-0.7

Table 11-6. Node Data and Model Results for Alternative 4

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L03-0030	63.5	72.1	69.1	-2.9	68.8	-3.2	-0.3	71.6	-0.4	71.0	-1.1	-0.7
L03-0040	63.5	72.1	69.4	-2.7	69.3	-2.8	0.0	72.5	0.4	72.3	0.2	-0.2
L03-0050	64.0	72.6	69.4	-3.2	69.4	-3.2	0.0	72.5	-0.1	72.3	-0.3	-0.2
L03-0060	64.6	73.2	69.4	-3.8	69.5	-3.8	0.0	72.5	-0.7	72.3	-0.9	-0.2
L03-0062	64.7	73.3	69.6	-3.8	69.6	-3.7	0.0	72.7	-0.6	72.5	-0.8	-0.2
L03-0070	65.9	74.5	69.7	-4.8	69.8	-4.7	0.1	72.7	-1.8	72.5	-2.0	-0.2
L03-0080	66.1	74.7	71.7	-3.0	71.8	-2.8	0.1	74.7	0.0	74.7	0.0	0.0
L03-0090	67.8	76.4	71.9	-4.5	72.0	-4.4	0.1	74.8	-1.6	74.7	-1.7	0.0
L03-0092	67.8	76.4	71.9	-4.5	72.0	-4.4	0.1	74.8	-1.6	74.7	-1.7	0.0
L03-0094	67.9	76.5	79.8	3.3	79.8	3.3	0.0	80.9	4.4	80.9	4.4	0.0
L04-0030	66.9	71.9	71.3	-0.6	70.3	-1.7	-1.1	73.9	2.0	71.3	-0.7	-2.7
L04-0040	67.0	71.6	71.3	-0.3	70.6	-1.0	-0.7	73.9	2.3	71.4	-0.2	-2.5
L04-0050	67.8	72.1	71.3	-0.7	71.0	-1.1	-0.4	73.9	1.9	71.7	-0.4	-2.3
L04-0060	68.3	71.4	71.4	0.0	71.0	-0.4	-0.4	73.9	2.6	71.7	0.4	-2.2
L04-0062	68.2	73.1	71.4	-1.7	71.1	-1.9	-0.2	73.9	0.9	71.8	-1.2	-2.1
L04-0064	68.4	73.3	71.6	-1.7	71.6	-1.7	0.0	74.0	0.7	72.8	-0.5	-1.2
L04-0066	68.0	71.7	71.6	-0.1	71.6	-0.1	0.0	74.0	2.3	72.8	1.1	-1.2
L04-0068	67.8	72.0	72.0	0.1	72.1	0.1	0.1	74.2	2.3	73.7	1.8	-0.5
L04-0070	68.0	74.4	72.2	-2.3	72.2	-2.2	0.1	74.2	-0.2	73.8	-0.6	-0.4
L04-0080	68.1	76.0	72.2	-3.8	72.3	-3.7	0.1	74.3	-1.7	73.9	-2.1	-0.4
L04-0088	68.5	75.0	72.4	-2.7	72.4	-2.6	0.1	74.4	-0.6	74.1	-0.9	-0.3
L04-0090	69.4	73.0	72.5	-0.5	72.6	-0.4	0.1	74.5	1.5	74.3	1.3	-0.2
L04-0092	69.5	73.6	72.6	-1.1	72.7	-1.0	0.1	74.5	0.9	74.3	0.7	-0.2
L04-0094	69.5	73.7	73.0	-0.7	73.1	-0.6	0.1	75.1	1.3	75.1	1.3	0.0
L04-0100	69.6	73.8	73.0	-0.8	73.1	-0.7	0.1	75.1	1.2	75.1	1.2	0.0
L05-0010	65.6	73.8	72.0	-1.8	69.8	-4.0	-2.2	75.0	1.2	71.6	-2.2	-3.4
L05-0012	65.7	73.0	72.0	-0.9	69.9	-3.1	--	75.0	2.0	71.6	-1.4	-3.4
L05-0014	66.0	74.2	72.0	-2.2	70.2	-4.1	--	75.0	0.8	71.6	-2.7	-3.4
L05-0020	66.4	75.9	72.0	-3.8	71.2	-4.6	-0.8	75.0	-0.9	72.5	-3.3	-2.5
L05-0040	66.5	74.0	72.0	-2.0	71.5	-2.5	-0.5	75.0	1.0	73.1	-0.9	-1.9
L05-0050	66.6	74.0	72.7	-1.3	72.1	-1.9	-0.6	75.6	1.6	74.0	0.0	-1.6
L05-0060	69.3	74.2	72.8	-1.4	71.7	-2.5	-1.1	75.6	1.4	74.2	0.0	-1.4
L05-0070	69.4	74.5	72.9	-1.6	72.3	-2.2	-0.6	75.7	1.2	74.4	0.0	-1.2
L05-0080	69.4	74.5	72.9	-1.6	72.3	-2.2	-0.6	75.7	1.1	74.5	0.0	-1.2
L05-0090	69.6	74.8	73.0	-1.9	72.5	-2.3	-0.5	75.7	0.8	74.6	-0.3	-1.1
L05-0100	69.7	75.1	73.0	-2.1	72.7	-2.5	-0.4	75.7	0.5	74.6	-0.5	-1.0
L05-0110	69.8	75.5	73.1	-2.4	72.8	-2.6	-0.3	75.7	0.2	74.7	-0.7	-0.9
L06-0020	69.0	77.2	73.5	-3.6	73.4	-3.7	-0.1	75.7	-1.5	74.6	-2.5	-1.1
L06-0040	68.5	77.2	73.7	-3.5	73.5	-3.7	-0.2	75.7	-1.5	74.7	-2.5	-1.0
L06-0140	69.6	77.6	73.7	-3.9	73.5	-4.1	-0.2	75.8	-1.8	74.7	-2.9	-1.1
L06-0141	69.4	77.2	73.7	-3.5	73.5	-3.7	-0.2	75.7	-1.5	74.7	-2.5	-1.0
L06-0142	69.7	78.2	73.8	-4.4	73.5	-4.6	-0.3	76.0	-2.2	74.9	-3.3	-1.1
L06-0143	71.3	78.2	73.8	-4.4	73.6	-4.6	-0.2	76.0	-2.2	75.2	-3.0	-0.8
L06-0143NA	72.0	77.6	--	--	74.0	-3.6	--	--	--	77.6	0.0	--
L06-0144	72.6	78.1	78.1	0.0	78.1	0.0	0.0	78.4	0.4	78.4	0.4	0.0
L06-0145	72.3	78.3	76.6	-1.7	76.6	-1.7	0.0	77.6	-0.6	77.6	-0.6	0.0
L06-0146	72.8	75.0	75.6	0.6	75.7	0.7	0.0	76.6	1.6	76.6	1.6	0.0
L06-0147	75.0	79.0	76.8	-2.2	76.8	-2.2	0.0	77.0	-2.0	77.0	-2.0	0.0
L06-0148	71.8	77.5	73.7	-3.8	73.6	-3.9	-0.1	75.8	-1.8	74.9	-2.6	-0.8
L06-0149	71.5	77.5	73.7	-3.8	73.6	-3.9	-0.1	75.8	-1.7	74.8	-2.6	-0.9
L06-0150	71.6	77.7	74.2	-3.4	73.6	-4.1	-0.7	76.7	-1.0	75.1	-2.6	-1.5
L06-0150D	72.5	77.0	--	--	73.7	-3.3	--	--	--	76.0	-1.0	--
L06-0151	69.9	77.6	74.0	-3.6	73.6	-4.0	-0.4	76.3	-1.2	75.1	-2.5	-1.2
L06-0151NA	70.5	76.2	--	--	73.8	-2.4	--	--	--	75.8	-0.4	--
L06-0151NB	71.6	76.4	--	--	74.1	-2.3	--	--	--	76.1	-0.2	--
L06-0151NC	72.0	76.5	--	--	74.5	-2.0	--	--	--	76.7	0.2	--
L06-0152	74.0	76.7	76.9	0.2	74.0	-2.7	-2.9	77.3	0.6	75.2	-1.6	-2.2
L06-0200	73.0	79.7	76.6	-3.1	73.7	-5.9	-2.9	78.5	-1.2	75.2	-4.5	-3.3
L06-0220	74.4	79.0	78.3	-0.8	74.9	-4.1	-3.3	80.0	1.0	75.4	-3.6	-4.7
L06-0221	77.0	79.5	78.1	-1.4	77.3	-2.2	-0.8	80.0	0.5	77.3	-2.2	-2.7
L06-0222	77.0	79.5	77.9	-1.6	77.8	-1.7	-0.1	78.8	-0.7	78.2	-1.3	-0.6
L06-0230	75.1	80.5	79.4	-1.1	75.7	-4.8	-3.7	81.5	1.0	75.9	-4.6	-5.6
L06-0240	77.2	80.3	79.5	-0.8	77.5	-2.8	-1.9	81.5	1.2	77.6	-2.7	-3.9
L06-0240AA	67.3	80.5	74.7	-5.9	74.7	-5.9	0.0	75.8	-4.7	75.8	-4.7	0.0
L06-0242	73.4	80.8	79.5	-1.3	--	--	--	81.6	0.8	--	--	--
L06-0245	73.6	80.9	79.5	-1.3	--	--	--	81.6	0.7	--	--	--
L06-0250	73.7	81.4	79.7	-1.7	--	--	--	81.7	0.3	--	--	--
L06-0260	73.8	79.9	79.7	-0.2	--	--	--	81.7	1.9	--	--	--
L06-0270	73.9	81.3	79.7	-1.6	--	--	--	81.8	0.5	--	--	--
L06-0280	74.5	82.9	79.8	-3.2	--	--	--	81.8	-1.1	--	--	--
L06-0290	74.6	83.3	79.9	-3.3	--	--	--	82.1	-1.2	--	--	--
L06-0292	75.4	82.8	79.9	-2.8	--	--	--	82.1	-0.7	--	--	--
L06-0294	75.4	83.3	80.0	-3.3	--	--	--	82.1	-1.2	--	--	--
L06-0300	75.7	83.2	80.0	-3.2	--	--	--	82.1	-1.1	--	--	--
L06-0310	75.9	84.0	85.6	1.6	--	--	--	86.9	2.9	--	--	--
L06-0340	68.3	77.1	74.1	-3.0	73.7	-3.4	-0.4	76.2	-0.9	75.0	-2.1	-1.2
L06-0350	69.1	78.1	74.5	-3.6	73.9	-4.2	-0.6	76.6	-1.5	75.3	-2.8	-1.3
L06-0360	70.0	79.1	74.6	-4.6	73.9	-5.2	-0.6	76.7	-2.4	75.3	-3.8	-1.4
L06-0361	70.0	79.1	74.3	-4.9	73.6	-5.5	-0.7	76.6	-2.5	75.2	-4.0	-1.5
L06-0380	70.9	76.7	75.6	-1.1	74.7	-2.0	-0.9	78.6	1.8	76.3	-0.4	-2.3
L06-0390	71.7	78.8	75.7	-3.1	74.9	-3.9	-0.8	78.6	-0.2	76.5	-2.3	-2.1
L06-0390D	73.5	78.5	--	--	75.0	-3.5	--	--	--	76.6	-1.9	--
L06-0390E	74.0	78.0	--	--	75.2	-2.8	--	--	--	76.9	-1.1	--
L06-0390F	74.0	78.0	--	--	75.0	-3.0	--	--	--	76.6	-1.4	--
L06-0400	72.5	78.2	76.7	-1.5	75.2	-3.0	-1.5	79.7	1.5	76.7	-1.5	-3.1
L06-0430	73.2	81.8	76.9	-4.8	75.5	-6.3	-1.4	79.8	-2.0	76.7	-5.0	--
L06-0432	74.5	81.8	77.0	-4.8	77.2	-4.6	0.2	79.9	-1.9	78.9	-2.9	-1.0
L06-0433	71.2	80.4	76.8	-3.6	75.6	-4.8	-1.2	79.8	-0.6	76.9	-3.5	-2.9
L06-0434	72.2	80.5	76.8	-3.7	76.1	-4.4	-0.7	79.8	-0.7	77.2	-3.3	-2.7
L06-0435	72.0	80.2	76.8	-3.4	75.4	-4.8	-1.4	79.8	-0.4	76.7	-3.5	-3.1
L06-0436	73.3	80.4	77.4	-3.0	77.4	-3.0	0.0	80.2	-0.2	79.1	-1.3	-1.1
L06-0438	73.7	79.5	80.1	0.7	80.1	0.7	0.0	81.0	1.5	81.0	1.5	0.0

