MANDEVILLE
A Historic Lakefront Community

OLD GOLDEN SHORES DRAINAGE ANALYSIS

COM PROJECT NO. 700.23.001

PREPARED FOR

THE CITY OF MANDEVILLE
3101 EAST CAUSEWAY APPROACH
MANDEVILLE, LA 70448
August 31, 2023

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1 Project Overview

The Old Golden Shores subdivision is located on the north shore of Lake Pontchartrain within the city limits of Mandeville. The subdivision is bounded on the east by Causeway Boulevard, to the north by Bayou Chinchuba, the south by Lake Pontchartrain, and the west by Lewisburg. Currently, the area drains through a combination of roadside ditches and subsurface culverts into a primary outfall channel which drains the neighborhood. The outfall channel runs in a north-south direction and discharges into both Bayou Chinchuba and Lake Pontchartrain as shown in Figure 1 below. This report includes the area of the subdivision highlighted below. The area of Old Golden Shores subdivision north of Monroe St. will be analyzed separately and added as an addendum to this report at a later time.

The City of Mandeville (the City) has engaged High Tide Consultants, LLC (HTC) to assess the existing drainage conditions within Old Golden Shores and provide recommendations for improvements to the primary outfall channel and improvements to the interior conveyance system throughout the subdivision. HTC engaged Intracoastal Consultants, LLC (IC) as a sub-consultant to assist with the hydrologic and hydraulic (H&H) modeling. As a part of the H&H model, the improvements within the primary outfall channel are proposed within the existing drainage servitude.

Figure 1 – Project Location

2 Methodology

2.1 Hydrology

To determine runoff and peak flow rates at different locations within the project area the U.S. Environmental Protection Agency (USEPA) Storm Water Management Model (SWMM) version 5.2 was

used. This model incorporates characteristics of the drainage basins to estimate the runoff generated by a storm event. Basin area, slope, land surface characteristics, and overland flow width were the primary parameters considered when developing the model for this assessment. The land surface characteristics include the percent imperviousness and the infiltration method. The infiltration method chosen for this project was the National Resources Conservation Service (NRCS) Curve Number. This method uses surface characteristics such as land cover and soil type to estimate infiltration losses. The following sections summarize the input parameters used to develop the runoff hydrographs for the project area.

2.1.1 Rainfall

The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates were extracted for the analysis within the Old Golden Shores area using the online data extraction tool[1]. The point estimates are generated for multiple design storm durations and recurrence intervals. The focus of this study is to assess the impacts of the 24-hr duration storm for the 25- and 100-yr recurrence intervals (i.e., design storms) for the primary outfall channel and for the 10- and 25-yr recurrence intervals for the interior drainage improvements. These recurrence intervals correspond to the 10%, 4%, and 1% annual exceedance probability (AEP) events. The rainfall depths associated for each of these events are provided in Table 1.

Table 1 – Design event precipitation depths for the 24-hr storm

Recurrence Interval (years)	Annual Exceedance Probability (AEP) (%)	Rainfall Depth (in)
10	10%	7.83
25	4%	9.74
100	1%	13.1

To project these cumulative storm depths into a timeseries that spans the 24-hr storm interval, the rainfall distribution developed for Atlas 14 for the Midwest and Southeast (MSE) United States was used. MSE Curve 5 is applicable to St. Tammany Parish and is shown below in Figure 2.

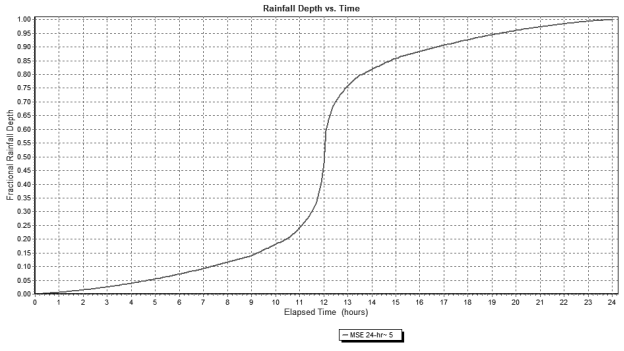

Figure 2 – MSE 5 24-hr Rainfall Distribution USDA-NRCS (Merkel and Moody, 2015)

[1] https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

2.1.2 Soil Type

The NRCS Curve Number method uses soil type and classification to determine a runoff curve number for subbasin or drainage area. The soil parameters for the project area were obtained from the U.S. Department of Agriculture (USDA) NRCS Web Soil Survey[2]. Provided in the web soil survey are the associated hydrologic soil groups (HSG) that range from A-D, with Group A producing the least amount of runoff and Group D the most.

As shown in Figure 3, the HSGs for the drainage areas defined for this project are HSG C and C/D, which are common for south Louisiana, where soils have slow infiltration rates and high water tables.

Figure 3 – Soils Map for the Project Location

2.1.3 Runoff Curve Number

Curve Numbers (CN) for each subbasin were determined using the HSGs described in the previous section along with tables developed as part of Technical Release 55 (TR-55) from the USDA-NRCS (1986), and the National Land Cover Database (NLCD). Using these resources, the project area was classified as a mixture of open, low, and medium density developed areas. Composite CN values were developed to provide a better representation of the land use and land cover in a given area. The CN values used in this analysis are representative of a normal Antecedent Moisture Condition (AMC), AMC II.

[2] https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

2.1.4 Drainage Areas

The project area was divided into subbasins based on an existing 2017 Louisiana Upper Delta Plain Light Detection and Ranging (LiDAR) Digital Elevation Model (DEM) dataset from the U.S. Geological Survey[3] (USGS) and topographic survey information. These subbasins were defined based on overland flow paths generated using the Hydrology analysis tools available in ArcGIS Pro 3.0 Spatial Analyst. Additional survey data from Lowe Engineers (Lowe) were also reviewed as part of this effort.