Table 11-6. Node Data and Model Results for Alternative 4

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
L06-0460	71.8	80.5	77.1	-3.4	77.1	-3.3	0.1	79.9	-0.5	78.5	-1.9	-1.4
L06-0480	71.9	80.8	77.1	-3.7	77.2	-3.6	0.1	79.9	-0.9	78.8	-2.0	-1.2
L06-0490	72.2	81.0	77.1	-3.9	77.2	-3.8	0.2	79.9	-1.1	79.0	-2.0	-0.9
L06-0492	72.2	81.1	77.6	-3.6	77.2	-3.9	-0.3	80.8	-0.3	79.0	-2.1	-1.8
L06-0500	72.8	81.5	77.6	-3.9	77.4	-4.0	-0.1	80.8	-0.7	79.3	-2.1	-1.4
L06-0502	72.8	81.0	77.7	-3.2	77.5	-3.5	-0.3	81.0	0.1	79.3	-1.6	-1.7
L06-0510	73.6	82.7	77.9	-4.7	77.7	-5.0	-0.2	81.1	-1.6	79.9	-2.7	-1.1
L06-0520	73.6	82.8	78.9	-3.9	77.7	-5.1	-1.2	81.5	-1.3	79.9	-2.8	-1.6
L07-0040	74.4	78.7	75.2	-3.5	75.2	-3.5	0.0	76.8	-1.9	76.8	-1.9	0.0
L07-0041	74.4	81.4	75.2	-6.2	75.2	-6.2	0.0	76.8	-4.6	76.8	-4.6	0.0
L07-0042	73.7	80.2	74.2	-5.9	74.9	-5.2	0.7	76.8	-3.4	76.8	-3.4	0.0
L07-0043	72.9	80.2	74.1	-6.1	75.2	-5.0	1.1	76.8	-3.4	76.7	-3.5	-0.1
L07-0050	76.2	80.0	76.5	-3.4	76.6	-3.4	0.0	76.9	-3.1	76.9	-3.0	0.1
L07-0060	74.8	79.6	80.6	1.0	76.6	-3.0	-4.0	81.9	2.3	77.0	-2.5	-4.9
L07-0061	73.3	78.3	79.2	0.9	74.8	-3.6	-4.4	79.3	1.0	78.3	0.0	-0.9
L-070061N	74.0	79.2	--	--	74.8	-4.4	--	--	--	78.6	-0.6	--
L07-0062	76.3	79.6	80.6	1.0	76.8	-2.8	-3.8	81.9	2.3	77.2	-2.4	-4.8
L07-0064	76.4	79.1	79.5	0.4	76.6	-2.5	-2.9	80.4	1.3	77.5	-1.6	-2.9
L07-0068	72.5	79.8	79.2	-0.6	74.3	-5.5	-4.9	79.3	-0.5	77.2	-2.5	-2.0
L07-0070	76.9	80.0	79.5	-0.5	77.0	-3.0	-2.5	80.4	0.4	77.6	-2.4	-2.8
L07-0080	77.3	80.1	80.3	0.3	77.5	-2.6	-2.9	81.4	1.4	78.0	-2.0	-3.4
L07-0100	75.0	81.0	79.8	-1.1	79.7	-1.3	-0.1	81.3	0.4	81.1	0.1	-0.3
L07-0130	72.6	91.7	80.6	-11.1	80.6	-11.1	0.0	80.6	-11.1	80.7	-11.0	0.2
L07-0140	66.9	72.8	80.6	7.8	80.6	7.8	0.0	80.6	7.8	80.7	7.9	0.1
L07-0150	67.0	72.6	86.7	14.1	86.7	14.1	0.0	86.7	14.1	86.7	14.1	0.0
L08-0010	60.5	70.7	64.9	-5.8	64.5	-6.2	-0.4	67.2	-3.5	66.6	-4.1	-0.6
L08-0012	60.5	70.8	64.9	-5.8	64.5	-6.2	-0.4	67.2	-3.5	66.8	-4.0	-0.5
L08-0020	60.9	71.2	64.9	-6.3	64.5	-6.6	-0.4	67.2	-3.9	66.8	-4.4	-0.5
L08-0030	61.0	71.2	64.9	-6.3	64.5	-6.7	-0.4	67.2	-4.0	66.9	-4.4	-0.4
L08-0040	61.4	71.7	64.9	-6.8	64.7	-7.0	-0.2	67.3	-4.5	66.9	-4.8	-0.4
L08-0050	61.6	71.8	64.9	-6.9	64.8	-7.0	-0.1	67.3	-4.5	67.2	-4.6	-0.1
L08-0060	62.5	72.8	65.6	-7.2	65.6	-7.1	0.0	67.4	-5.3	67.4	-5.3	0.0
L09-0010	69.4	75.5	73.0	-2.5	73.2	-2.2	0.2	75.5	0.1	74.4	-1.0	-1.1
L09-0040	73.1	77.3	75.2	-2.1	75.2	-2.1	0.1	75.9	-1.4	76.1	-1.2	0.2
L09-0050	72.9	77.3	75.4	-2.0	75.4	-1.9	0.1	76.1	-1.2	76.3	-1.0	0.2
L09-0060	76.6	82.2	77.6	-4.7	77.6	-4.7	0.0	77.6	-4.6	77.6	-4.6	0.0
L09-0070	77.3	82.1	83.9	1.8	83.9	1.8	0.0	85.4	3.3	85.4	3.3	0.0
L11-0020	79.6	85.6	81.1	-4.6	80.9	-4.7	-0.1	84.5	-1.1	84.1	-1.6	-0.4
L11-0030	79.6	85.6	87.1	1.4	87.1	1.4	0.0	88.6	3.0	88.6	2.9	0.0
L13-0010	76.0	80.3	78.4	-1.9	78.6	-1.7	0.2	80.8	0.5	80.2	-0.2	-0.6
L13-0020	77.6	79.9	80.4	0.5	80.4	0.5	0.0	81.1	1.3	81.2	1.3	0.0
L15-0010	71.9	77.2	73.4	-3.7	74.0	-3.2	0.5	75.8	-1.4	75.0	-2.1	-0.7
L15-0050	72.7	77.1	79.4	2.3	79.4	2.3	0.0	80.7	3.6	80.7	3.5	0.0
MC0010	50.7	59.9	56.3	-3.6	56.3	-3.6	0.0	59.9	0.0	59.8	-0.1	-0.1
MC0020	50.7	59.9	56.3	-3.6	56.3	-3.6	0.0	59.9	0.0	59.8	-0.1	-0.1
MC0030	51.1	60.3	56.6	-3.7	56.4	-3.9	-0.3	60.1	-0.2	59.9	-0.4	-0.3
MC0040	51.4	59.7	56.7	-3.0	56.4	-3.3	-0.3	60.5	0.8	60.2	0.5	-0.3
MC0050	51.5	60.1	56.9	-3.3	56.6	-3.5	-0.2	60.6	0.5	60.4	0.2	-0.3
MC0060	51.5	60.1	56.9	-3.3	56.7	-3.5	-0.2	60.7	0.5	60.4	0.2	-0.3
MC0070	52.2	64.1	57.1	-7.0	56.9	-7.2	-0.2	60.8	-3.3	60.5	-3.6	-0.3
MC0080	52.4	61.1	57.1	-4.1	56.9	-4.3	-0.2	60.8	-0.3	60.5	-0.6	-0.3
MC0090	53.3	63.2	58.3	-4.8	58.3	-4.8	0.0	61.7	-1.5	61.4	-1.7	-0.2
MC0100	53.2	62.2	58.4	-3.9	58.3	-3.9	0.0	61.7	-0.5	61.4	-0.8	-0.2
MC0110	54.3	63.6	59.9	-3.7	60.0	-3.7	0.1	63.1	-0.6	62.8	-0.8	-0.2
MC0120	54.4	66.8	60.0	-6.8	60.0	-6.7	0.0	63.1	-3.6	62.9	-3.9	-0.2
MC0130	54.2	64.0	60.3	-3.7	60.3	-3.7	0.0	63.4	-0.6	63.1	-0.9	-0.3
MC0140	53.9	64.1	60.3	-3.8	60.3	-3.8	0.0	63.4	-0.7	63.2	-1.0	-0.3
MC0150	57.2	68.6	62.5	-6.1	62.4	-6.2	-0.2	65.3	-3.3	64.9	-3.7	-0.4
MC0160	57.2	68.7	62.6	-6.2	62.4	-6.3	-0.2	65.3	-3.4	65.0	-3.8	-0.4
MC0170	57.9	69.2	63.0	-6.1	62.8	-6.3	-0.2	65.7	-3.4	65.4	-3.8	-0.4
MC0172	58.1	69.3	63.2	-6.1	63.0	-6.3	-0.2	65.9	-3.5	65.5	-3.9	-0.4
MC0174	58.2	69.3	63.2	-6.1	63.0	-6.4	-0.2	65.9	-3.5	65.5	-3.9	-0.4
MC0176	58.2	69.4	63.2	-6.1	63.0	-6.4	-0.2	65.9	-3.5	65.5	-3.9	-0.4
MC0178	58.2	69.4	63.2	-6.1	63.0	-6.4	-0.2	65.9	-3.5	65.5	-3.9	-0.4
MC0180	58.8	69.7	63.6	-6.1	63.3	-6.4	-0.3	66.2	-3.5	65.7	-4.0	-0.4
MC0190	58.8	69.7	63.6	-6.1	63.4	-6.4	-0.3	66.2	-3.5	65.8	-4.0	-0.5
MC0200	59.3	70.8	64.2	-6.6	63.9	-6.9	-0.3	66.7	-4.2	66.1	-4.7	-0.5
MC0210	58.5	70.2	64.3	-5.9	63.9	-6.3	-0.3	66.7	-3.5	66.1	-4.0	-0.5
MC0220	60.1	70.4	64.9	-5.5	64.5	-5.9	-0.4	67.2	-3.2	66.6	-3.8	-0.6
MC0230	61.4	70.9	66.8	-4.1	66.2	-4.7	-0.6	68.8	-2.1	67.7	-3.2	-1.0
MC0240	61.5	70.9	66.8	-4.1	66.3	-4.7	-0.6	68.9	-2.0	67.8	-3.1	-1.1
MC0250	62.0	71.1	67.7	-3.4	67.1	-4.0	-0.6	69.7	-1.4	68.5	-2.7	-1.3
MC0260	62.9	71.5	68.8	-2.6	68.2	-3.3	-0.6	70.8	-0.7	69.4	-2.0	-1.4
MC0270	62.2	70.5	68.9	-1.6	68.2	-2.2	-0.7	70.9	0.5	69.5	-1.0	-1.5
MC0280	65.4	71.4	69.6	-1.9	68.8	-2.7	-0.8	71.4	0.0	69.8	-1.7	-1.7
MC0282	65.5	71.5	69.7	-1.8	68.8	-2.6	-0.8	71.5	0.0	69.8	-1.7	-1.7
MC0290	65.6	71.5	70.4	-1.1	69.1	-2.4	-1.2	73.5	2.0	70.2	-1.3	-3.3
MC0292	67.1	71.9	71.3	-0.6	70.0	-2.0	-1.4	73.9	2.0	70.9	-1.0	-3.0
MC0296	65.8	71.6	71.6	0.0	70.0	-1.6	-1.6	74.1	2.5	71.0	-0.6	-3.1
MC0298	65.4	71.6	71.6	0.0	70.0	-1.6	-1.6	74.1	2.5	71.0	-0.6	-3.1
MC0300	63.3	73.3	71.6	-1.6	70.0	-3.3	-1.7	74.1	0.8	71.0	-2.3	-3.1
MC0310	63.3	72.5	71.7	-0.8	70.0	-2.5	-1.7	74.3	1.8	71.5	-0.9	-2.7
MC0320	65.4	74.7	71.7	-3.0	70.0	-4.8	-1.8	74.3	-0.5	71.6	-3.2	-2.7
MC0330	65.2	71.6	72.0	0.4	70.2	-1.4	-1.9	75.0	3.4	71.6	0.0	-3.4
MC0340	65.3	72.5	72.1	-0.4	70.7	-1.7	-1.3	75.0	2.6	71.7	-0.8	-3.3
MC0350	65.3	72.8	72.1	-0.7	70.9	-2.0	-1.3	75.1	2.3	72.0	-0.8	-3.1
MC0360	65.5	75.5	72.2	-3.2	71.3	-4.1	-0.9	75.2	-0.2	72.6	-2.8	-2.6
MC0370	64.9	75.5	72.2	-3.3	71.4	-4.2	-0.9	75.2	-0.3	72.7	-2.8	-2.6
MC0380	65.8	74.7	72.3	-2.4	71.7	-3.0	-0.6	75.3	0.6	73.1	-1.6	-2.2
MC0390	67.1	73.5	72.4	-1.1	72.0	-1.5	-0.4	75.3	1.8	73.3	-0.2	-2.0
MC0400	67.1	74.8	72.4	-2.4	72.0	-2.8	-0.4	75.3	0.5	73.4	-1.5	-1.9
MC0410	68.1	78.7	72.9	-5.8	73.0	-5.7	0.1	75.5	-3.2	74.3	-4.4	-1.2

Table 11-6. Node Data and Model Results for Alternative 4

Model Input Data			10-Year Model Results					100-Year Model Results				
			Existing Conditions		Future Conditions			Existing Conditions		Future Conditions		
Node	Invert Elevation, ft	Ground Elevation (Spill Crest), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Max Water Elevation, ft NAVD	Flooding Depth (+ Flooding, - Freeboard), ft	Change in Maximum Water Surface Elevation, ft
MC0420	69.2	77.2	73.0	-4.2	73.4	-3.8	0.3	75.5	-1.7	74.5	-2.7	-1.0
MC0422	69.2	77.2	73.1	-4.2	73.4	-3.8	0.4	75.6	-1.7	74.6	-2.7	-1.0
MC0430	69.4	77.2	73.4	-3.8	73.9	-3.3	0.5	75.7	-1.5	75.0	-2.2	-0.7
MC0431	70.1	80.0	80.7	0.7	80.7	0.7	0.0	81.4	1.5	81.4	1.5	0.0
MC0440	69.0	76.0	73.4	-2.6	74.0	-2.0	0.5	75.8	-0.2	75.1	-0.9	-0.7
MC0450	70.4	78.1	73.7	-4.3	74.3	-3.8	0.6	76.0	-2.1	75.4	-2.7	-0.6
MC0451	69.7	77.4	73.6	-3.8	74.1	-3.3	0.5	75.9	-1.5	75.2	-2.1	-0.7
MC0460	71.7	77.3	74.1	-3.3	74.8	-2.5	0.7	76.7	-0.6	76.1	-1.3	-0.6
MC0461	70.4	77.6	74.2	-3.4	74.8	-2.8	0.6	76.7	-0.9	76.1	-1.5	-0.6
MC0462	71.1	77.4	74.2	-3.2	74.9	-2.5	0.7	76.7	-0.7	76.2	-1.2	-0.5
MC0463	71.3	76.7	74.2	-2.5	75.0	-1.7	0.7	76.7	0.0	76.7	0.0	0.0
MC0464	71.7	78.6	74.2	-4.4	74.9	-3.7	0.7	76.8	-1.8	76.3	-2.3	-0.5
MC0470	72.2	78.7	74.5	-4.2	74.9	-3.8	0.3	76.8	-1.9	76.1	-2.6	-0.7
MC0480	71.8	77.5	74.7	-2.8	74.9	-2.6	0.2	77.3	-0.2	76.1	-1.4	-1.1
MC0490	72.0	78.3	75.6	-2.7	76.7	-1.6	1.0	77.7	-0.6	78.6	0.3	0.9
MC0500	72.3	78.4	75.8	-2.7	76.7	-1.7	1.0	78.2	-0.2	78.7	0.3	0.5
MC0510	73.0	80.2	76.8	-3.5	77.6	-2.6	0.9	78.7	-1.5	78.8	-1.5	0.0
MC0520	73.0	81.1	77.1	-4.0	77.4	-3.7	0.3	79.9	-1.1	79.6	-1.5	-0.3
MC0530	73.3	81.3	77.1	-4.2	77.4	-3.9	0.3	79.9	-1.4	79.6	-1.7	-0.3
MC0540	73.3	81.4	77.3	-4.1	77.7	-3.8	0.3	80.7	-0.7	80.2	-1.3	-0.5
MC0545	73.6	81.7	77.6	-4.1	77.7	-3.9	0.1	80.8	-0.9	80.2	-1.5	-0.6
MC0550	74.0	81.9	77.9	-4.0	77.7	-4.2	-0.1	80.9	-1.0	80.2	-1.8	-0.7
MC0560	74.1	82.0	78.1	-3.9	77.9	-4.0	-0.1	81.4	-0.5	80.6	-1.4	-0.8
MC0570	74.5	82.1	78.3	-3.8	78.0	-4.1	-0.3	81.5	-0.6	80.6	-1.5	-0.9
MC0580	74.5	82.1	78.5	-3.7	78.1	-4.0	-0.3	81.9	-0.2	80.9	-1.2	-1.0
MC0590	75.6	82.9	79.3	-3.6	78.4	-4.5	-0.9	82.2	-0.8	81.0	-2.0	-1.2
MC0600	75.6	83.0	79.5	-3.4	78.7	-4.3	-0.8	82.7	-0.3	81.5	-1.5	-1.2
MC0610	76.0	83.2	79.7	-3.5	78.9	-4.4	-0.8	82.7	-0.5	81.5	-1.7	-1.2
MC0620	76.0	83.9	79.9	-4.0	79.2	-4.7	-0.7	83.3	-0.6	82.3	-1.6	-1.0
MC0630	75.1	83.2	80.0	-3.1	79.5	-3.6	-0.5	83.3	0.2	82.4	-0.7	-0.9
MC0640	75.3	83.3	80.1	-3.2	79.6	-3.7	-0.5	83.4	0.1	82.5	-0.8	-0.9
MC0642	76.2	83.8	80.1	-3.7	79.7	-4.1	-0.4	83.4	-0.4	82.5	-1.3	-0.9
MC0650	77.1	84.3	80.9	-3.4	80.7	-3.6	-0.2	84.5	0.2	84.1	-0.3	-0.4
MC0660	76.2	83.7	80.1	-3.6	79.6	-4.1	-0.5	83.3	-0.4	82.4	-1.3	-0.9
MC0662	76.3	83.8	80.6	-3.2	80.5	-3.3	-0.2	84.7	0.9	84.3	0.5	-0.4
MC0670	78.0	84.8	80.9	-3.9	80.8	-4.0	-0.1	84.7	-0.1	84.3	-0.5	-0.4
WIC0005	50.5	56.7	57.0	0.4	56.5	-0.1	-0.5	59.7	3.0	59.0	2.3	-0.7
WIC0010	50.9	60.3	58.7	-1.6	58.0	-2.3	-0.8	61.2	0.9	60.0	-0.3	-1.2
WIC0020	50.9	58.9	58.8	-0.1	58.0	-0.8	-0.8	61.3	2.5	60.2	1.3	-1.1
WIC0030	51.8	59.4	59.4	0.0	58.8	-0.6	-0.6	61.9	2.5	60.9	1.5	-1.1
WIC0032	52.5	60.1	59.9	-0.2	59.4	-0.7	-0.5	62.4	2.3	61.4	1.3	-1.0
WIC0034	54.1	61.4	60.9	-0.5	60.7	-0.7	-0.2	63.3	1.9	62.5	1.1	-0.8
WIC0040	54.9	62.1	61.3	-0.9	61.2	-1.0	-0.1	63.6	1.5	63.0	0.8	-0.6

Overall, the improvements reduce the water levels for both the 10-year and 100-year storms. However, at some nodes water levels increase, but have freeboard of 1 foot or more, which is acceptable. Also, a few nodes experience increased water levels in an already flooded or near flooded condition. These increased water levels are categorized and are described below:

Increased Water Level and More Than 1 Foot of Freeboard

This category includes nodes where the water levels increases for either the 10-year or 100-year storm but have more than 1 foot of freeboard, which is acceptable.

For the 10-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- EIC0100, EIC0110, EIC0120, EIC0130, EIC0140, EIC0150 – Located on the East Intercepting Canal. The water levels at these nodes increase by 0.3 feet but have a freeboard of 2.0 to 7.0 feet.
- L03-0040, L03-0050, L03-0060, L03-0062, L03-0070, L03-0080, L03-0090, L03-0092 – Located along Lateral 3 downstream of the South Detention Basin and downstream of future build out growth areas. The water levels at these nodes increase by up to 0.3 feet but have 2.6 to 4.6 feet of freeboard, well within the 10-year storm requirement of 1 foot freeboard.
- L04-0064, L04-0070, L04-0080, L04-0088 – Located on Lateral 4 downstream of the South Detention Basin and downstream of future build out growth areas. The water level at these nodes increase by 0.1 feet to 0.2 feet but have a freeboard of 1.6 to 3.6 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0432 – Located at Highway 99 and part of the improved storm drain system. The water level at this node increases by 0.2 feet, but has a freeboard of 4.6 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L06-0460, L06-0480, L06-0490 – Located on Lateral 6 and part of improved storm drain system. The water levels at these nodes increase by 0.1 feet, but have freeboards 3.3 feet to 3.8 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L07-0042, L07-0043 – Located along the storm drain on Pennington Road near J Street. The water levels at these nodes increase by 0.7 feet and 1.1 feet, but have freeboards of 5.9 and 5.8 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.1 feet. These nodes are on the river side of the levee.
- L15-0010 – Located at Archer Avenue. The water level at this node increases by 0.5 feet but has freeboard of 3.2 feet, well within the 10-year storm requirement of 1 foot freeboard.
- L08-0050, L08-0060– Located on Lateral 8 downstream of future build out areas. The water levels at these node increased by 0.1 feet but have a freeboard of 6.9 and 7.1 feet, respectively.

- L09-0010, L09-0040, L09-0050 – Located on Lateral 9 that discharges to the Main Canal. The water levels at these nodes increase by 0.1 to 0.3 feet but have freeboards of 1.9 to 2.2 feet.
- L13-0010 – Located on a lateral that discharges to the Main Canal in the north section of future build out areas. The water level at this node increases by 0.2 feet, but has 1.7 feet of freeboard.
- MC0410, MC0420, MC0422, MC0430, MC0440, MC0450, MC0451, MC0460, MC0461, MC0462, MC0463, MC0464, MC0470, MC0480, MC0490, MC0500, MC0510, MC0520,MC0530, MC0540, MC0545 – Located along the Main Canal and part of the improved channel. The water levels at these nodes increase by 0.1 feet to 0.7 feet, but have a freeboard of 1.7 feet to 3.9 feet, well within the 10-year storm requirement of 1 foot freeboard.

For the 100-year storm, the water levels at the following nodes increase but have more than 1 foot of freeboard:

- EIC0120, EIC0130 – Located on the East Intercepting Canal upstream of the West Intercepting Canal. The water levels at these nodes increase by 0.1 feet but have 3.5 feet and 1.2 feet of freeboard.
- L02-0291, L02-0292 – Located in the Pennington Ranch development. The water levels at these nodes increase but have one foot of freeboard or more.
- L02-0300 – Located in the open channel downstream of the Garden Glen Division Development. The water level at this node increased by 0.4 feet, but has a freeboard of 3.3 feet.
- L02-0050 – Located at the junction of Laterals 1 and 2 downstream of the City. The water level at this node increases by 0.1 feet but has a freeboard of 3.2 feet.
- L03-0090, L03-0092 – Located on Lateral 3 downstream of future build out areas. The water levels at these nodes increase by 0.1 feet, but have a freeboard of 1.6 feet.
- L07-0140, L07-0130 – These nodes represent the Feather River and receive the pumped discharge from the East Detention Basin. The water levels at these nodes increase by 0.2 and 0.1 feet. These nodes are on the river side of the levee.
- L07-0050 – Located Pennington Road and Sinnard Avenue. The water level at this node increases by 0.1 feet, but has a freeboard of 3.0 feet.
- L08-0050, L08-0060 – Located on Lateral 8 downstream of build out areas. The water levels at these nodes increase by 0.1 and 0.2 feet but have a freeboard of 4.4 feet and 5.2 feet, respectively.
- L09-0040, L09-0050 – On Lateral 9 and tributary to the Main Canal. The water levels at these nodes increase by 0.2 feet, but have a freeboard of 1.0 to 1.2 feet.

Increased Water Level but Within City Storm Drain Criteria

This category includes nodes where water levels increase for the 100-year storm, but result in no more than minor flooding of streets where there is an urban storm drain system. Even though water levels increase, the storm drain freeboard criteria for the 10-year storm are met, and some ponding of water in the streets in the 100-year storm is allowed.

For the 100-year storm, these nodes include:

- L02-0239, L02-0243, L02-0244 – Located in the Pennington Ranch development. The water level in these nodes increase by 0.6 to 1.6 feet bringing the freeboard to less than 1 foot. This is acceptable for a 100-year storm in an urban storm drain system.
- L02-0277, L02-0278, L02-0279 – Part of the Pennington Ranch storm drain system. The water level in these nodes increase by 0.1 to 0.5 feet bring the flooding water depth up to 0.5 feet during the 100-year storm. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system. Notably, the water level at the downstream nodes, L02-0247, decreases by 0.6 feet from existing conditions.
- L02-0281, L02-0283, L02-0288, L02-0293 – Part of the Pennington Ranch storm drain system. The water level in theses node increase by 0.1 feet bringing the flooded water level up to 0.1 feet. This depth of minor flooding is acceptable for a 100-year storm in an urban storm drain system and has more than 1 foot freeboard during the 10-year storm.
- L02-0506, L02-0507 – Part of the P Street storm drain system. The water level at these node increase by up to 1.5 feet over existing conditions, resulting in minor street flooding depths of 0.1 feet, which is acceptable for a 100-year storm.
- MC0490, MC0500 – Located on the Main Canal at the restrictive orifice to divert flow to the East Detention Basin. The water levels increase by up to 0.9 feet, resulting in 0.3 feet of flooding in the channel. The developed area at this location would need to be built up to ensure 1 foot of freeboard in the channel during the 100-year storm.
- L02-0471 – Located on the storm drain along N Street and part of an urban storm drain system. The water level at this node increases by 0.1 feet, but has a freeboard of 0.2 feet, which is acceptable during a 100-year storm.
- L02-0517 – Located on the storm drain on Fir Street. The water level at this node increases by 0.9 feet, which results in 0 feet of freeboard. Notably the downstream node does not change over existing.
- L02-0520 – Located on the Alternative 4 storm drain system east of the future Garden Glen Division and downstream of the proposed North Detention Basin. The water level at this node increases by 0.1 feet, resulting in a flooding depth of 0.3 feet. This minor flooding is acceptable during the 100-year storm.

Increased Water Level and Increased Flooding

This category includes nodes where the water levels increase over an existing flooded condition.

- L02-0010, L02-0020, L02-0030, L02-0032, L02-00400, L02-0042, L02-0044 – Located on Lateral 2 downstream of future build out areas. The water levels at these nodes increase by up to 0.2 feet, resulting in flooding levels up to 1.3 feet. Even though flow coming from built out areas are reduced, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. This minor increase in water surface elevation could be mitigated with improved channel maintenance funded by City storm drain fees.
- L03-0080 – Located on Lateral 3 downstream of future build out areas and upstream of a CMP culvert. The water level at this nodded increases by 0.1 feet, resulting in a flooding level of 0.1 feet. Even though flow coming from built out areas are reduced and peak water surface elevations are reduced downstream, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. This minor increase in water surface elevation could be mitigated with improved channel maintenance funded by City storm drain fees.
- L04-0094 – Located on Lateral 4 downstream of future build out areas. This node increases by 0.1 feet, resulting in up to 1.4 feet of flooding. Even though flow coming from built out areas are reduced and peak water surface elevations are reduced downstream, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. This minor increase in water surface elevation could be mitigated with improved channel maintenance funded by City storm drain fees.
- MC0010, MC0020, MC0030, MC0040 – Located on the Main Canal Downstream of future build out areas. The water levels at these nodes increase by 0.1 feet, resulting in up to 0.9 feet of flooding depth. Even though the upstream water surface elevations are the same as existing conditions and the flow rate in these segments are decreased, the downstream water surface elevations along the East Intercepting Canal increase. See discussion below.
- EIC0040, EIC0050, EIC0060, EIC0070, EIC0075, EIC0080, EIC0090, EIC0100, EIC0110, EIC0140, EIC0150 – Located at the downstream end of the East Intercepting Canal. For the 100-year storm, the water levels at these nodes increase by 0.1 feet. See discussion below.

- WIC0005, WIC0010, WIC0020, WIC0030, WIC0032, WIC0034, WIC0040 – Located at the downstream end of the West Intercepting Canal just upstream of the East Intercepting Canal. For the 10-year storm, the water level at WIC0005 increases bringing the flooded water depth from 0.2 feet to 0.5 feet. The upstream water levels decrease and the downstream water levels remain the same. This is due to the boundary condition used in the model at the downstream end of the East Intercepting Canal. For the 10-year model and 100-year storm models, a "full channel" water level is used as the boundary condition. Because upstream flooding has been reduced, the downstream boundary condition controls the water level at WIC0005. If a lower water level was used for the 10-year storm model, the water level at WIC0005 would be below the channel top and there would not be increased flooding. For the 100-year storm, the water levels at these nodes increase by 0.2 feet. Even though flow coming from built out areas are reduced, it appears that the timing of the peaks of the built out flows coincide with timing of the peaks from the agricultural areas downstream of the growth areas. These minor increases of water levels would be mitigated with improved channel maintenance along the East Intercepting Canal and West Intercepting Canal. Also, raising the bank elevations along these channels would ensure a foot of freeboard or more during the 100-year storm.

COST ESTIMATES

The construction and capital costs for each of the drain/channel/basin systems discussed above are presented in Table 11-7. As shown, the estimated total construction cost is $21.1 million and the estimated capital cost is $35.6 million. The following assumptions were made for the preparation of the cost estimate:

- Within the future build out area, the excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks. Outside of the future build out area, excavated dirt will be disposed offsite.
- All land will be purchased (versus easements) at a cost of $50,000 per acre for land within the City's 2030 General Plan Planning Area and at a cost of $25,000 per acre for land outside the City's Planning Area.

Build out of the general plan includes development of 3,375 acres. Alternative 4 results in an overall cost of $10,540 per acre.

Table 11-7. Cost Estimate for Alternative 4

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
1. Main Canal Improvement and Diversion Channel to East Basin				
Site Preparation (Clear and Grub)	acre	500	33.0	16,500
Channel Excavation (on-site)	CY	4	88,000	352,000
Landscape and Erosion Control	acre	10,000	29.9	299,000
18-Inch Orifice Plate	each	2,000	1	2,000
36-Inch RCP	feet	216	514	111,024
42-Inch RCP	feet	252	240	60,480
60-Inch RCP	feet	330	548	180,675
Headwalls	each	8,000	14	112,000
12' Asphalt Access Road	feet	72	18,316	1,318,717
Mobilization/demobilization (at 5 percent)				122,620
Construction Contingency (at 20 percent)				490,480
Estimated Construction Cost				3,065,500
Land/Easements (for channel)	acre	50,000	29.9	1,495,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,226,200
Estimated Capital Cost				5,786,700
2. East Detention Basin				
Site Preparation (Clear and Grub)	acre	500	12.4	6,199
Basin Excavation	CY	4	50,082	200,328
Landscape and Erosion Control	acre	2,000	8.6	17,120
Rock Scour Protection	CY	100	10	1,000
Pump Station (20 cfs)	cfs	39,500	20	790,000
36-Inch RCP	ft	216	2,400	518,400
12' Asphalt Access Road	feet	72	2,950	212,400
Mobilization/demobilization (at 5 percent)				87,270
Construction Contingency (at 20 percent)				349,090
Estimated Construction Cost				2,181,810
Land/Easements (for basin)	acre	25,000	12.4	310,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				872,700
Estimated Capital Cost				3,364,500
3. Lateral 5 Storm Drain				
12-Inch RCP	feet	72	300	21,600
48-Inch RCP	feet	288	661	190,368
60-Inch RCP	feet	330	1,255	414,150
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				35,310
Construction Contingency (at 20 percent)				141,220
Estimated Construction Cost				882,650
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				353,100
Estimated Capital Cost				1,235,800
4. South Detention Basin				
Site Preparation (Clear and Grub)	acre	500	28.0	14,017
Basin Excavation	CY	4	267,884	1,071,534
Landscape and Erosion Control	acre	2,000	26.0	51,904
Rock Scour Protection	CY	100	10	1,000
Side Flow Weir (CY of concrete)	CY	500	50	25,000
42-Inch RCP	feet	252	100	25,200
54-Inch RCP	feet	311	100	31,050
24-Inch RCP	feet	144	268	38,592
24-Inch Flap Gate	each	2,800	1	2,800
Headwalls	each	8,000	6	48,000
Aggregate Base Access Road	feet	20	4,704	94,080
Fencing	feet	16	4,704	75,264
Mobilization/demobilization (at 5 percent)				73,920
Construction Contingency (at 20 percent)				295,690
Estimated Construction Cost				1,848,050
Land/Easements (for basin)	acre	25,000	28.0	700,900
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				739,200
Estimated Capital Cost				3,288,200
5. Lateral 6 Improvements and Diversion to North Detention Basin				
Site Preparation (Clear and Grub)	acre	500	6.3	3,150
Channel Excavation (on-site)	CY	4	26,400	105,600
Landscape and Erosion Control	acre	2,000	4.4	8,700
12-Inch RCP	feet	72	540	38,900
54-Inch RCP	feet	311	916	284,500
66-Inch RCP	feet	347	1,576	546,100
72-Inch RCP	feet	360	1,827	657,720
5' x 6' Box RCP	feet	600	677	406,200
Maintenance Holes	each	6,000	9	54,000
Drain Inlets	each	5,000	18	90,000
Headwalls	each	8,000	3	24,000
12' Asphalt Access Road	feet	72	2,085	150,120
Mobilization/demobilization (at 5 percent)				118,450
Construction Contingency (at 20 percent)				473,800
Estimated Construction Cost				2,961,240
Land/Easements (for channel)	acre	50,000	6.3	313,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,184,500
Estimated Capital Cost				4,459,200

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
6. North Detention Basin and Storm Drain				
Site Preparation (Clear and Grub)	acre	500	33.9	16,954
Basin Excavation	CY	4	306,607	1,226,427
Landscape and Erosion Control	acre	2,000	188.2	376,400
Rock Scour Protection	CY	100	10	1,000
12-Inch RCP	feet	72	360	25,920
18-Inch RCP	feet	108	554	59,832
30-Inch RCP	feet	180	72	12,960
36-Inch RCP	feet	216	1,940	419,040
Headwalls	each	8,000	2	16,000
12' Asphalt Access Road	feet	72	4,704	338,688
Maintenance Holes	each	6,000	6	36,000
Drain Inlets	each	5,000	12	60,000
Mobilization/demobilization (at 5 percent)				129,460
Construction Contingency (at 20 percent)				517,840
Estimated Construction Cost				3,236,520
Land/Easements (for basin)	acre	50,000	33.9	1,695,400
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,294,600
Estimated Capital Cost				6,226,500
7. Caltrans Property Detention Basin				
Site Preparation (Clear and Grub)	acre	500	25.5	12,774
Basin Excavation	CY	4	119,750	478,999
Landscape and Erosion Control	acre	2,000	21.4	42,700
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
24-Inch RCP	feet	144	268.0	38,592
24-Inch Flap Gate	each	2,800	1.0	2,800
12' Asphalt Access Road	feet	72	4,120	296,640
Mobilization/demobilization (at 5 percent)				44,930
Construction Contingency (at 20 percent)				179,700
Estimated Construction Cost				1,123,130
Land/Easements (for basin)	acre	10,000	26.0	260,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				449,300
Estimated Capital Cost				1,832,400
8. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road				
Site Preparation (Clear and Grub)	acre	500	19.2	9,600
Channel Excavation (on-site)	CY	4	141,600	566,400
Landscape and Erosion Control	acre	2,000	19.2	38,400
24-Inch Orifice Plate	each	2,000	1	2,000
18-Inch RCP	feet	108	80	8,640
48-Inch RCP	feet	288	120	34,560
Headwalls	each	8,000	6	48,000
12' Asphalt Access Road	feet	72	8,345	600,806
Mobilization/demobilization (at 5 percent)				65,420
Construction Contingency (at 20 percent)				261,680
Estimated Construction Cost				1,635,510
Land/Easements (for channel)	acre	50,000	17.0	851,600
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				654,200
Estimated Capital Cost				3,141,300
9. WWTP Storm Drain and Inlet Weir Improvements				
Side Flow Weir (CY of concrete)	CY	500	50	25,000
12-Inch RCP	feet	72	300	21,600
30-Inch RCP	feet	180	3,600	648,000
36-Inch RCP	feet	216	2,133	460,663
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				61,763
Construction Contingency (at 20 percent)				247,053
Estimated Construction Cost				1,544,079
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				617,600
Estimated Capital Cost				2,161,700
10. Lateral 2 Improvements at Township Road				
12-Inch RCP	feet	72	420	30,240
42-Inch RCP	feet	252	5,700	1,436,400
Maintenance Holes	each	6,000	7	42,000
Drain Inlets	each	5,000	14	70,000
Mobilization/demobilization (at 5 percent)				78,932
Construction Contingency (at 20 percent)				315,728
Estimated Construction Cost				1,973,300
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				789,300
Estimated Capital Cost				2,762,600

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
11. West Detention Basin				
Site Preparation (Clear and Grub)	acre	500	6.9	3,464
Basin Excavation	CY	4	53,722	214,887
Landscape and Erosion Control	acre	2,000	6.0	11,912
Pump Station (5 cfs)	cfs	50,000	5.0	250,000
Headwalls	each	8,000	1	8,000
Aggregate Base Access Road	each	20	2,037	40,748
Fencing	each	16	2,200	35,200
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				28,260
Construction Contingency (at 20 percent)				113,040
Estimated Construction Cost				706,510
Land/Easements (for basin)	acre	50,000	6.9	346,402
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				282,600
Estimated Capital Cost				1,335,500
Total Estimated Construction Cost				21,158,300
Total Land/Easement Cost				5,972,802
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				8,463,300
Total Estimated Capital Cost				35,594,402

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent
Costs are for June 2009 (20 City Average ENRCCI of 8,578).