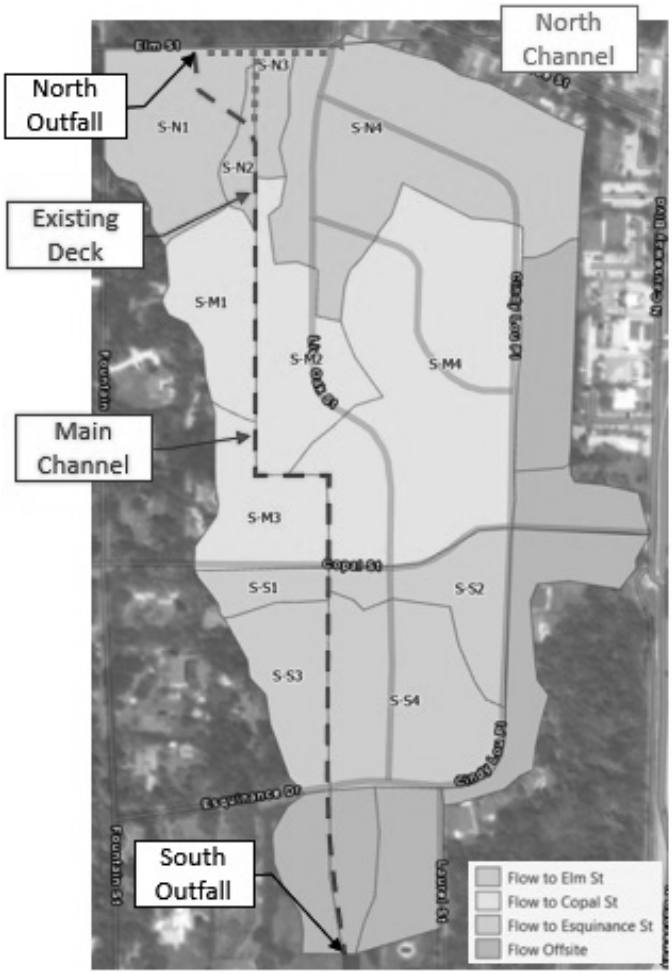

Figure 4 – Project Drainage Basin Extents

For the analysis performed within the residential area, the subbasins were grouped based on their outfall location. An overview of these drainage areas is displayed in Figure 4. Subbasins flowing to the northern outfall at Elm Street are shown in orange. The subbasins near the cross drain at Copal Street are colored green; these areas can flow to the northern and southern outfalls. Subbasins between Copal Street and Esquinance Street are shown in pink; these discharge to Lake Pontchartrain at the south. Additionally, the gray subbasins east of Cindy Lou Place are partially connected to the primary outfall channel. Although the majority of this area flows east towards Causeway, an existing cross drain under Cindy Lou Place near the intersection with Copal Street allows for bi-lateral flow to exchange between the primary outfall channel and Causeway Boulevard. The areas north of Monroe Street do not enter the primary outfall channel, although these areas do discharge into the northern outfall prior to the confluence of Bayou Chinchuba.

2.1.5 Slope and Overland Flow Width

The subbasin land surface slope was extracted from the referenced USGS LiDAR DEM (2017 LA Upper Delta Plain). Slopes along several flow paths for each basin were calculated to determine a representative value for the average basin slope. Additionally, initial estimates for the overland flow width for each basin were performed using methods detailed in the SWMM Reference Manual for Hydrology (Rossman and Huber, 2016). The width estimates were refined based on the results from each basin to more accurately capture the overall peak flow within the Old Golden Shores subdivision.

[3] https://www.sciencebase.gov/catalog/item/5eace30382cefae35a247486

2.2 Hydraulics

With the information developed from the hydrologic analysis of the drainage area, the hydraulic analysis was performed using the dynamic wave flow routing method in SWMM version 5.2 to assess peak flows and water surface elevations (WSE) within the Old Golden Shores drainage system. The routing calculations in SWMM consider each component of the drainage network including geometry and roughness for conduits (culverts and channels); storage within overbank areas; and overtopping at critical locations (weirs). Descriptions of the datasets and their application within the model setup for each of the alternatives are provided in the following subsections.

2.2.1 Elevation Data

Lowe provided topographic survey data for all drainage features within the project area that were used for the hydraulic analysis including representative ditch cross sections and culvert information (i.e., sizes, inverts, and material). The topographic survey provided detailed information for the existing drainage features along Elm Street, Live Oak Street, Cindy Lou Place, Carole Drive, Copal Street, and Esquinance Street. Additionally, cross sections were taken along the primary outfall channel with detailed topographic information for existing utilities, property lines, and drainage structures within the channel limits and the overbank area. The horizontal datum for all topographic survey data is the North American Datum of 1983 (NAD83) referenced to the State Plane Coordinate System, Louisiana South Zone (1702) in U.S. Survey Feet, and the vertical datum for all elevations is the North American Vertical Datum of 1988 (NAVD88) in feet referenced to Geoid 2018.

Additionally, as noted above, this effort reviewed other elevation data sources. Specifically, the available USGS LiDAR DEM dataset (2017 LA Upper Delta Plain) was used to supplement the survey data collected and to calculate storage volume available in subbasins and offsite drainage areas.

2.2.2 Design Criteria

The design criteria for the proposed improvements within the primary outfall channel are summarized as follows:

- Reduce maintenance in the primary outfall channel.
- Eliminate road overtopping at Elm Street, Copal Street, and Esquinance Street for the 25 year (4% AEP) and evaluate reductions in WSE for the 100 year (1% AEP)
- Design the primary outfall channel to accommodate increased flows from future improvements within the interior roadside ditches and subsurface drainage system (Phase II).
- Assign a downstream boundary condition that is reflective of mean higher high water (MHHW) within Lake Pontchartrain. MHHW is calculated as +1.3 feet from USGS Station 07375280, located on the Tchefuncte River.