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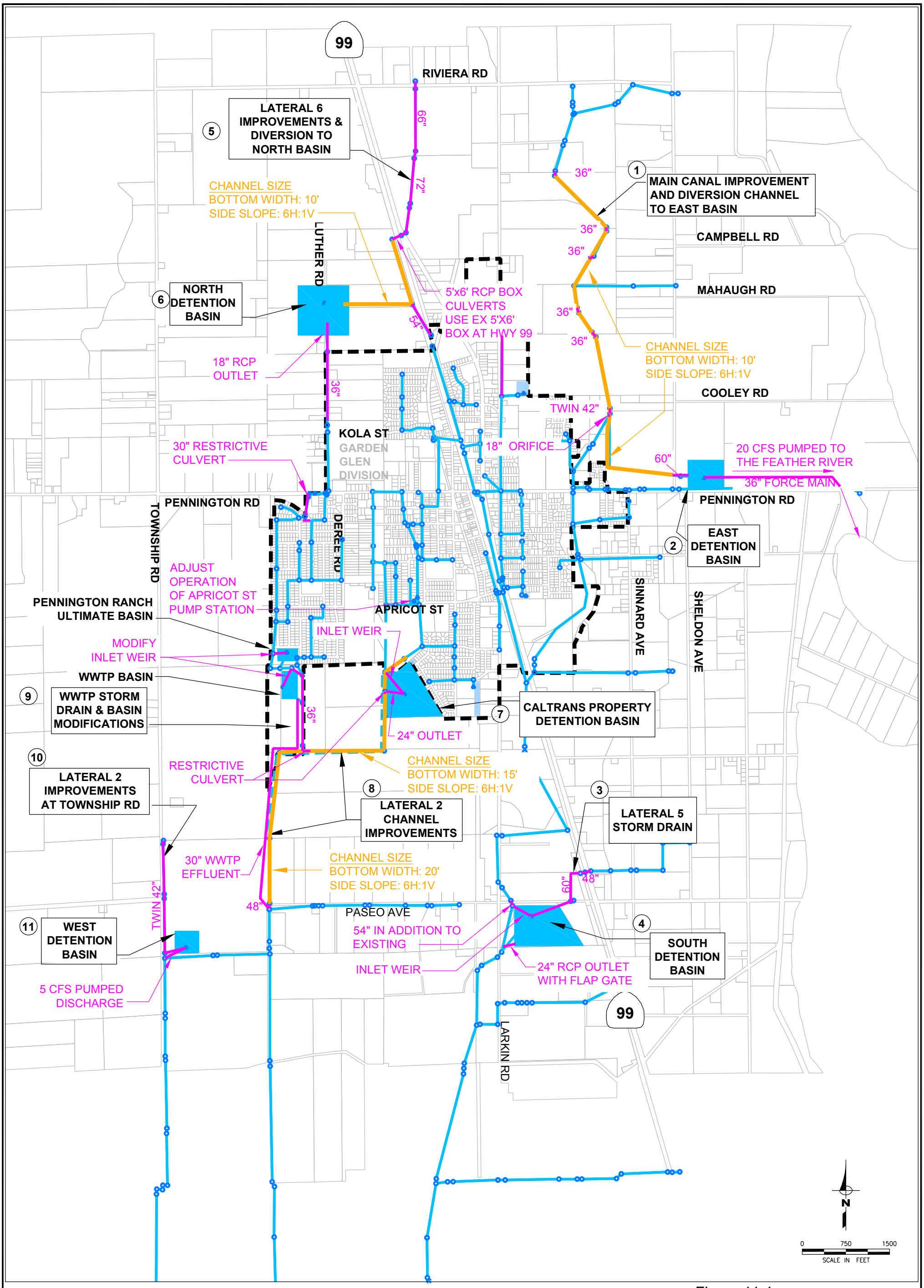


LEGEND

- CITY LIMITS
- CHANNEL
- PROPOSED STORAGE
- PROPOSED STORM DRAIN
- EXISTING STORM DRAIN
- MODEL LINK
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL

Figure 11-1

City of Live Oak
Master Drainage Study
ALTERNATIVE 4

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 12. COMPARISON OF ALTERNATIVES

This chapter presents a comparison of Alternatives 1, 2, 3 and 4. Also, Alternative 4 is identified as the recommended project.

INITIAL CAPITAL COST ESTIMATES

The initial construction and capital costs for each alternative were developed in Chapters 8 through 11, and are summarized in Table 12-1. These costs are in 2010 dollars. As shown, Alternative 4 has the lowest capital cost, at $35.6 million.

ANNUAL OPERATIONS AND MAINTENANCE COSTS

The facilities proposed in Alternatives 1 through 4 include channels, culverts, detention basins, and pump stations. The development of the annual operations and maintenance unit costs for each facility type are presented below.

Mr. John Currey, General Manager of the Dixon Resource Conservation District (DRCD), provided the following information regarding open channel operation and maintenance costs.

- The DRCD channels are sprayed with herbicides once during the dry season and once during the wet season. The average cost per spraying is $15 to $32 per acre for labor and $14 to $43 for materials, for a total of $29 to $75 per acre per spraying. The annual cost is about $58 to $150 per acre for spraying. For this analysis, an annual unit cost of $150 per acre was used for regular drainage channels that must remain relatively clear of vegetation. For joint use channels which are intended to have dense vegetation, it is assumed that spraying may be needed on the average once every five years, for an annual cost of $30 per acre.
- The DRCD excavates sediment from the channels once every 4 to 6 years. The typical cost of removing sediment is about $1,200 to $1,650 per mile, and depends on the channel size and the quantity of sediment that has accumulated. The sediment is piled alongside the ditch and then disked into the maintenance road at a cost of about $150 to $280 per mile. These costs are based on a channel that has a top width of about 25 feet (or 3 acres per mile). Thus, the annual costs for sediment removal and disking per acre of channel is $90 to $129. For this analysis, an annual unit cost for sediment excavation of $110 per acre was used for non-joint use channels. The joint use channels are sized to allow for dense vegetation and very slow water velocities; thus joint use channels can accommodate a higher level of sediment accumulation than nonjoint use channels. For this analysis, it is assumed that joint use channels will require sediment removal only once every ten years, for an annual cost of $55 per acre.
- Periodically it is necessary to remove trash and debris that is thrown into the channel (e.g. shopping carts, refrigerators, etc.). The cost is usually about $300 to $800 per occurrence. The annual cost per acre of channel is very difficult to estimate, but for this analysis, a cost of $25 per acre of channel per year was used for both joint use and non joint use channels.

Table 12-1. Estimated Capital Costs for Alternatives 1 through 4[1]

Item	Alternative 1 (from Table 8-5)	Alternative 2 (from Table 9-6)	Alternative 3 (from Table 10-6)	Alternative 4 (from Table 11-7)
Total Construction Cost, millions dollars	23,600,000	36,700,000	21,800,000	21,158,000
Total Land/Easement Cost, millions dollars[2]	4,867,800	6,500,000	9,616,022	5,972,802
Total Engineering, CM/Insp, CEQA, City Admin, millions dollars	9,440,000	14,680,000	8,720,000	8,460,000
Total Estimated Capital Cost, millions dollars	37,910,000	57,880,000	40,140,000	35,590,000
Total Development Area, acres	3,375	3,375	3,375	3,375
Cost per Acre, dollars/acre	11,200	17,100	11,900	10,500

(1) Based on 2010 dollars.

(2) Based on 40 percent of the total construction cost.

- As part of the DRCD's NPDES permit, they are required to perform water quality monitoring for pesticides used in the spraying program. The cost of this monitoring and reporting program is about $7,500 per year. This cost is about $40 per acre of channel per year. Therefore, $40 per acre per year was used in this analysis for both joint use and non joint use channels.
- For this analysis, the total annual cost of channel O&M (from top of bank to top of bank) was $325 per acre per year for nonjoint use channels and $150 for joint use channels.

Mr. Rolf Ohlemutz with the Vallejo Sanitation and Flood Control District reported that they spend about $8,000 per year on maintenance of the leveed Austin Creek Channel. Including the levee banks, this channel is about 120 feet wide and about 1.2 miles long. Consequently, the annual cost per acre is about $460. The cost estimated from data from DRCD of $325 per acre per year is lower than this, but it appears to be reasonable since the DRCD channels do not have levees.

Ms. Violet Jakab provided information on annual pump station costs from the City of Elk Grove. Based on the actual expenditures for the 9-month period of July 2004 through March 2005, it appears that the annual unit cost for pump station operations and maintenance is about $420 per cfs per year (including a share of departmental administrative costs). Information was also provided on storm drain system maintenance, and it appears that the annual cost to maintain 370 miles of pipe is about $457,000 per year (including a share of administrative costs), or about $1,200 per mile per year.

Reliable information for detention basin costs could not be obtained. However, spraying costs should be lower than for open channels because the basins are not linear features adjacent to roads like channels and spraying should not be slowed by adjacent traffic. Similarly, sediment removal should be less than that for channels because the detention basin can be designed with a sediment basin feature to facilitate the removal of the accumulated sediment. Consequently, a unit cost of $200 per acre was used for O&M of detention basins.

Using the unit costs discussed above, the estimated annual O&M costs for Alternatives 1 through 4 are presented in Table 12-2. Alternative 4 has the lowest cost of $50,500 per year. The present value costs for 50 years of annual O&M costs are also presented in Table 12-2. As shown, Alternative 4 also has the lowest O&M present value cost, at $1.59 million. The present value evaluation was based on a discount rate of 2 percent per year and a term of 50 years (or that interest rates would average 2 percent higher than inflation over the next 50 years).

REPLACEMENT COSTS

Replacement costs (in current dollars) are summarized in Table 12-3. These costs are also converted to present value costs using a discount rate of 2 percent and a 25-year or 50-year term. It was assumed that concrete facilities (RCP, headwalls, pump station structures, etc.) have a useful life of 50 years. It was also assumed that pump station electronics and pumps have a useful life of 25 years, and that these facilities represent 1/3 of the total pump station cost. The items with a 25-year life would be replaced after 25 years and again after 50 years as part of the 50 year replacement costs. These costs are 2010 dollars. A 10 percent construction contingency was included in replacement costs, which is reduced from the 20 percent value used in the initial construction/capital cost estimates. Engineering, CM/Insp, CEQA, City Administration were included at 20 percent in the replacement costs, which is reduced from the 40 percent value used in the initial construction/capital cost estimates. Some costs from the initial construction/capital cost estimates were excluded from the replacement cost; examples of the excluded costs are land costs, excavation costs, and landscape costs.

Table 12-2. Annual O&M Cost Comparison

Cost Item	Unit Cost ($/yr)	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
		Quantity	Annual Cost ($/yr)	Quantity	Annual Cost ($/yr)	Quantity	Annual Cost ($/yr)	Quantity	Annual Cost ($/yr)
Trunk Drains Length (mi)	1,200	9.0	10,764	7.4	8,884	7.0	8,452	8.2	9,781
Joint Use Open Channels (ac)	150	0.0	0	0.0	0	42.5	6,375	59.1	8,865
Regular Drainage Open Channels (ac)	325	42.9	13,943	155.1	50,408	0	0	0	0
Det Basin (acres)	200	80.2	16,040	85.7	17,140	197	39,420	107	21,340
Pump Stations (cfs)	420	35.0	14,700	0.0	0	20	8,400	25	10,500
Total Annual O&M Cost			55,446		76,432		62,647		50,486
Present Value of 50 years of O&M Costs (Discount Rate = 2%)			1,742,000		2,402,000		1,969,000		1,586,000

Table 12-3. Future Replacement Cost Comparison[(a)]

Cost Item	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	Estimated Cost ($)	Present Value Cost ($)	Estimated Cost ($)	Present Value Cost ($)	Estimated Cost ($)	Present Value Cost ($)	Estimated Cost ($)	Present Value Cost ($)
25-Year Life Cost Items (replaced twice)	740,000	451,053	0	0	420,000	256,003	560,000	341,337
50-Year Life Cost Items (replaced once)	22,070,000	8,199,620	17,050,000	6,334,550	18,160,000	6,746,946	18,540,000	6,888,127
Total		8,650,000		6,330,000		7,000,000		7,230,000

(a) It was assumed that concrete facilities (RCP, headwalls, pump station structures, etc.) have a useful life of 50 years. It was also assumed that pump station electronics and pumps have a useful life of 25 years, and that these facilities represent 1/3 of the total pump station cost. The items with a 25-year life would be replaced after 25 years and again after 50 years as part of the 50 year replacement costs.

As shown in Table 12-3, Alternative 2 has the lowest present value replacement cost, at $6.3 million. Alternative 4 has the third lowest present value replacement cost at $7.2 million, or about $900,000 higher than Alternative 2.

LIFE CYCLE COST SUMMARY

A summary of the life cycle costs (present values) is presented in Table 12-4 for Alternatives 1 through 4. The life cycle costs are the sum of the initial capital costs from Table 12-1, the O&M costs from Table 12-2, and the replacement costs from Table 12-3. As shown, Alternative 4 has the lowest life cycle cost, at $44.4 million.

LAND REQUIREMENTS

A comparison of the land requirements for the proposed basins and channels in each alternative is shown in Table 12-5. The land requirements are the total land required for the facility, including land that must be purchased and land already owned by the City of Live Oak or Reclamation District 777. During the preparation of this MDS, the City of Live Oak purchased approximately 26 acres from Caltrans, which is the Caltrans Detention Basin site.

GROUNDWATER ISSUES

Groundwater typically is encountered at depths of 6 to 8 feet in the City of Live Oak area. If the basin depth exceeds the depth to the groundwater table, loss of storage volume, mosquito breeding, or difficulty in maintaining the basin bottom may result. The depths of each of the basins are shown in Table 12-6. All basins are planned to be at least six feet deep. Groundwater depth information at each site will need to be collected prior to designing any of these basins. For Alternative 4, only a small portion of the North Basin exceeds 6 feet in depth. This was necessary to match the bottom elevation of the channel flowing into the basin.

COMPARISON OF ALTERNATIVES

Presented in Table 12-7 is a summarized comparison of the major issues related to the alternatives. This comparison includes costs, land requirements, maximum basin depths, number of pump stations and their capacities, phasing potential, and potential environmental issues.

Presented in Table 12-8 is a ranking of the alternatives based point scores associated with critical issues. Presented in the top row of Table 12-8 are the points assigned to each issue, with higher points meaning the issue is more important. Capital cost and land requirements were given a maximum point value of 10 points each. Intrusion into the groundwater table was also another major issue, so it was assigned a maximum value of 10 points. Pump stations, phasing potential, and permitting/environmental issues were each assigned a value of 5 points.

Table 12-4. Life Cycle Cost Comparison, dollars

Cost Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial Capital Costs	37,910,000	57,880,000	40,140,000	35,590,000
Present Value of O&M Costs	1,742,000	2,402,000	1,969,000	1,586,000
Present Value of Replacement Costs	8,650,000	6,330,000	7,000,000	7,230,000
Total	48,302,000	66,612,000	49,109,000	44,406,000

Table 12-5. Land Requirements

Item	Alternative 1, acres	Alternative 2, acres	Alternative 3, acres	Alternative 4, acres
Detention Basin				
North	27.2	--	64.3	33.9
East	7.6	--	12.4	12.4
Caltrans Property	15.1	--	25.5	25.5
South	22.7	--	28.0	28.0
West	7.6	--	66.9	6.9
Regional Detention Basin	--	85.7	--	--
Total Area for Basins	80.2	85.7	197.1	106.7
Channels				
Main Canal	18.6	59.2	32.7	33.0
Lateral 6 to North Basin	2.1	2.4	6.3	6.9
Lateral 2 to Paseo Road	22.2	35.7	3.5	19.2
Lateral 2 at Township Road	--	7.8	--	--
Diversion Channel	--	29.9	--	--
Paseo Road	--	6.6	--	--
Paseo Road to Regional Detention Basin	--	10.2	--	--
Channel at Regional Detention Basin	--	3.3	--	--
Total Area for Channels	42.9	155.1	42.5	59.1
Total Area for Basins and Channels	123.1	240.8	239.6	165.8

Table 12-6. Depth[(a)] of Basins

Detention Basin	Alternative 1, feet	Alternative 2, feet	Alternative 3, feet	Alternative 4, feet
North [(b)]	7.0	--	8.0	8.0
East	14.0	--	6.0	6.0
Caltrans Property	10.0	--	6.0	6.0
South	10.0	--	7.0	7.0
West	10.5	--	6.5	6.0
Regional Detention Basin	--	7.2	--	--
Maximum Depth	14.0	7.2	8.0	8.0

(a) Groundwater is typically encountered at depths of 6 to 8 feet in the City of Live Oak area.

(b) Only a small portion of the North Basin bottom (2.2 acres out of 33.9 acres) is at depth of 8 feet for Alternatives 3 and 4. The rest of the basin is at depth of 6 feet. The deep section of the North Basin was necessary to match the bottom elevations of the channels flowing into and out of the basin.

Table 12-7. Comparison of Alternatives

Alternative	Brief Description	Capital Cost, millions dollars	Land Requirements, acres						Max Basin Depth , ft [a]	No. of Pump Stations	Pump Station Capacities & Locations	Ability to Phase Construction of Facilities	Environmental Issues & Permits
			Basin	Channel	Total	Land Located Inside of City Growth Area	Land Located Outside of City Growth Area	Land Available for Joint Uses					
1	Five flood control detention basins throughout City growth area, enlarged Lateral 2 channel, diversion to Feather River, piping of Main Canal and Larkin Road Ditch	37.9	80.2	42.9	123.1	105.7	7.6	0	14	3	▪20 cfs to Feather River at Pennington Rd ▪10 cfs at Caltrans Basin to Lateral 2 ▪5 cfs to Lateral 2 at Township Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	High: ▪Extensive piping of channels, including the Main Canal, results in loss of habitat.
2	One large regional detention basin outside City growth area, channel improvements for increased conveyance	57.9	85.7	155.1	240.8	77	99.2	0	7.2	0	None	Minimal: ▪To minimize habitat impacts, full channel widening would be done initially and would not be phased. ▪Regional basin excavation can be phased.	High: ▪Extensive channel modification to convey flows efficiently could affect giant garter snake habitat.
3	Four dual-use detention basins that function for flood control and recreational purposes, one flood control basin, piping of Lateral 2, diversion to Feather River	40.1	197.1	42.5	239.6	209.9	40.4	222.3	8(b)	1	▪20 cfs to Feather River at Pennington Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	Moderate: ▪Replacement of Lateral 2 with piping results in loss of some habitat.
4	Two dual-use detention basins that function for flood control and recreational purposes, three flood control basins, Lateral 2 channel widening, diversion to Feather River	35.6	106.7	59.1	165.8	120.1	40.4	91.7	8(b)	2	▪20 cfs to Feather River at Pennington Rd ▪5 cfs to Lateral 2 at Township Rd	Moderate: ▪Basins can be constructed as the areas develop. ▪Excavated dirt to be used as development fill.	Minimal : ▪Dual use functions of improved channels may enhance habitat. ▪Minimal piping of existing channels

(a) Groundwater is typically encountered at depths of 6 to 8 feet in the City of Live Oak area.

(b) Only a small portion of the North Basin bottom (2.2 acres) is at depth of 8 feet. The rest of the basin is at depth of 6 feet. The deep section of the North Basin was necessary to match the bottom elevations of the channels flowing into and out of the basin.

Table 12-8. Ranking of Alternatives 1-4

Alternative	Capital Cost (10 points)		Land Requirements (10 points)		Groundwater (10 points)		Pump Stations (5 points)		Phasing Potential (5 points)		Environmental Issues & Permitting (5 points)		Total Score (45 points)
	Capital Cost, millions dollars	Point Score	Total Land, acres	Point Score	Max Basin Depth, ft	Point Score	No. of Pump Stations	Point Score	Relative Ranking	Point Score	Relative Ranking	Point Score	
1	37.9	9.6	123.1	10.0	14	1.5	3	0.0	High	5	Moderate	2	26.1
2	57.9	6.1	240.8	5.1	7.2	10.0	0	5.0	Low	1	High	1	27.3
3	40.1	9.2	239.6	5.2	8	9.0	1	3.3	High	5	Moderate	2	31.7
4	35.6	10.0	165.8	8.2	8	9.0	2	1.7	High	5	Minimal	4	33.9

Each alternative was then given a point score for each of the major issues. Higher point scores are better than lower scores. For example, Alternative 4 has the lowest capital cost, and it was given a score of 10 points. Alternative 2 has the highest capital cost, so was given a score of 5.9 points. The point rankings for the Capital Costs are calculated based inversely on the cost for the alternative above the cost of the lowest cost alternative. In addition, Alternative 1 requires the least amount of land, so it was given a score of 10 points. Alternative 3 requires the most land (about twice the amount of land required for Alternative 1), so it was given a score of 5.2 (about half the score of Alternative 1). The point rankings for Land Requirement are calculated based inversely on the area required for the alternative above the area required for the alternative with the lowest land requirement.

The other issues were given qualitative rankings based on the issue descriptions in Table 12-7. Point scores were then assigned to each alternative based the qualitative rankings and the point value for the issue.

The maximum score of 45 points is possible. For each alternative, the point scores are totaled in the far right column of Table 12-8, with higher scores better than lower scores. As shown, Alternative 1 has the lowest point score with 26.1 points, while Alternative 4 has the highest ranking of 33.9 points. Based on this ranking Alternative 4 is the preferred alternative, primarily due to the lowest land requirements and lowest cost.

SELECTION OF THE RECOMMENDED PROJECT

Alternatives 1 through 4 were presented to the City of Live Oak City Council and Planning Commission at a General Plan Update workshop covering stormwater, potable water, and wastewater on April 28, 2010. A copy of the presentation is provided as Appendix 12-A. The goals for the presentation were to:

- Present the alternatives
- Compare the alternatives
- Answer questions about the alternatives
- Determine if the City Council and Planning Commission generally support the concept of including joint use channels and detention basins in the recommended project

At the time of the presentation, the life cycle cost evaluation presented above had not been completed, and the Council asked that a life cycle evaluation be performed. This work is presented above.

Additionally, the Council asked if it would be more cost effective to eliminate the 5 cfs pump station that serves the West Detention Basin (for Alternative 4) and replace it with a gravity drain. Use of a gravity drain would require that the basin be shallow in order to gravity drain into Lateral 2. The shallower basin would require a much larger area. The capital costs of these two options are presented in Table 12-9. As shown, the life cycle cost with the pump station is $1.36 million and without the pump station it is $1.43 million. Also, without the pump station, the drains upstream of the West Detention Basin will have standing water in them, resulting in increased maintenance costs, and in the summer this water will become stagnant and odorous. For these reasons the 5 cfs pump station has been retained in the West Detention Basin facility.

Neither the City Council nor the Planning Commission took official action to adopt Alternative 4 as the recommended project. However, they were generally supportive of the concept of joint use channels and detention basins.

Based on the analyses conducted and the comparison and rating of the Alternatives, Alternative 4, with the West Detention Basin Pump Station, is selected as the Recommended Project.

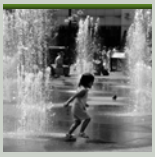
Table 12-9. West Detention Basin Option Capital Costs Comparison

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
West Detention Basin with Pump Station				
Initial Capital Costs				
Site Preparation (Clear and Grub)	acre	500	6.9	3,464
Basin Excavation	CY	4	53,722	214,887
Landscape and Erosion Control	acre	2,000	6.0	11,912
Pump Station (5 cfs)	cfs	50,000	5.0	250,000
Headwalls	each	8,000	1	8,000
Aggregate Base Access Road	feet	20	2,037	40,748
Fencing	feet	16	2,037	32,599
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				28,130
Construction Contingency (at 20 percent)				112,520
Estimated Construction Cost				703,260
Land/Easements (for basin)	acre	50,000	6.9	346,402
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				281,300
Estimated Capital Cost				1,331,000
Annual O&M Costs				
Pump Station	cfs	420	5	2,100
Detention Basin	acre	200.0	7	1,386
Total Annual O&M Cost				3,486
Present Value of 50-Years of O&M				109,530
Present Value of Future Replacement Costs				199,983
Total Present Value Cost				1,640,514
West Detention Basin without Pump Station				
Initial Capital Costs				
Site Preparation (Clear and Grub)	acre	500	18.9	9,450
Basin Excavation	CY	4	81,344	325,377
Landscape and Erosion Control	acre	2,000	17.3	34,560
Headwalls	each	8,000	1	8,000
Aggregate Base Access Road	each	20	3,470	69,407
Fencing	each	16	3,470	55,526
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				25,166
Construction Contingency (at 20 percent)				100,664
Estimated Construction Cost				629,150
Land/Easements (for basin)	acre	50,000	18.9	945,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				251,700
Estimated Capital Cost				1,825,900
Annual O&M Costs				
Detention Basin	acre	200.0	19	3,780
Increased O&M for Upstream Drain because of Standing Water	mile	5.0	1,200	6,000
Total Annual O&M Cost				9,780
Present Value of 50-Years of O&M				307,323
Present Value of Future Replacement Costs				56,797
Total Present Value Cost				2,190,019

APPENDIX 12A

Title: City of Live Oak Master Drainage Study (MDS)

April 28, 2010


WEST YOST ASSOCIATES

Agenda

- **Background**
- **Alternatives Evaluation**
- **Recommended Alternative**
- **Questions**

Background

Began as a MDS for RD 777 in 2005 → **Expanded Study to Support City's General Plan Update in 2008**

Goal: Allow City to Grow Without Increasing City or Agricultural Flooding

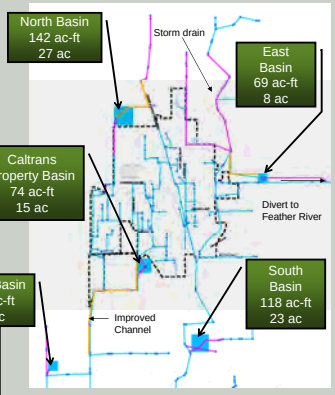
- **Evaluated 4 Alternatives**
- **Identified Recommended Project – Seeking Council Input**

Agenda

- ~~Background~~
- **Alternatives Evaluation**
- ~~Recommended Alternative~~
- ~~Questions~~

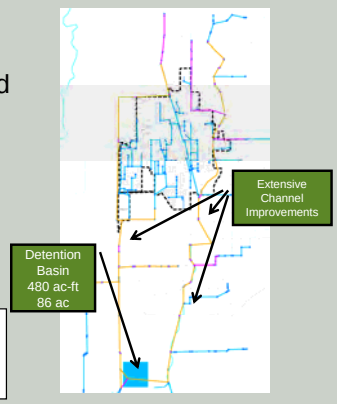
Alternative 1: Flood Control

- 5 Detention Basins
  - Total Storage: 455 ac-ft
  - Total Area: 80 ac
- Divert NE Quadrant Runoff to Feather River
- Large Storm Drains & Channel Improvements
- Capital Cost: $34 million



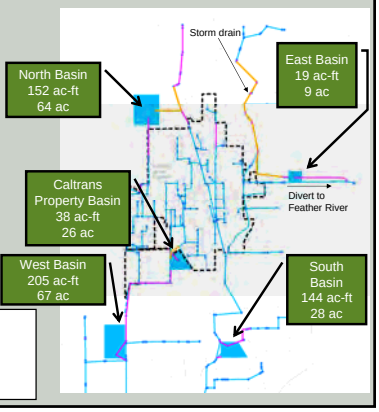
Alternative 2: Regional Detention Storage & Increased Channel Capacity

- Detention Basin
  - Total Storage: 480 ac-ft
  - Total Area: 86 ac
- Increased Channel Conveyance
- Capital Cost: $53 million



Alternative 3: Dual Use

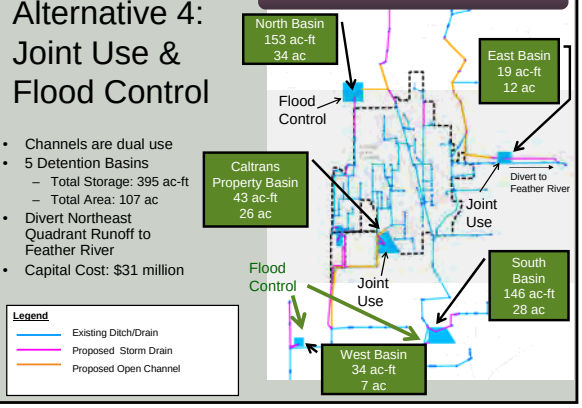
- Basins & Channels provide recreation, habitat, and flood protection
- 5 Detention Basins
  - Total Storage: 558 ac-ft
  - Total Area: 194 ac
- Divert Northeast Quadrant Runoff to Feather River
- Capital Cost: $33 million



Recommended Alternative

Alternative 4: Joint Use & Flood Control

- Channels are dual use
- 5 Detention Basins
  - Total Storage: 395 ac-ft
  - Total Area: 107 ac
- Divert Northeast Quadrant Runoff to Feather River
- Capital Cost: $31 million



Agenda

- Background
- Alternatives Evaluation
- **Recommended Alternative**
- Questions

Recommended Alternative

Joint Use Basins

Recommended Alternative

Joint Use Channels

City of Vacaville
Ulatis Creek Walk

Recommended Alternative

Joint Use Channels

City of Dixon
Lateral 2

Alternative Comparison Summary

Item	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Basin Volume (ac-ft)	455	480	558	395
Basin Area (acres)	80	86	197	107
Channel Area (acres)	33	90	53	54
Total Area (acres)	113	176	250	160
Pump Stations	3	0	1	2
Total Cost ($, million)	34	53	33	31
Cost per Acre of Growth ($/acre)	10,100	15,700	9,700	9,200

Recommended Alternative

Agenda

- Background
- Alternatives Evaluation
- Recommended Alternative
- **Questions**

CHAPTER 13. DETENTION FACILIITIES FOR RD 2056

The northwest corner of the City of Live Oak's General Plan growth is within the RD 2056 service area. This area was divided into six subwatersheds based upon their current drainage patterns (see Figure 7-1). The RD 2056 channels were originally sized for a runoff rate of 15 cfs per square mile, or 0.0234 cfs per acre. Off-line detention basins have been sized to reduce the flow into Morrison Slough to be less than the original design runoff rate after development of the areas tributary to each basin.

Each of the detention basin systems was configured to include a large channel (12 foot bottom width and 4H:1V side slopes) from Township Road to near Morrison Slough. This large channel both conveys the peak flows and provides the first increment of detention storage. At the west end of the channel a small culvert restricts the flow into Morrison Slough to slightly less than the original design runoff rate. Also, a side flow weir directs the peak flows from the channel into a detention basin located adjacent to the channel.

Each detention basin was configured to have a deep section with a depth of 5.0 to 5.5 feet, and a shallow section with a depth of about 2.0 to 2.5 feet. This approach was used to allow the shallow section to continue to be farmed. In a 10-year storm, the water will remain in the deep section of the basin. In a 100-year storm, both sections are completely filled with water, leaving about one foot of freeboard. This two step approach results in conserving some land for continued farming, but also results in the overall basin foot print being larger than if the entire basin was excavated to a depth of 5.0 to 5.5 feet.

When the basins are to be designed and constructed, the final basin configuration should be reevaluated in cooperation with the individual land owners. There are many potential configurations that could be used to minimize the impacts to the property and farming operations.