The design criteria for the proposed improvements within the interior conveyance system for Old Golden Shores are summarized as follows:

- Evaluate the installation of subsurface drainage within roadside ditches along Copal Street and Esquinance Street and compare the results against existing conditions for the overall project that includes the primary outfall channel.
- Evaluate WSE for the 10-year (10% AEP) and 25-year (4% AEP) design storm events.

2.2.3 Hydraulic Analysis

The primary outfall channel and the interior drainage features within the Old Golden Shores subdivision were modeled using SWMM version 5.2. This software was used to analyze the capacity of the existing outfall channel and to evaluate several proposed improvement alternatives for the channel and portions of the interior drainage network.

2.2.3.1 Conceptual Alternatives for Primary Outfall Channel

2.2.3.1.1 Existing Conditions

After dividing the project area into subbasins as described above, an existing conditions model was developed to provide a baseline assessment of the current outfall channel at specific nodes such as Points of Intersection (PIs) and cross drains under Elm Street, Copal Street, and Esquinance Street. Additionally, since the outfall channel can flow bi-directionally to the northern and southern outfalls during the peak of the flood, the dynamic wave flow routing method was chosen for this assessment. This calculation method can account for conditions such as backwater and flow reversal within a drainage network.

The standard configuration in the model consists of a subbasin node routed to a storage unit near the downstream end of a subbasin. Storage units represent junctions within the hydraulic model with the ability of adding storage volume curves to account for ponding within the subbasins. Cross sections for the outfall channel were inserted at various locations between the junctions and the cross drains. At the cross drains along the primary outfall channel, weirs were also included in the model setup to account for overtopping of the roadway.

For the initial screening of alternatives within the primary outfall channel, the subbasins within the Old Golden Shores area were divided into larger basins that flow directly into the primary outfall channel. As previously shown, these areas are depicted in Figure 4 and range in size from 0.6 acres to 10.7 acres as shown in Table 2 below.

Table 2 – Drainage Areas

Basin Name	Area (Ac)	Basin Name	Area (Ac)
S-N1	3.8	S-M3	2.5
S-N2	0.6	S-M4	10.7
S-N3	0.8	S-S1	0.8
S-N4	9	S-S2	2.3
S-M1	2.5	S-S3	2.2
S-M2	3.3	S-S4	5

2.2.3.1.2 Proposed Conditions

The proposed conditions model started with the existing model as a baseline and evaluated proposed improvements for the primary outfall channel. The northern outfall across Elm Street was modeled with improvements; however, modifications to this structure were not considered due to the size of this drainage area and the available storage within the channel. The initial alternatives that were considered for the primary outfall channel are described below and extend from the northern outfall near Elm Street to the southern outfall in Lake Pontchartrain. The alternatives considered in this evaluation are described as follows:

1) Open channel design evaluating a combination of concrete lined channels in the upper reach and U-frame channels from upstream of Copal Street to Esquinance Street. From Esquinance Street to Lake Pontchartrain, only subsurface improvements were considered.

2) Subsurface drainage design evaluating a system through the entire outfall channel utilizing reinforced concrete boxes (RCB).

The main consideration in sizing the U-frame channel and the RCBs for the subsurface alternative was governed by constructability and the City's request for a design that adheres to their maintenance requirements. This required larger structures for the contractor to access on top of the system after construction of a specified reach. U-frame structures were evaluated at 4-, 6-, and 8-foot-wide bottoms and RCBs were evaluated as 6' x 3' RCBs and 8' x 3' RCBs. The concrete lined channel in Alternative 1 assumes a similar cross section as the existing channel with only requiring the contractor to clear, grub, and reshape the channel as needed prior to installing products similar to Concrete Canvas or Shoreflex.

2.2.3.2 Primary Outfall Channel Model Refinement

Through the initial screening of alternatives within the primary outfall channel, the subsurface drainage system alternative was selected for further evaluation. This alternative was selected to reduce future maintenance within the primary outfall channel while improving the drainage within Old Golden Shores. The improvements include a combination of 6' x 3' RCBs and 30" RCPAs from the southern outfall at Lake Pontchartrain to the northern portion of the channel near Lot 93. The 6' x 3' RCBs will extend from Lake Pontchartrain to the existing 18" RCP, which discharges runoff from Live Oak Street, north of Copal Street. North of the 18" Live Oak Street discharge, the channel improvements include approximately 770 feet of 30" RCPA until it reaches Lot 93. Improvements for the northern connection to Elm Street propose to replace the two existing 18" CMPs (crushed) under the driveway culverts just south of Elm Street with two (2) 24" RCPAs.

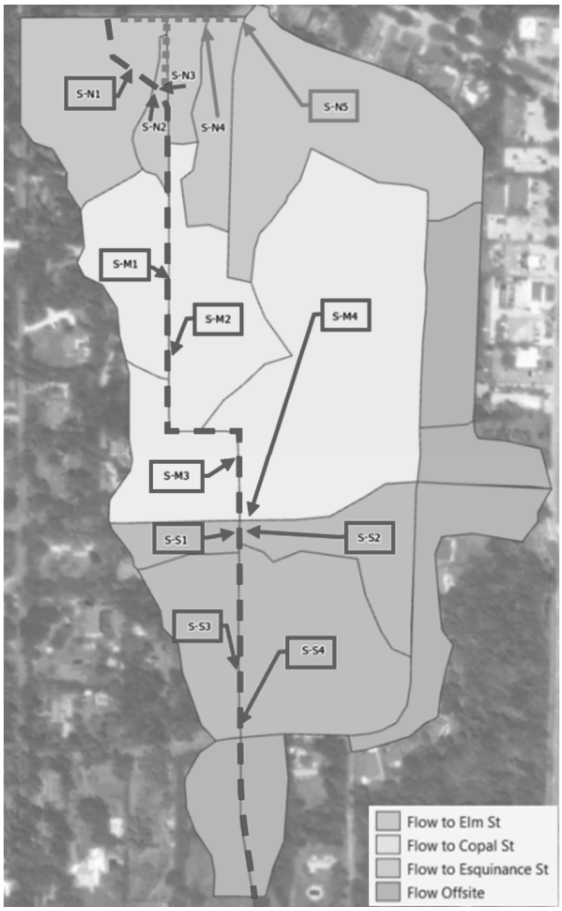

Figure 5 – Drainage Basin Outfalls

2.2.3.2.1 Existing Conditions

The existing conditions model was further refined to divide the interior, larger sub basins on the eastern side of the primary outfall channel used in the initial alternatives screening (Section 2.2.3.1.2), into smaller drainage areas to capture impacts and/or benefits along the interior roads of Old Golden Shores. The original, larger drainage areas were delineated based on their discharge locations within the primary outfall channel as

shown in Figure 5. In addition to subdividing the larger drainage areas into smaller areas ranging from approximately 0.25 acres to just over 1 acre, the interior conveyance system was modeled to include all driveway culverts, roadside ditches, and cross drains (Figure 6).

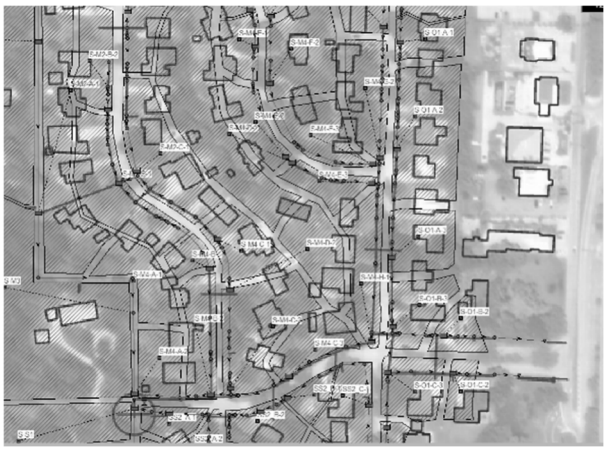

Figure 6 – SWMM Model Configuration

2.2.3.2.2 Proposed Conditions

The proposed conditions model utilized the refined, existing conditions model as a baseline and evaluated proposed improvements for the primary outfall channel. The improvements shown in this model were built off the selected alternative, as described above in Section 2.2.3.2. As a part of the model development, the primary junctions modeled within the channel considered installing the inverts of the subsurface system at an elevation that would allow positive drainage flow to the tops of the catch basins. Figure 7 shows the proposed profile of the subsurface system in relation to the top banks of the existing outfall channel.

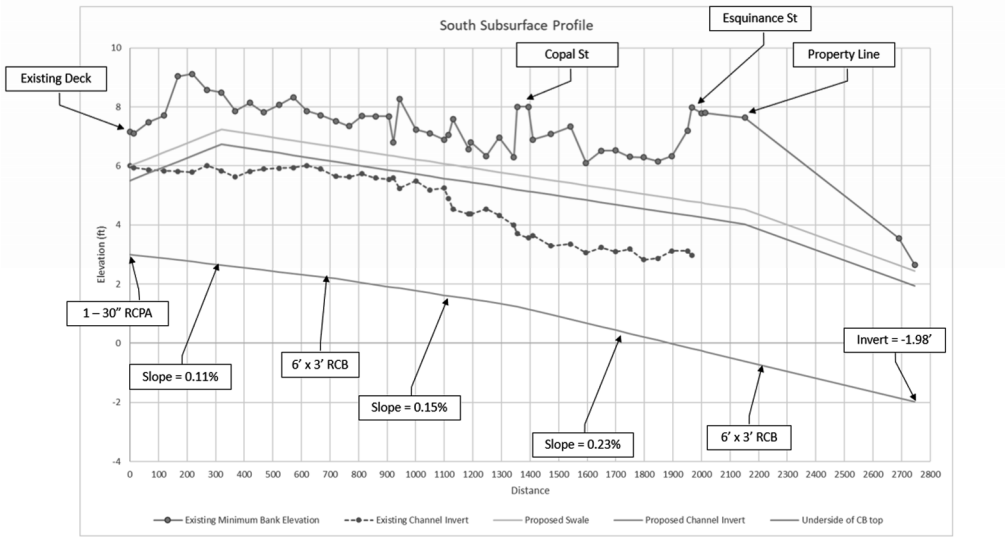

Figure 7 – Primary Outfall Channel Subsurface Profile

2.2.3.2.3 Comparison of Results

The results from the refined model showed additional reductions in WSEs within the primary outfall channel as well as provided results for the interior drainage system. The increased benefits seen in the primary outfall channel when compared to the model utilized for the initial screening of alternatives is directly related to the increase in lag time for the peak runoff within the interior drainage areas. The increased lag time is attributed to the subdivision of the interior drainage areas and the routing of stormwater runoff through the interior conveyance system (i.e., driveway culverts, roadside ditches, and cross drains).

Table 3 and Table 4 below provide the WSE for the primary outfall channel for both the existing and proposed conditions model based on the 10-yr, 25-yr, and 100-yr design storm events. The locations of each node within Table 3 and Table 4 are shown in Figure 8. Additionally, the results showing the WSE at key locations within the interior conveyance system for both the existing conditions model and the proposed improvements in the primary outfall channel can be seen on Sheets 1 through 4 in Appendix B.