The current configurations of the basins are described in the following sections:

NORTH BASIN (OUT OF SYSTEM 7 SUBWATERSHED)

The proposed system for the subwatershed labeled Out of System 7 (shown on Figure 7-1) is summarized below:

- The total area of 282.9 acres. For this area, the original design runoff rate is 6.6 cfs. The peak 10-year runoff rate is 230 cfs, and the peak 100-year runoff is 300 cfs.
- The channel from Township Road to near Morrison Slough reduces the 10-year flow, resulting in a peak discharge to Morrison Slough to 5.4 cfs (through 80 feet of 12 inch CMP culvert with no headwalls, but with a flap gate) and the peak flow over the weir (60 feet long at elevation 77.3 feet) to the detention basin is 170 cfs. The 100-year flow into Morrison slough is 5.3 cfs and the peak flow over the weir to the detention basin to 239 cfs.
- The detention basin stage-area-volume data are provided in Table 13-1. The maximum water depth in the basin in the 10-year storm is 2.1 feet. The maximum water depth in the basin in the 100-year storm is 4.2 feet, leaving 1.3 feet of freeboard.

- In a 10-year storm, about 8 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 7.8 cfs, and the flow from the large channel is under 4 cfs, for a total discharge of under 12 cfs. At this time, the water surface elevation in Morrison Slough at this location is about 74 feet, or about 4 feet below the top of bank. In a 100-year storm, about 12 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 11.2 cfs, and the flow from the large channel is under 4 cfs, for a total discharge of under 15 cfs. At this time, the water surface elevation in Morrison Slough at this location is about 77 feet, or about 1 foot below the top of bank.

The 10-year and 100-year storms used in this evaluation are design storm events, and they build to a very intense, but short duration peak rainfall. Most large actual, historical storms include several storm fronts that pass through over several days. Consequently, creek water levels may stay high longer in actual storms than in these design storms. Also, not all the culverts along Morrison Slough have been included in this Morrison Slough model. If all the culverts were modeled, it is likely that flooding flows would be partially held in the upper watershed, which would contribute to an increased duration of flooding at the location of this proposed detention basin (and the basins described below).

Table 13-1. Stage - Area - Volume Data for RD 2056 Basins

Stage (above bottom), ft	North Basin Area, acres	North BasinVolume, ac-ft	Mid Basin Area, acres	Mid Basin Volume, ac-ft	South Basin Area, acres	South Basin Volume, ac-ft
0.00	0.10	—	0.10	—	0.10	—
0.50	7.00	1.78	2.00	0.53	4.10	1.05
3.00	7.46	19.85	2.25	5.84	4.46	11.75
3.50	11.13	24.50	4.84	7.61	9.11	15.14
5.50	11.62	47.26	5.18	17.64	9.58	33.82

MID BASIN (OUT OF SYSTEM 6 SUBWATERSHED)

The proposed system for the subwatershed labeled Out of System 6 (shown on Figure 7-1) is summarized below:

- The total subwatershed area is 134.8 acres. For this area, the original design runoff rate is 3.2 cfs. After development, the peak 10-year runoff rate is 135 cfs, and the peak 100-year runoff is 172 cfs.

- The channel from Township Road to near Morrison Slough reduces the peak 10-year flow, resulting in a peak discharge to Morrison Slough to 3.2 cfs (through 80 feet of 10 inch CMP culvert with no headwalls, but with a flap gate) and the peak flow over the weir (60 feet long at elevation 76.0 feet) to the detention basin is 8 cfs. The 100-year flow into Morrison slough is 3.1 cfs and the peak flow over the weir to the detention basin is 73 cfs.
- The detention basin stage-area-volume data are provided in Table 13-1. The maximum water depth in the basin in the 10-year storm is 1.4 feet. The maximum water depth in the basin in the 100-year storm is 4.5 feet, leaving 1.0 feet of freeboard.
- In a 10-year storm, about 9 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 5.1 cfs, and the flow from the large channel is under 3 cfs, for a total discharge of under 8 cfs. At this time, the water surface elevation in Morrison Slough at this location is under 73 feet, or about 4 feet below the top of bank. In a 100-year storm, about 19 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 10.8 cfs, and the flow from the large channel is less than 3 cfs, for a total discharge of under 14 cfs. At this time, the water surface elevation in Morrison Slough at this location is about 73 feet, or about 4 feet below the top of bank.

The owner of the airport located on the west side of Morrison Slough at this location has reported that over the last 22 years water has flooded into his farm buildings a few times, to a depth of about 6 inches over the road/culvert over Morrison Slough. This water level was surveyed to be about 78.5 feet NAVD. A 10-year storm model run was performed approximating existing conditions, and the water level on the upstream side of this culvert was 78.4 feet, which agrees very closely with the historically observed flooding at this site.

SOUTH BASIN (OUT OF SYSTEM 1, 2, AND 3 SUBWATERSHEDS)

The proposed system for the subwatersheds labeled Out of System 1, 2, and 3 (shown on Figure 7-1) is summarized below:

- The peak 10-year runoff from Out of System 1 subwatershed is 121 cfs, and the peak 100-year runoff rate is 156 cfs. This runoff will flow in a 72-inch concrete pipe from Pennington Road through the Out of System 2 subshed. On the north side of Pennington Road, in the 10-year storm this drain system will have about 4.0 feet of freeboard, and in the 100-year storm there will be ponding in the street, but less than 0.1 foot deep.
- At the southwest corner of the Out of System 2 subshed, the 72-inch pipe will discharge into an open channel. The channel will have a bottom width of 12 feet and 4H:1V side slopes. The channel will flow south through the Out of System 3 subshed and cross Township Road at the southwest corner of the Out of System 3 subshed. The peak 10-year runoff from out of System 2 is 123 cfs, and the peak 100-year runoff rate is 162 cfs. The peak 10-year runoff from out of System 3 is 63 cfs, and the peak 100-year runoff rate is 84 cfs.
- The total area for the Out of System 1, 2, and 3 shubheds is 304.2 acres. For this area, the original design runoff rate is 7.1 cfs.

- The channel segments upstream of Township Road and from Township Road to near Morrison Slough reduces the 10-year flow, resulting in a peak discharge to Morrison Slough to 5.1 cfs (through 80 feet of 12 inch CMP culvert with a headwall on the upstream end and with a flap gate), and the peak flow over the weir (60 feet long at elevation 72.0 feet) to the detention basin is less than 1 cfs. The 100-year flow into Morrison slough is 5.0 cfs, and the peak flow over the weir to the detention basin is 95 cfs.
- The detention basin stage-area-volume data are provided in Table 13-1. The maximum water depth in the basin in the 10-year storm is 0.6 feet (including the rain falling directly on the basin). The maximum water depth in the basin in the 100-year storm is 4.4 feet, leaving 1.1 feet of freeboard.
- In a 10-year storm, about 14 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 1.2 cfs, and the flow from the large channel is less than 4.5 cfs, for a total discharge of under 6 cfs. At this time, the water surface elevation in Morrison Slough at this location is about 68 feet, or about 5 feet below the top of bank. In a 100-year storm, about 25 hours after the peak of the storm has passed, the peak flow from the detention basin to Morrison Slough reaches about 11.5 cfs, and the flow from the large channel is less than 4.5 cfs, for a total discharge of under 16 cfs. At this time, the water surface elevation in Morrison Slough at this location is about 68 feet, or about 5 feet below the top of bank.

COMPARISON WITH EXISTING CONDITIONS

An existing conditions model of the RD 2056 area was not prepared since it was determined that the post development runoff rates would be detained to be less than the original RD 2056 channel design rate (15 cfs per square mile). Nevertheless, a comparison of the approximate existing conditions 100-year runoff rates with developed runoff rates and detained peak discharge rates is provided in Table 13-2. As shown, the detention basins reduce the post-development discharge rates at the peak of the storm event to about 10 percent of the pre-development agricultural runoff rates. This reduction in flow would reduce the maximum water level in the channel at the upstream side of the 17 foot wide by 8 foot tall Pennington Road box culvert by about one foot. Similarly, it would reduce the flood water level near the private airport north of Pennington Road by about one foot.

COST ESTIMATES

The construction and capital costs for each of the channel/basin systems discussed above are presented in Table 13-3. As shown, the estimated total construction cost is $2.4 million and the estimated capital cost is $4.4 million. The following assumptions were made for the preparation of the cost estimate:

- The excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks.
- All land will be purchased (versus easements) at a cost of $25,000 per acre.

Table 13-2. Comparison of Existing Conditions and Post Development Runoff Rates and Discharge Rates.

Subwatershed	North Basin Out of System 7	Mid Basin Out of System 6	South Basin Out of System 1, 2, 3
Subwatershed Area (acres)	282.9	134.8	304.2
Existing Condition 100-Year Runoff Rate from Figure 3-2 (cfs)	57	30	61
Developed Conditions Morrison Slough Discharge Rate at Peak of Storm (cfs)	5.3	3.1	5.0
Reduction of Peak Flow (cfs)	51	27	56
Cost	$1.13 Mil	$640,000	$3.57 Mil

Table 13-3. Cost Estimate for Detention Basins and Channels in the RD 2056 Area

Item	Unit of Measure	Unit Cost	Quantity	Item Cost
1. North System - Channel and Basin				
Site Preparation (Clear and Grub)	acre	500	14.8	7,400
Channel Excavation	CY	4	12,480	49,920
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	76,238	304,953
Aggregate Base Access Road	feet	20	3,881	77,616
Fencing	feet	16	3,201	51,213
Landscape or Erosion Control Vegetation	acre	2,000	14.8	29,600
12-Inch CMP	feet	60	80	4,800
18-Inch CMP	feet	90	80	7,200
12-inch flap gate	each	1,000	1	1,000
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	10,000	0	0
Rock scour protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				28,060
Construction Contingency (at 20 percent)				112,240
Estimated Construction Cost				701,502
Land/Easements (for channel)	acre	25,000	1.5	37,500
Land/Easements (for basin)	acre	25,000	13.3	332,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				280,601
Estimated Capital Cost				1,352,103
2. Mid System - Channel and Basin				
Site Preparation (Clear and Grub)	acre	500	9.1	4,550
Channel Excavation	CY	4	22,400	89,600
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	28,452	113,809
Aggregate Base Access Road	feet	20	4,344	86,890
Fencing	feet	16	2,333	37,322
Landscape or Erosion Control Vegetation	acre	2,000	9.1	18,200
10-Inch CMP	feet	50	80	4,000
18-Inch CMP	feet	90	80	7,200
10-inch flap gate	each	900	1	900
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	8,000	0	0
Rock scour protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				19,499
Construction Contingency (at 20 percent)				77,994
Estimated Construction Cost				487,464
Land/Easements (for channel)	acre	25,000	2.7	67,500
Land/Easements (for basin)	acre	25,000	6.4	160,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				194,985
Estimated Capital Cost				909,949
2. South System - Trunk Drain, Channel, and Basin				
Site Preparation (Clear and Grub)	acre	500	19.0	9,500
Channel Excavation	CY	4	64,480	257,920
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	54,569	218,275
Aggregate Base Access Road	feet	20	9,987	199,736
Fencing	feet	16	10,187	162,989
Landscape or Erosion Control Vegetation	acre	2,000	19.0	38,000
12-Inch CMP	feet	60	80	4,800
18-Inch CMP	feet	90	80	7,200
12-inch flap gate	each	1,000	1	1,000
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	8,000	1	8,000
Rock scour protection	CY	100	100	10,000
Mobilization/demobilization (at 5 percent)				47,196
Construction Contingency (at 20 percent)				188,784
Estimated Construction Cost				1,179,900
Land/Easements (for channel)	acre	25,000	7.8	195,000
Land/Easements (for basin)	acre	25,000	11.2	280,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				471,960
Estimated Capital Cost				2,126,861
Total Estimated Construction Cost				2,368,866
Total Land/Easement Cost				1,072,500
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				947,546
Total Estimated Capital Cost				4,388,912

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent

CHAPTER 14. RECOMMENDED PROJECT

As described in Chapter 12, Alternative 4 was selected as the Recommended Project (RP). Alternative 4 was initially described in Chapter 11. Presented in this chapter is a further discussion of the RP, including layout and sizing of additional trunk drains, and a preliminary review of likely environmental impacts.

RECOMMENDED PROJECT DESCRIPTION AND EVALUATION

The RP is shown on Figures 14-1A and 14-1B. The RP includes:

- All of the facilities from Alternative 4 as described in Chapter 11. These facilities are within the RD 777 service area. These facilities would be funded by development impact fees and constructed by the City.
- All of the facilities described in Chapter 13, which are within the RD 2056 service area. These facilities are within the RD 2056 service area. These facilities would be funded by development impact fees and constructed by the City.
- Additional trunk drains within the City that would likely serve more than one individual development project. These drains are described and sized below. These drains would be funded and constructed by the development projects that use the drains.
- Increased channel maintenance to achieve a Manning's n value of 0.035 and increase culvert maintenance to keep the culverts free of sediment. These reaches of drains that require increased maintenance are shaded yellow on Figure 14-1B. The increased maintenance would be funded through increased fees collected by RD 777 from the new growth areas of the City (see RD 777 Funding Evaluation below).

ADDITIONAL TRUNK DRAIN LAYOUT AND SIZING

Several additional trunk drains (beyond the facilities planned in Chapters 11 and 13) will be required. These drains are shown in green on Figure 14-1A and their sizes shown in Table 14-1. These drains have been planned for areas that may serve more than one development project. These trunk drains have been aligned along existing or proposed roads or streets. As shown in Table 14-1, these drains range in size from 48 inches to 78 inches in diameter.

PRELIMINARY ENVIRONMENTAL IMPACT REVIEW

The RP consists of storm drains, pump stations, open channel improvements, and detention basins. The construction of these facilities has the potential to cause environmental impacts. From a project permitting perspective, the potential biological impacts are most critical. Important biological resources include plants, animals, or habitat areas. The City has prepared a CEQA review of the General Plan Update and associated infrastructure requirements. A summary of the General Plan Update CEQA review of the potential biological impacts is provided below, based on the following documents:

Table 14-1. Sizing of Trunk Drains
(see Figure 14-1 for Trunk Drain Locations)

Trunk Drain Label (see Figure 13-1)	Tail Water Node Name from XP-SWMM Model	10-Year Water Surface Elevation from XP-SWMM Model, ft, NAVD	XP-SWMM Watershed	XP-SWMM Model Unit Runoff, cfs/ac	Flow (Apportioned from XP-SWMM Runoff Model Results), cfs	Trunk Drain Size, inches	Water Velocity, fps	Hydraulic Grade Line Slope, ft/ft	Trunk Drain Length, ft	Trunk Drain Upstream Water Surface Elevation, ft, NAVD
RD 2056-7	2056-146 (Note A)	78.30	2056-7	0.82	114.2	78	3.4	0.000628	1,550	79.27
L02-0530A-1	NBSN	76.03	L02-0530A	1.12	104.9	78	3.2	0.000531	1,280	76.71
L02-0530A-2					44.7	60	2.3	0.000389	1,210	77.18
L06-0460	L06-0462	77.05	L06-0460	0.68	40.6	54	2.6	0.000564	1,280	77.77
L06-0480-1	L06-0502	77.45	L06-0480	0.67	37.3	54	2.3	0.000475	990	77.92
L06-0480-2	L06-0490	77.24	L06-0480	0.67	33.9	48	2.7	0.000739	1,040	78.01
L02-0250	L06-0462	69.74	L02-0250B	1.02	55.9	60	2.8	0.000610	2,380	71.19
L02-0240	L02-0240	69.73	L01-0290	0.78	65.2	66	2.7	0.000499	2,380	70.92
L05-0050-1	L05-0050	72.06	L05-0050	0.86	68.9	72	2.4	0.000350	1,660	72.64
L05-0050-2					42.2	60	2.1	0.000347	1,120	73.03

Note A: The XP-SWMM model results are from the RD 2056 model.

- Biological Resources Inventory for the City of Live Oak General Plan Update Sutter County, California, prepared for the City of Live Oak, prepared by SCWA Environmental Consultants, January 10, 2006.
- Public Review Draft, City of Live Oak, Draft 2030 General Plan Environmental Impact Report.

Four special status plant species were identified for which suitable habitat occurs in the City and RD 777 areas, and consequently, these species could be impacted by construction of the RP facilities. These species include Fox sedge, Rose-mallow, Sanford's arrowhead, and Columbian watermeal. Each of these plant species could occur in the sloughs, drainage channels, and irrigation canals in the City and RD 777 areas.