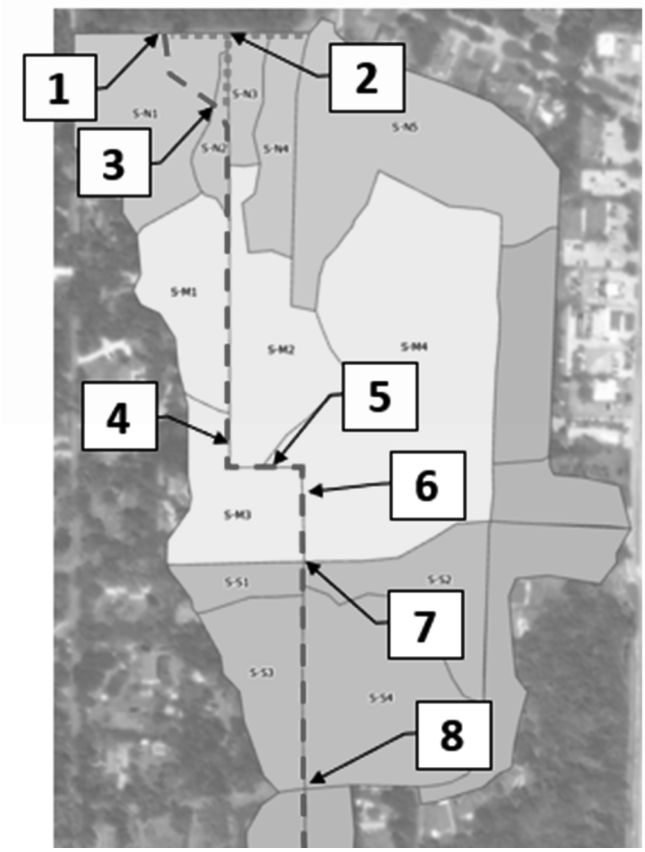

Figure 8 – WSE at Key Locations

Table 3 – Existing Conditions WSE within Primary Outfall Channel

WATER SURFACE ELEVATION SUMMARY TABLE Existing Conditions - Main Channel				
NODE ID	10 YEAR	25 YEAR	100 YEAR	Street EL
	Max HGL	Max HGL	Max HGL	
1	5.42	5.99	6.63	6.75
2	6.83	6.98	7.21	7.97
3	7.02	7.10	7.21	6.85
4	7.88	8.15	8.48	N/A
5	7.85	8.13	8.46	N/A
6	7.84	8.12	8.45	N/A
7	7.76	8.02	8.20	8.01
8	7.11	7.36	7.74	7.98

Table 4 – Proposed Conditions WSE within Primary Outfall Channel

WATER SURFACE ELEVATION SUMMARY TABLE Proposed Conditions - Main Channel Only				
NODE ID	10 YEAR	25 YEAR	100 YEAR	Street EL
	Max HGL	Max HGL	Max HGL	
1	5.03	5.54	6.18	6.75
2	6.81	6.97	7.13	7.97
3	5.03	5.58	6.31	6.85
4	4.91	5.76	6.81	N/A
5	4.91	5.75	6.79	N/A
6	4.90	5.73	6.76	N/A
7	4.86	5.68	6.66	8.01
8	3.93	4.52	5.09	7.98

2.2.3.3 Interior Drainage Improvements

The interior drainage improvements within the Old Golden Shores subdivision aim to capitalize on the benefits received from the proposed improvements to the primary outfall channel. The below sections describe the existing conditions model, the proposed conditions models, and the comparison of results.

2.2.3.3.1 Existing Conditions

The initial existing conditions model developed for the primary outfall channel improvements can be used as the basis for evaluating the interior drainage improvements. As described in previous sections, this model was refined to reduce the overall size of the interior drainage basins to between 0.25 acre and just over 1 acre in area. It also provides a detailed model of the existing conveyance system including all driveway culverts, roadside ditches, and cross drains.

In addition to evaluating the existing conditions of the interior based on the existing conditions of the primary outfall, the existing conditions of the interior drainage system can also be looked at based on the improvements proposed in the primary outfall channel. These results will be compared to the interior drainage improvements in the below section. Sheets 1 through 4 in Appendix B shows the WSE for these two models.

2.2.3.3.2 Proposed Conditions

The proposed conditions model for the interior drainage system is built off the proposed improvements from the primary outfall channel model. The interior drainage improvements considered two scenarios for filling in the existing ditches to create full subsurface systems along key locations within the Old Golden Shores subdivision.

Scenario A proposes to fill in the existing roadside ditches along Copal Street and Esquinance Street and convert the drainage to a subsurface system along these roads. As a part of Scenario A, the City is looking to utilize the existing subsurface system along the streets and tie-in the upstream and downstream culverts within the roadside ditches with proposed culverts of the same size capacity. Therefore, this model did not evaluate replacement of existing culverts except in the following areas.

- The existing driveway culvert near the Esquinance Street outfall (west of Live Oak Street). This culvert (18" RCP) is currently smaller than the upstream culvert (24" RCPA) that drains to it.
- An existing 24" CMP driveway culvert along Esquinance Street that is proposed to be replaced with a 24" RCPA
- Replacement of the existing 24" RCPA on the south side of Copal Street near the discharge location to the primary outfall channel (west of Live Oak Street) with a 36" RCPA.

Scenario B improvements are a continuation of Scenario A that evaluate replacing two existing culverts that discharge into the primary outfall channel to capitalize on additional benefits within the interior system.

- The first culvert is a 30" RCPA located on the north side of Copal Street between Live Oak Street and the primary outfall channel. The proposed replacement is a 42" RCPA.
- The second culvert is an existing 18" RCP which drains a portion of Live Oak Street, north of Copal. The proposed replacement is a 30" RCPA.

For both replacements, the inverts of the culverts will be lowered. The inverts where the two culvert replacements discharge into the primary outfall channel are as follows:

- The invert for the 42" RCPA on the north side of Copal Street is lowered from +3.72' to +2.50'.
- The invert for the 30" RCPA that drains Live Oak Street is lowered from +5.32' to +3.50'.

2.2.3.3.3 Comparison of Results

The results of Scenario A and Scenario B can be found on Sheets 5 through 8 of Appendix B. The sheets provide WSE at key locations throughout the interior drainage system as well as the primary outfall channel. Below is a list of observations from reviewing the model results for both scenarios.

- Scenario A and B both see reductions in WSE in the interior areas that drain to the Copal Street and Esquinance Street outfalls, when compared to the existing conditions model for the primary outfall channel.
- Filling in the roadside ditches with subsurface drainage will slightly decrease the benefits in WSE in some of the upstream locations within the interior drainage areas. This can be seen by comparing Scenario A to the proposed improvements within the primary outfall channel.
- With the increased outfall culvert sizes, Scenario B allows more water to get out of the interior drainage system on the north side of Copal, which offsets the increase in WSE from filling in ditches.
- Northern drainage areas that flow towards the Elm Street outfall show minimal to no benefits from the improvements in the primary outfall channel, Scenario A, or Scenario B. Vice versa, this area also does not see any adverse effects from the proposed improvements.
- Within the northern drainage area, portions of Live Oak Street are shown as overtopping the edge of the street during the 10-year and 25-year events. This can be seen in nodes North B, C, and D within Appendix B. Improvements to reduce WSE within this area would

need to consider a direct connection from the west side of Live Oak Street to the primary outfall channel.

2.2.4 Assumptions and Limitations

- Areas along the west side of the primary outfall channel and the area near Monroe Street were modeled as larger subbasins. Monroe Street drains to the north side of Elm Street into Bayou Chinchuba and the areas west of the primary outfall channel sheet flow directly into the channel.
- A connection to Causeway Boulevard under Cindy Lou Place was confirmed by the City as a 24" RCPA.
- Existing pipes were assumed to be clean and unobstructed unless noted in the survey data collected.
- Manning's "n" values for proposed pipes not including junctions or transitions were assumed to be 0.013 which is representative of reinforced concrete pipe. Other pipe materials may be used that provide a similar "n" value.
- Minimum slope used for the primary outfall channel and structure evaluations varies between 0.11% and 0.23% for the subsurface system as shown in Figure 7. The final profile for the proposed improvements should be developed through detailed evaluations by the design engineer.
- The pipe sizes used are intended to represent equivalent capacity required at a particular location. Consideration was given to constructability; however, no detailed design was performed to confirm the proposed pipe size meets all design considerations including but not limited to pipe cover and conflicts with other utilities. The number of barrels, size, material, and shape should be selected by the design engineer for the proposed improvements.
- The outfall channel sizing was performed using a steady non-varying tidal boundary approach that considers only peak WSE as the tailwater condition and varied flow along channel cross sections. The boundary WSEs were calculated from the USGS Station 07375230 in the Tchefuncte River. The tailwater selected for this project is 1.3 feet which is representative of the Mean Higher High Water (MHHW) for the area.
- Any future developments within the lakefront property would drain directly into Lake Pontchartrain and not into the proposed subsurface system that drains Old Golden Shores.
- Interior drainage improvements shown in Scenario A and B: Proposed improvements along Copal St. may be completed before the main channel improvements are installed. Proposed improvements along Esquinance and Cindy Lou south of Copal should not be completed until the Phase I main channel improvements are completed. Modeling of a phased construction project was not considered as a part of this scope. The main outfall improvements can be phased as long as construction begins at the Lake and proceeds north.

3 Results and Recommendations

Based on the hydraulic analysis and as described in previous sections, all alternatives show benefits from the existing conditions, although the interior drainage improvements for Scenario B shows the greatest benefits within the Old Golden Shores subdivision. The minimal increase in quantities from Scenario B to Scenario A is directly related to the removal and replacement of two sets of culverts.

- Remove approximately 174 linear feet of 18" diameter RCP and replace with a 30" RCPA.
- Remove approximately 155 linear feet of 30" diameter RCPA and replace with a 42" RCPA.

Below is a list of the estimated length of culverts required to complete 100% construction of Scenario B. Quantities may change slightly based on detailed engineering. Additionally, these quantities only consider culvert lengths as shown in the model.

Primary Outfall Channel Quantities (from north to south)

- Remove two (2) 30foot, 18" CMPs under driveway and replace with two (2) 24" RCPAs.
- Install approximately 770 linear feet of 30" RCPA from existing deck to the Live Oak outfall.
- Install approximately 1,695 linear feet of 6'x3' RCBs from the Live Oak outfall to Lake Pontchartrain.
- Remove approximately 32 feet of 30" RCP cross drain under Copal Street. The length of 6'x3' RCB is included in the 1,695-foot quantity.
- Remove approximately 267 feet of 30" RCP cross drain under Copal Street. The length of 6'x3' RCB is included in the 1,695-foot quantity.
- Remove approximately 218 feet of 48" equivalent RCPA under the lakefront property. The length of 6'x3' RCB is included in the 1,695-foot quantity.

Interior Drainage Improvements (Scenario B)

- Remove approximately 175 linear feet of 18" diameter RCP and replace with a 30" RCPA at the Live Oak Street outfall.
- North side of Copal Street
    - Remove and replace approximately 160 linear feet of 30" RCPA with 42" RCPA between the primary outfall channel and Live Oak Street.
- South side of Copal Street
    - Remove approximately 34 linear feet of 24" RCPA and replace with approximately 153 linear feet of 36" RCPA between the primary outfall channel and Live Oak Street.
- North side of Esquinance Street
    - Remove approximately 22 linear feet of 18" RCP and replace with approximately 150 linear feet of 36" RCPA between the primary outfall channel and Live Oak Street.

4 Construction Cost Estimate

An Engineer's Opinion of Probable Construction Cost has been developed and is included in Appendix C. For budgetary and construction reasons, the estimate has been broken up into three phases that correlate to the anticipated construction phasing of the main channel improvements. A summary of the Opinion of Probable Cost is provided below:

PHASE 1	FROM LAKE TO NORTH OF EQUINANCE ST	$930,180.00
PHASE 2	ESQUINANCE TO COPAL ST.	$970,266.00
PHASE 3	COPAL ST. TO ELM ST	$1,286,580.00
	TOTAL ESTIMATED CONSTRUCTION COST	$3,187,026.00

5 References

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USDA-NRCS, 1986. Urban Hydrology for Small Watersheds, Technical Release 55. June 1986.