There are 23 special status wildlife species that could occur in the City and RD 777 areas. The species that occur in the sloughs, drainage channels, and irrigation canals include: Valley elderberry longhorn beetle, Northwestern pond turtle, giant garter snake (GGS), tricolored blackbird, and Song sparrow (Modesto population). The detention basins will be constructed in agricultural land areas that are either orchards or cropland. The species that occur in orchards are: Loggerhead shrike, White-tailed kite, and Western red bat. The species that occur in cropland are: Western burrowing owl, Swainson's hawk, Lesser sandhill crane, and Greater sandhill crane.

The special status fish species that could be impacted are Central Valley spring run chinook salmon and Central Valley steelhead. These fish use the Feather River for migration and spawning. The east detention basin and pump station will discharge to the Feather River. The force main will end at the water side toe of the existing levee, which is over 1,050 feet from the active river channel and significantly above the summertime water level in the river. The flow will be conveyed to the active river by an existing channel and culverts. Thus, construction of the force main should not impact the river or these special status fish.

The City has prepared an Environmental Impact Report covering implementation of the 2030 General Plan. The EIR evaluated the following impacts related to stormwater facilities: on-site and downstream erosion and sedimentation; construction related water quality impacts; exposure of people or structures to flood hazards from increased stormwater runoff; impacts to special status plant species; impacts to special status wildlife and fish species; loss and degradation of federally and state protected wetlands and/or riparian vegetation; and require the construction of new or expanded stormwater drainage facilities. Implementation of City policies associated with the 2030 General Plan result in all of these impacts receiving a less-than-significant evaluation. In particular, this MDS is part of the mitigation for several of the stormwater related potential impacts.

PERMIT REQUIREMENTS

Although the impacts associated with these stormwater drainage facilities have been evaluated and found to be less-than-significant, several permits will be required for the implementation of these stormwater facilities.

Waters and Wetlands of the US Delineation

Waters of the US are defined as those aquatic areas that are within the jurisdiction of the U.S. Army Corps of Engineers (Corps). Under current Corps regulations and judicial interpretation, it is likely that some of the drainage channels in the City and RD 777 area would be considered waters of the US. As such, any discharge of fill (including concrete for headwalls or storm drain outlets) to these features will fall with in the Corps regulatory programs and require Corps permitting. Mitigation of these impacts will be required to ensure that there will be an overall no-net-loss of waters of the US due to the project. It is likely that modification of the existing drainage channels to become joint use channels and the construction of the detention basins will result in a net increase in waters of the US and may compensate for other possible impacts to waters of the US, though other compensatory measures may be identified during the permitting processes for the individual drainage facilities.

The waters and wetlands of the US must be delineated to determine if the Clean Water Act Section 404 Discharge Permit and/or Clean Water Act Section 401 Water Quality Certification will be needed. After the delineation is prepared, it is submitted to the Corps for verification.

Based upon the regulatory framework and potential impacts, the following federal, state, and local permits would likely be required to construct the RP facilities.

Clean Water Act Section 404 Individual Discharge Permit

Section 404 permits (for wetlands and waters of the US) are frequently required for projects that result in fill or discharge into waters of the US. The in-channel work associated with the channel improvements and culvert placement/replacement will likely fall within the jurisdiction of the U.S. Army Corps of Engineers. Issuance of an Individual Permit could require 6 months to one year.

Clean Water Act Section 401 Water Quality Certification

Section 401 of the Clean Water Act requires a water quality certification to be issued by the Regional Water Quality Control Board for any permitted activities authorized by the Corps. Issuance of this certification could require 3 to 6 months, and cannot be issued until a CEQA document covering the project has been certified.

Endangered Species Act Section 7 USFWS Consultation

The RP may affect GGS. The GGS is a state and federally threatened species. Federal agencies conducting activities that may effect federally listed species (including issuance of a Section 404 Permit) must consult with the United States Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act. Consultation periods are limited to 180 days, but can be extended through the discretion of the lead agency.

Section 1602 Streambed Alteration Agreement

Alterations to the drainage channels will require compliance with Section 1600 of the California Fish and Game Code. This section requires public and private entities that plan to engage in activities that may disturb creeks, streams, rivers and lakes, to obtain a streambed alteration agreement (SBAA) from the California Department of Fish and Game (CDFG) through Section 1602 of the Code. Issuance of this agreement could require 3 to 6 months, and it can not be issued until a CEQA document covering the project has been certified.

The terms of this permit will likely require the minimization of the potential for the projects to disturb or disrupt wildlife or habitat areas.

CVFPB Encroachment Permit

The Central Valley Flood Protection Board has jurisdiction over the Feather River levee. The force main from the East Detention Basin will need to cross this levee, and consequently a CVFPB encroachment permit will be required. This permit will likely require 3 to 6 months to acquire.

Construction General Permit Order 2009-0009-DWQ

Because the RP facilities will disturb more than one acre, coverage will be required under the General Permit for Discharges of Storm Water Associated with Construction Activity. Effective July 1, 2010 all dischargers are required to obtain coverage under the Construction General Permit Order 2009-0009-DWQ, which was adopted on September 2, 2009.

The Construction General Permit requires the submission of a Notice of Intent, calculation of risk category for the project, and the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP should contain a site map(s) which shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect storm water runoff quality and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

Filing for this permit can be done on-line and does not require a long time frame.

RD 777 and RD 2056 Encroachment Permits

Proposed facilities that require work within the RD 777 or RD 2056 channels, rights-of-way, or easements will require encroachment permits from these Districts. These permits will require 1 to 2 months to acquire.

POSSIBLE WILDLIFE DISTURBANCE REDUCTION

Although the City's EIR for the 2030 General Plan has concluded that there should be no significant impacts from the adoption and implementation of the updated General Plan (and associated infrastructure), it is likely that the SBAA will include terms intended to minimize the potential for the construction of the stormwater projects to disturb wildlife. In particular, described below are possible permit requirements to reduce the disturbance of GGS, Western Pond Turtles, and Swainson's Hawk.

The GGS is listed by both the federal and state agencies as a threatened species. This aquatic species prefers low gradient marsh habitat comprised of dense, emergent vegetation (such as water hyacinth) for cover, deep or shallow pools of water for hunting, open areas along the margins of wetlands for basking, and upland habitat suitable for hibernation and safety during winter floods. Sections of the existing drainage channels may provide habitat for GGS. Improvement to these sections could result in "take" of individuals or habitat that supports this species. Impacts to GGS can be minimized by improving the existing channels one side at a time, and allowing escape opportunity for the species if they are in the aquatic environment. Activities in upland habitat should occur from May 1 through September 30 when the snakes are active, and are more easily seen and avoided. In addition, there is an opportunity to create or restore effected GGS habitat in the improved channels. Other compensatory measures may be identified during the permit acquisition period.

The northwestern pond turtle is a federal species of special concern. This aquatic species lives in marshes, ponds, and along slow reaches of streams and rivers. Similar to the GGS, sections of the existing channels and adjacent upland areas may currently support western pond turtle. Avoidance measures identified for the GGS, and conducting preconstruction surveys will minimize impacts to northwestern pond turtle. Other compensatory measures may be identified during the permit acquisition period.

The Swainson's hawk is a state-listed threatened species that nests along riparian corridors and in isolated trees throughout the Central Valley. Open grasslands and agricultural fields located within 10 miles of a Swainson's hawk's nest constitute suitable foraging habitat for this species. The area of the proposed detention basins may be considered foraging habitat for Swainson's hawks. In addition, trees that support nesting Swainson's hawks may be present throughout the project area. Construction activities occurring in the nesting season (March 1 through August 31) in the area of the occupied nesting trees may disrupt nesting activities. Avoiding construction activities within 500 feet of occupied nesting site during the nesting season will minimize effects to nesting Swainson's hawks. Other compensatory measures may be identified during the permit acquisition period.

COST ESTIMATE

A cost estimate for the RP is presented in Table 14-2. This cost estimate includes all the facilities from the RD 777 service area (Chapter 11), the detention basins and channels from the RD 2056 service area (Chapter 13).The trunk drains would be funded and constructed by individual development projects or groups of development projects. As shown, the estimated total construction cost is $23.5 million and the estimated capital cost is $40.0 million. The following assumptions were made for the preparation of the cost estimate:

Table 14-2. Cost Estimate for the Recommended Project

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
1. Main Canal Improvement and Diversion Channel to East Basin				
Site Preparation (Clear and Grub)	acre	500	33.0	16,500
Channel Excavation (on-site)	CY	4	88,000	352,000
Landscape and Erosion Control	acre	10,000	29.9	299,000
18-Inch Orifice Plate	each	2,000	1	2,000
36-Inch RCP	feet	216	514	111,024
42-Inch RCP	feet	252	240	60,480
60-Inch RCP	feet	330	548	180,675
Headwalls	each	8,000	14	112,000
12' Asphalt Access Road	feet	72	18,316	1,318,717
Mobilization/demobilization (at 5 percent)				122,620
Construction Contingency (at 20 percent)				490,480
Estimated Construction Cost				3,065,500
Land/Easements (for channel)	acre	50,000	29.9	1,495,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,226,200
Estimated Capital Cost				5,786,700
2. East Detention Basin				
Site Preparation (Clear and Grub)	acre	500	12.4	6,199
Basin Excavation	CY	4	50,082	200,328
Landscape and Erosion Control	acre	2,000	8.6	17,120
Rock Scour Protection	CY	100	10	1,000
Pump Station (20 cfs)	cfs	39,500	20	790,000
36-Inch RCP	feet	216	2,400	518,400
12' Asphalt Access Road	feet	72	2,950	212,400
Mobilization/demobilization (at 5 percent)				87,270
Construction Contingency (at 20 percent)				349,090
Estimated Construction Cost				2,181,810
Land/Easements (for basin)	acre	25,000	12.4	310,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				872,700
Estimated Capital Cost				3,364,500
3. Lateral 5 Storm Drain				
12-Inch RCP	feet	72	300	21,600
48-Inch RCP	feet	288	661	190,368
60-Inch RCP	feet	330	1,255	414,150
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				35,310
Construction Contingency (at 20 percent)				141,220
Estimated Construction Cost				882,650
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				353,100
Estimated Capital Cost				1,235,800
4. South Detention Basin				
Site Preparation (Clear and Grub)	acre	500	28.0	14,017
Basin Excavation	CY	4	267,884	1,071,534
Landscape and Erosion Control	acre	2,000	26.0	51,904
Rock Scour Protection	CY	100	10	1,000
Side Flow Weir (CY of concrete)	CY	500	50	25,000
54-Inch RCP	feet	311	100	31,050
42-Inch RCP	feet	252	100	25,200
24-Inch RCP	feet	144	268	38,592
24-Inch Flap Gate	each	2,800	1	2,800
Headwalls	each	8,000	6	48,000
Aggregate Base Access Road	feet	20	4,704	94,080
Fencing	feet	16	4,704	75,264
Mobilization/demobilization (at 5 percent)				73,920
Construction Contingency (at 20 percent)				295,690
Estimated Construction Cost				1,848,050
Land/Easements (for basin)	acre	25,000	28.0	700,900
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				739,200
Estimated Capital Cost				3,288,200
5. Lateral 6 Improvements and Diversion to North Detention Basin				
Site Preparation (Clear and Grub)	acre	500	6.3	3,150
Channel Excavation (on-site)	CY	4	26,400	105,600
Landscape and Erosion Control	acre	2,000	4.4	8,700
12-Inch RCP	feet	72	540	38,900
54-Inch RCP	feet	311	916	284,500
66-Inch RCP	feet	347	1,576	546,100
72-Inch RCP	feet	360	1,827	657,720
5' x 6' Box RCP	feet	600	677	406,200
Maintenance Holes	each	6,000	9	54,000
Drain Inlets	each	5,000	18	90,000
Headwalls	each	8,000	3	24,000
12' Asphalt Access Road	feet	72	2,085	150,120
Mobilization/demobilization (at 5 percent)				118,450
Construction Contingency (at 20 percent)				473,800
Estimated Construction Cost				2,961,240
Land/Easements (for channel)	acre	50,000	6.3	313,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,184,500
Estimated Capital Cost				4,459,200
6. North Detention Basin and Storm Drain				
Site Preparation (Clear and Grub)	acre	500	33.9	16,954
Basin Excavation	CY	4	306,607	1,226,427

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
Landscape and Erosion Control	acre	2,000	188.2	376,400
Rock Scour Protection	CY	100	10	1,000
12-Inch RCP	feet	72	360	25,920
18-Inch RCP	feet	108	554	59,832
30-Inch RCP	feet	180	72	12,960
36-Inch RCP	feet	216	1,940	419,040
Headwalls	each	8,000	2	16,000
12' Asphalt Access Road	feet	72	4,704	338,688
Maintenance Holes	each	6,000	6	36,000
Drain Inlets	each	5,000	12	60,000
Mobilization/demobilization (at 5 percent)				129,460
Construction Contingency (at 20 percent)				517,840
Estimated Construction Cost				3,236,520
Land/Easements (for basin)	acre	50,000	33.9	1,695,400
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				1,294,600
Estimated Capital Cost				6,226,500
7. Caltrans Property Detention Basin				
Site Preparation (Clear and Grub)	acre	500	25.5	12,774
Basin Excavation	CY	4	119,750	478,999
Landscape and Erosion Control	acre	2,000	21.4	42,700
Rock Scour Protection	CY	100	10.0	1,000
Side Flow Weir (CY of concrete)	CY	500	50.0	25,000
24-Inch RCP	feet	144	268.0	38,592
24-Inch Flap Gate	each	2,800	1.0	2,800
12' Asphalt Access Road	feet	72	4,120	296,640
Mobilization/demobilization (at 5 percent)				44,930
Construction Contingency (at 20 percent)				179,700
Estimated Construction Cost				1,123,130
Land/Easements (for basin)	acre	10,000	26.0	260,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				449,300
Estimated Capital Cost				1,832,400
8. Lateral 2 Improvements from Caltrans Property Detention Basin to Paseo Road				
Site Preparation (Clear and Grub)	acre	500	19.2	9,600
Channel Excavation (on-site)	CY	4	141,600	566,400
Landscape and Erosion Control	acre	2,000	19.2	38,400
24-Inch Orifice Plate	each	2,000	1	2,000
18-Inch RCP	feet	108	80	8,640
48-Inch RCP	feet	288	120	34,560
Headwalls	each	8,000	6	48,000
12' Asphalt Access Road	feet	72	8,345	600,806
Mobilization/demobilization (at 5 percent)				65,420
Construction Contingency (at 20 percent)				261,680
Estimated Construction Cost				1,635,510
Land/Easements (for channel)	acre	50,000	17.0	851,600
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				654,200
Estimated Capital Cost				3,141,300
9. WWTP Storm Drain and Inlet Weir Improvements				
Side Flow Weir (CY of concrete)	CY	500	50	25,000
12-Inch RCP	feet	72	300	21,600
30-Inch RCP	feet	180	3,600	648,000
36-Inch RCP	feet	216	2,133	460,663
Maintenance Holes	each	6,000	5	30,000
Drain Inlets	each	5,000	10	50,000
Mobilization/demobilization (at 5 percent)				61,763
Construction Contingency (at 20 percent)				247,053
Estimated Construction Cost				1,544,079
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				617,600
Estimated Capital Cost				2,161,700
10. Lateral 2 Improvements at Township Road				
12-Inch RCP	feet	72	420	30,240
42-Inch RCP	feet	252	5,700	1,436,400
Maintenance Holes	each	6,000	7	42,000
Drain Inlets	each	5,000	14	70,000
Mobilization/demobilization (at 5 percent)				78,932
Construction Contingency (at 20 percent)				315,728
Estimated Construction Cost				1,973,300
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				789,300
Estimated Capital Cost				2,762,600
11. West Detention Basin				
Site Preparation (Clear and Grub)	acre	500	6.9	3,464
Basin Excavation	CY	4	53,722	214,887
Landscape and Erosion Control	acre	2,000	6.0	11,912
Pump Station (5 cfs)	cfs	50,000	5.0	250,000
Headwalls	each	8,000	1	8,000
Aggregate Base Access Road	each	20	2,037	40,748
Fencing	each	16	2,200	35,200
Rock Scour Protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				28,260
Construction Contingency (at 20 percent)				113,040
Estimated Construction Cost				706,510
Land/Easements (for basin)	acre	50,000	6.9	346,402
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				282,600
Estimated Capital Cost				1,335,500