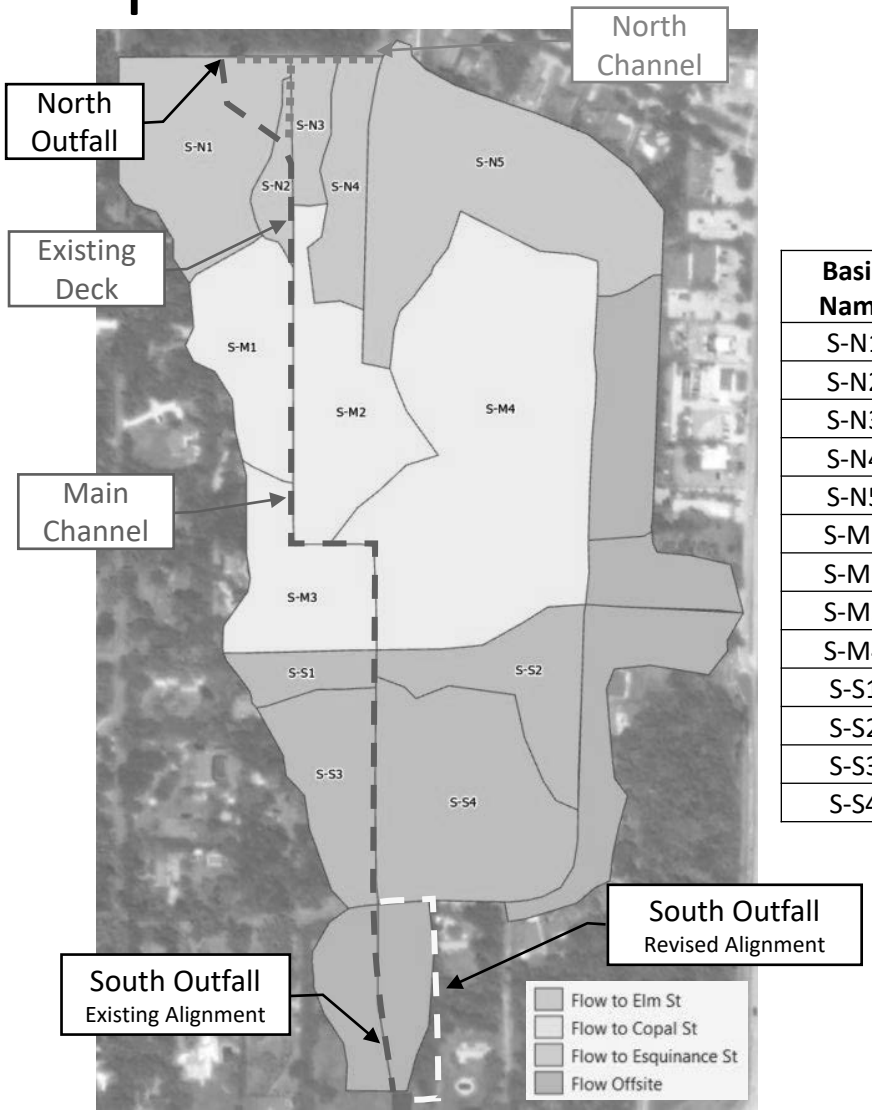
U.S. Geological Survey, 20200330, USGS one meter x20y337 LA UpperDeltaPlain 2017: U.S. Geological Survey

APPENDIX A

CONCEPTUAL ALTERNATIVES OF PRIMARY OUTFALL

Existing Conditions – Update

- Imperviousness
  - Previous estimates were based on averages from NLCD Land Use information
  - These values were adjusted based on:
    - Structure footprints from the City of Mandeville GIS
    - Estimates of roadway and driveway areas
- Elm St North Roadside Ditch
  - This ditch was added to evaluate the tailwater for North Option B, where an additional cross drain culvert was added.
  - Results indicate that at the peak the tailwater would be higher on the north side of Elm St.
- Effective Widths and Slopes
  - Effective width and slope values were adjusted for all basins using methods detailed in the SWMM Hydrology Manual and SWMM Applications Manual
- Drainage Area for S-N4
  - This drainage area was split along Live Oak St into S-N4 (west) and S-N5 (east)