Item	Unit of Measure	Unit Cost, dollars	Quantity	Item Cost, dollars
12. RD 2056 Area North System - Channel and Basin				
Site Preparation (Clear and Grub)	acre	500	14.8	7,400
Channel Excavation	CY	4	12,480	49,920
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	76,238	304,952
Aggregate Base Access Road	feet	20	3,881	77,620
Fencing	feet	16	3,201	51,216
Landscape or Erosion Control Vegetation	acre	2,000	14.8	29,600
12-Inch CMP	feet	60	80	4,800
18-Inch CMP	feet	90	80	7,200
12-inch flap gate	each	1,000	1	1,000
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	10,000	0	0
Rock scour protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				28,060
Construction Contingency (at 20 percent)				112,242
Estimated Construction Cost				701,510
Land/Easements (for channel)	acre	25,000	1.5	37,500
Land/Easements (for basin)	acre	25,000	13.3	332,500
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				280,604
Estimated Capital Cost				1,352,114
13. RD 2056 Area Mid System - Channel and Basin				
Site Preparation (Clear and Grub)	acre	500	9.1	4,550
Channel Excavation	CY	4	22,400	89,600
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	28,452	113,808
Aggregate Base Access Road	feet	20	4,344	86,880
Fencing	feet	16	2,333	37,328
Landscape or Erosion Control Vegetation	acre	2,000	9.1	18,200
10-Inch CMP	feet	50	80	4,000
18-Inch CMP	feet	90	80	7,200
10-inch flap gate	each	900	1	900
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	8,000	0	0
Rock scour protection	CY	100	10	1,000
Mobilization/demobilization (at 5 percent)				19,498
Construction Contingency (at 20 percent)				77,993
Estimated Construction Cost				487,458
Land/Easements (for channel)	acre	25,000	2.7	67,500
Land/Easements (for basin)	acre	25,000	6.4	160,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				194,983
Estimated Capital Cost				909,941
14. RD 2056 Area South System - Trunk Drain, Channel, and Basin				
Site Preparation (Clear and Grub)	acre	500	19.0	9,500
Channel Excavation	CY	4	64,480	257,920
Side Flow Weir (CY of concrete)	CY	500	50	25,000
Detention Basin Excavation	CY	4	54,596	218,384
Aggregate Base Access Road	feet	20	9,987	199,740
Fencing	feet	16	10,187	162,992
Landscape or Erosion Control Vegetation	acre	2,000	19.0	38,000
12-Inch CMP	feet	60	80	4,800
18-Inch CMP	feet	90	80	7,200
12-inch flap gate	each	1,000	1	1,000
18-inch flap gate	each	1,500	1	1,500
Headwalls	each	8,000	1	8,000
Rock scour protection	CY	100	100	10,000
Mobilization/demobilization (at 5 percent)				47,202
Construction Contingency (at 20 percent)				188,807
Estimated Construction Cost				1,180,000
Land/Easements (for channel)	acre	25,000	7.8	195,000
Land/Easements (for basin)	acre	25,000	11.2	280,000
Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				472,000
Estimated Capital Cost				2,127,000
Total Estimated Construction Cost				23,527,000
Total Land/Easement Cost				7,045,302
Total Engineering, CM/Insp, CEQA, City Admin (Note 1, at 40 percent)				9,411,000
Total Estimated Capital Cost				39,980,000
Average Cost Per Acre Evaluation				
Total Acreage (3,375 acres in RD 777 and 721 acres in RD 2056)				4,096
Average Cost Per Acre ($/ac)				9,761

Notes:

Engineering (conceptual and detailed design) at 15 percent of the construction cost
Construction period engineering services at 5 percent of the construction cost
CEQA environmental review and mitigation at 5 percent of the construction cost
Construction management and inspection at 10 percent of the construction cost
City administration (both during design and construction) at 5 percent
Costs are for June 2009 (20 City Average ENRCCI of 8,578).

- Within the future build out area, the excavated dirt will be placed on the tributary development area, allowing the dirt to be excavated using scrapers, and without the use of haul trucks. Outside of the future build out area, excavated dirt will be disposed offsite.
- All land will be purchased (versus easements) at a cost of $50,000 per acre for land within the City's 2030 General Plan Planning Area and at a cost of $25,000 per acre for land outside the City's Planning Area.

Buildout of the general plan includes development of 3,375 acres in the RD 777 service area and about 721 acres in the RD 2056 service area, for a total of 4,096 acres. The RP results in an overall cost of about $9,760 per acre of development area.

RD 777 FUNDING AND CHANNEL MAINTENANCE EVALUATION

RD 777 collects fees annually from each parcel within its boundaries. The fees are the larger of $2 per acre or $25 per parcel. For example, a 40 acre agricultural parcel would pay $80 per year, and a 0.25 acre residential lot would pay $25 per year. As the City develops, larger agricultural parcels will be converted to smaller urban parcels. For example, if a 40 acre agricultural parcel converted to the low density residential land use (at 3.89 units per acre, for a total of 156 parcels), the fees collected by RD 777 would increase from $80 per year to $3,900 per year. Presented in Table 14-3 is an estimate of the increase in funding that would be collected by RD 777 as the City grows to buildout of the 2030 General Plan. As shown, the fees collected by RD 777 from this area would increase from about $15,137 per year to about $345,576 per year.

Additionally, several of the channels that currently are maintained by RD 777 will be converted to joint use channels which will have improved landscaping and pedestrian/bike pathways. As the channels are improved, the City will take over maintenance of the channels. Also, some existing channels will be replaced with trunk drains, which will be maintained by the City. As shown in Table 14-4, RD 777 will be relieved of maintenance responsibility for 5 miles of channels.

Table 14-3. Financial Evaluation of RD 777 Funding

	Existing Land Uses					Buildout Land Uses					
Land Use	Total Area (acres)	Average Parcel Size (acres)	Number of Parcels	RD 777 Annual Fee ($/yr)	Total RD 777 Revenue ($/yr)	Acres	Dwelling Unit Density (dwelling units/acre)	Average Parcel Size (acres)	Number of Parcels	RD 777 Annual Fee ($/yr)	Total RD 777 Revenue ($/yr)
Low-Density Residential (1 EDDU)						1,508.0	3.89	0.26	5,866.1	$25/Parcel	146,653
Smaller-Lot Residential						1,179.0	5.83	0.17	6,873.6	$25/Parcel	171,839
Medium-Density Residential						51.0	10.00	0.10	510.0	$25/Parcel	12,750
Higher-Density Residential						11.0	19.45	2.00	5.5	$25/Parcel	138
Commercial Mixed Use						134.0		5.00	26.8	$25/Parcel	670
Downtown Mixed Use						13.0		1.00	13.0	$25/Parcel	325
Community Commercial						59.0		20.00	3.0	$25/Parcel	74
Employment						181.0		1.00	181.0	$25/Parcel	4,525
Parks and Open Space						130.0		5.00	26.0	$25/Parcel	650
Civic						1.0		2.00	0.5	$25/Parcel	13
Urban Reserve (continues as Agriculture)						3,045.0		NA	NA	$2/acre	6,090
Neighborhood Center						94.2		4.40	21.4	$25/Parcel	535
Civic Center						157.0		3.60	43.6	$25/Parcel	1,090
Buffer						18.0		2.00	9.0	$25/Parcel	225
Agriculture (parcels greater than 12.5 acres)	5,923	NA	NA	$2/acre	11,846						
Agriculture (parcels smaller than 12.5 acres)	658	5	132	$25/Parcel	3,291						
Total	**6,581**				**15,137**	**6,581**					**345,576**
RD 777 Per Acre Fee	$2										
RD 777 Per Parcel Fee	$25										

Table 14-4. Summary Table Channels

Miles	Exisitng Conditions	After Buildout
Maintained by RD777	37.3	31.3
Maintained by City - To become Storm Drain		2.3
Maintained by City - To Become Joint Use Channels		3.5
Maintained by City - New Joint Use Channel		0.8
Total	37.3	37.9

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RD 2056
RD 777
99
5
LATERAL 6 IMPROVEMENTS & DIVERSION TO NORTH BASIN
RIVIERA RD
L06-0480-2
L06-0480-1
L02-0530A-2
L02-0530A-1
L02-0460
RD 2056 NORTH DETENTION BASIN
RD 2056-7
1
MAIN CANAL IMPROVEMENT AND DIVERSION CHANNEL TO EAST BASIN
CAMPBELL RD
MAHAUGH RD
6
NORTH DETENTION BASIN
NBSN
RD 2056 MID DETENTION BASIN
LUTHER RD
TOWNSHIP RD
KOLA ST
GARDEN GLEN DIVISION
COOLEY RD
2
EAST DETENTION BASIN
EBSN
PENNINGTON RD
DEREE RD
RD 2056 SOUTH DETENTION BASIN
(72" DRAIN SEE CHAPTER 14)
PENNINGTON RANCH ULTIMATE BASIN
APRICOT ST
SINNARD AVE
SHELDON AVE
WWTP BASIN
WWTP_DB
9
WWTP STORM DRAIN & BASIN MODIFICATIONS
7
CALTRANS PROPERTY DETENTION BASIN
SBSN
8
LATERAL 2 CHANNEL IMPROVEMENTS
30" WWTP EFFLUENT LINE
L02-0250
L02-0240
L05-0050-2
3
LATERAL 5 STORM DRAIN
10
LATERAL 2 IMPROVEMENTS AT TOWNSHIP RD
11
WEST DETENTION BASIN
WBSN
PASEO AVE
4
SOUTH DETENTION BASIN
99
LARKIN RD
RD 2056
RD 777
LEVEE DISTRICT 9
RD 777
N
0 1000 2000
SCALE IN FEET

LEGEND
- CITY LIMITS
- RD777 BOUNDARY
- CITY PLANNING AREA
- PROPOSED STORAGE
- MODEL LINK (EXISTING DRAIN OR CHANNEL)
- L02-0120 MODEL NODE AND IDENTIFICATION
- PROPOSED CHANNEL IMPROVEMENTS
- PROPOSED STORM DRAIN
- ADDITIONAL PROPOSED TRUNK DRAINS (SEE TABLE 13-1)
- 11 IMPROVEMENT IDENTIFICATION

Figure 14-1A

City of Live Oak
Master Drainage Study
RECOMMENDED PROJECT

WEST YOST ASSOCIATES
Consulting Engineers

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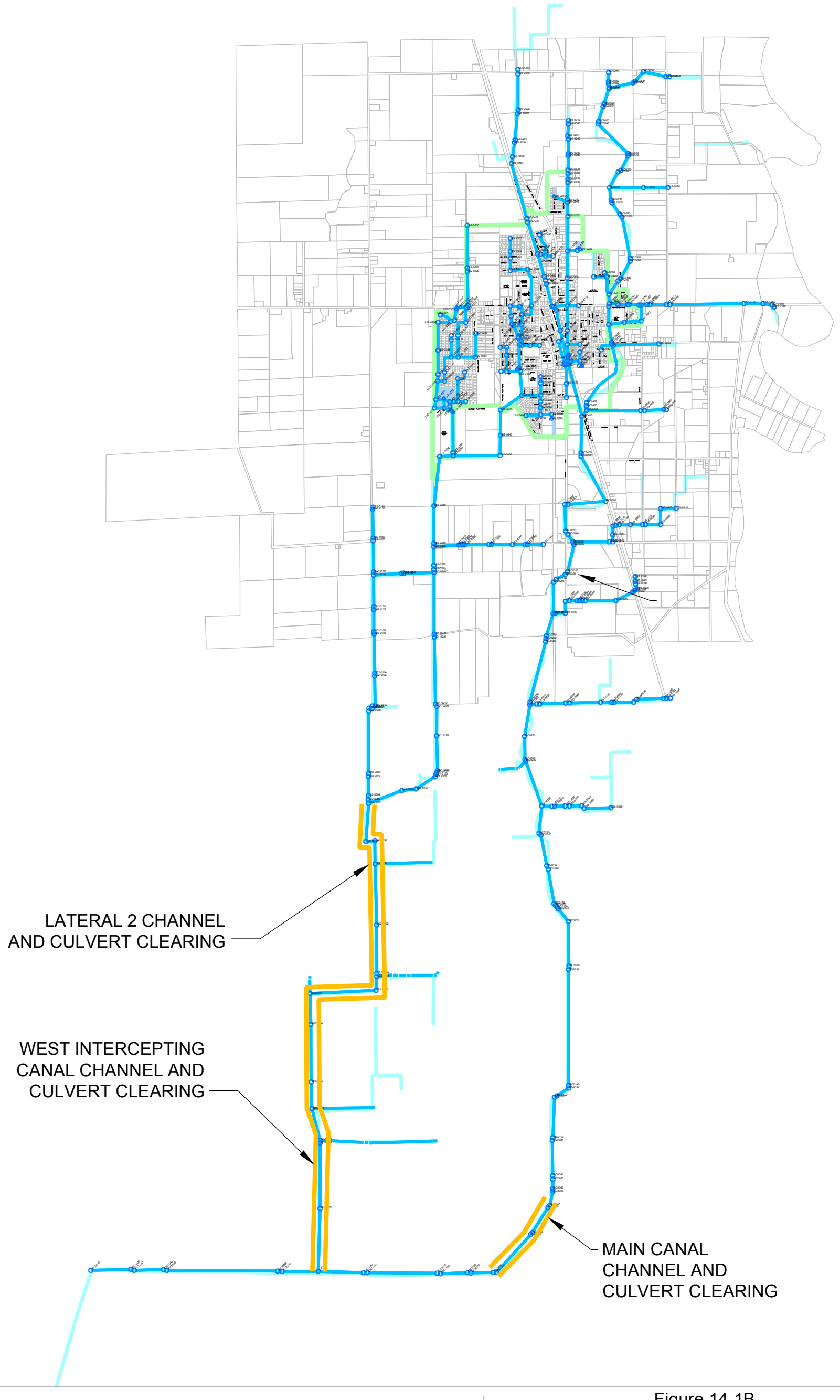

LEGEND

- CITY LIMITS
- CHANNEL
- DETENTION BASIN
- L02-0450 MODEL NODE & LABEL
- MODEL LINK

N

0 2000 4000

SCALE IN FEET

Figure 14-1B

City of Live Oak
Master Drainage Study
RECOMMENDED PROJECT

WEST YOST ASSOCIATES
Consulting Engineers

CHAPTER 15. CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations are provided below:

- The Recommended Project (RP), as described in Chapter 14, achieves the design criteria identified for the project (in Chapter 3), primarily sizing open channels and detention basins for the 100-year, 4-day storm, and sizing trunk storm drain to convey the peak 10-year storm flow.
- The RP was selected primarily because it achieves the design criteria at the lowest cost. It also enables many of the drainage channels and detention basins to serve as joint use facilities, providing space for sports fields, pedestrian/bike paths, and riparian habitat.
- The RP should be the basis for establishing drainage impact fees, annual operation and maintenance fees, and future facility replacement fees.
- Construction bids have been unusually low in recent years, and to the extent funding is available, the improvements to solve existing flooding problems should be designed and constructed soon to capitalize on these lower-than-normal construction costs. In particular, it is recommended that the J Street improvements (Figure 6-2), the L Street Improvements (Figure 6-3), the Highway 99 Improvements (Figure 6-4), and the Q Street Improvements (Figure 6-7) be designed and constructed as soon as possible.
- The Highway 99 Improvements will eliminate flooding that occurs on a major Caltrans highway. Consequently, cost sharing with Caltrans for this project should be explored.
- The City recently purchased from Caltrans the Caltrans Property Detention Basin site. Since this basin site is now owned by the City, preliminary design (including soils testing) of the basin could be performed to identify exactly where and how much excavation will be needed. This would allow the City to sell soil from this site when there is a demand for soil elsewhere. In particular, as levee projects are implemented in the future, there may be a significant demand for soil that is suitable for levee construction/repair. The sale of this material could result in this basin being constructed at a low or no cost to the City.
- Land prices have been unusually low in recent years, and to the extent funding is available, land for the proposed basins and channels should be acquired soon to capitalize on the lower-than-normal land costs. The purchased land could be leased for farming until it is needed.
- The RP is a large and complex project, and the individual project elements will require: preliminary design, land acquisition, detailed design, and acquisition of several permits. To the extent possible, predesign level engineering of the individual projects should be initiated about three years before the project needs to be completed. This allows one year for preliminary design, land acquisition, and permitting; one year for detailed design; and one year for construction. However, it is likely that for most projects, this schedule could be compressed to two years, if necessary.
- The RP includes replacement of the Lateral 2 channel south of the Apricot Street Pump Station and down to the Caltrans Property Detention Basin with a 72-inch drain. Use of a joint use channel at this location should be evaluated when this project element moves forward.