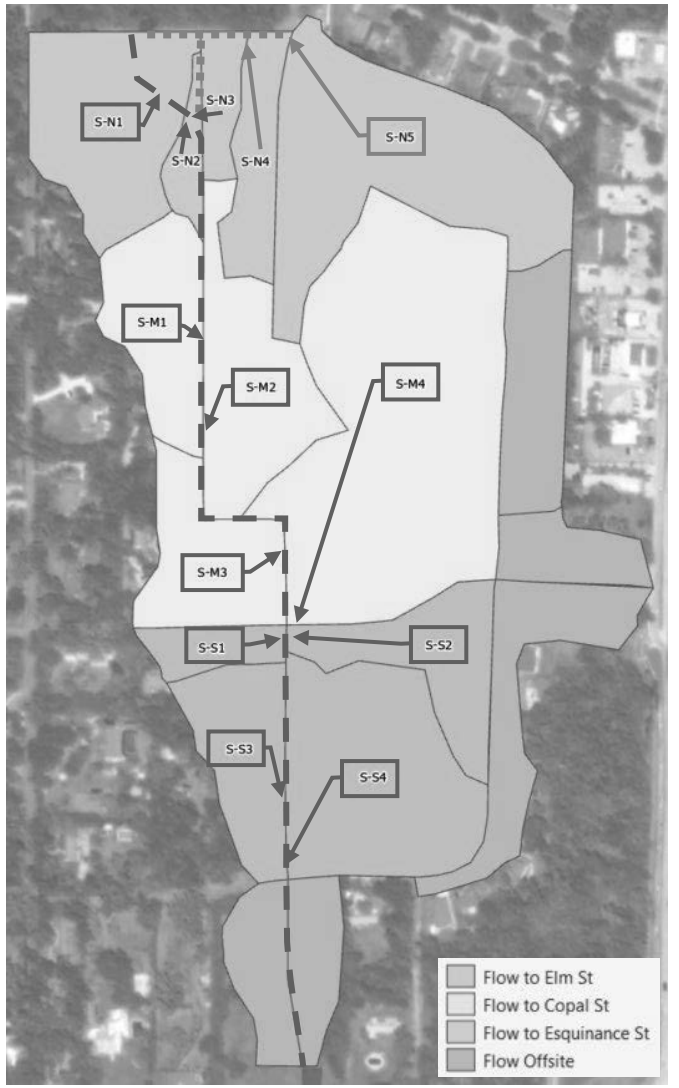
Drainage Subbasins

Basin Name	Area (Ac)	Soil Type	CN	Impervious (%)
S-N1	3.8	C, C/D	79	9%
S-N2	0.6	C/D	79	0%
S-N3	0.8	C/D	79	23%
S-N4	1.5	C/D	81	43%
S-N5	6.5	C/D	81	32%
S-M1	2.5	C/D	79	5%
S-M2	3.3	C, C/D	80	27%
S-M3	2.5	C, C/D	80	7%
S-M4	10.7	C/D	81	30%
S-S1	0.8	C, C/D	79	25%
S-S2	2.3	C, C/D	81	36%
S-S3	2.2	C	79	6%
S-S4	5.0	C, C/D	81	27%

Basin Outflow

- Design storms
  - Results are provided for the 25-yr and 50-yr events

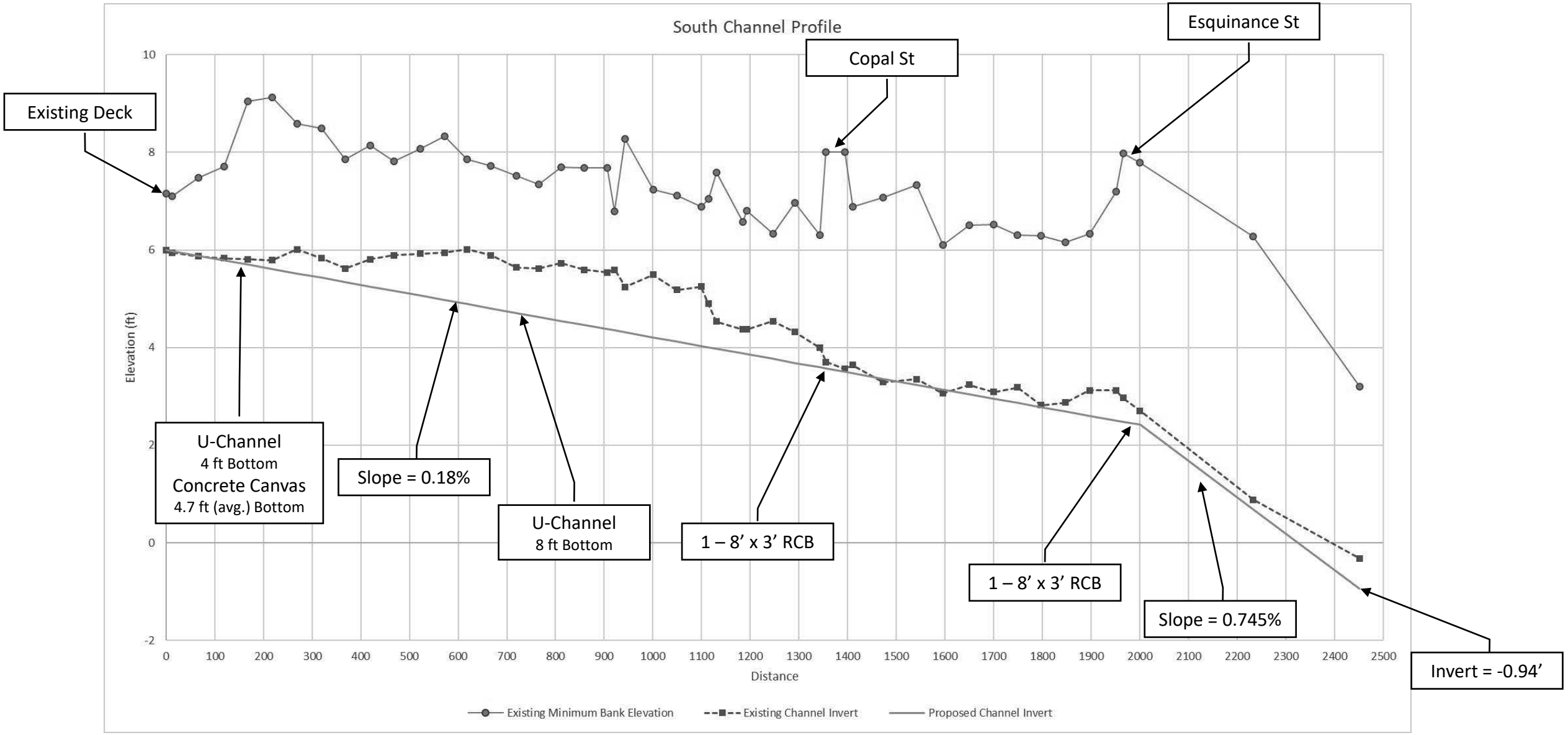
Basin Name	Design Storm			
	25-yr (**9.74 in**)		50-yr (**11.4 in**)	
	Runoff Depth (in)	Peak Flow (cfs)	Runoff Depth (in)	Peak Flow (cfs)
S-N1	7.51	28.73	9.11	35.59
S-N2	7.3	5.05	8.9	6.2
S-N3	7.86	7.64	9.47	9.18
S-N4	8.57	16.26	10.21	19.33
S-N5	8.2	55.4	9.83	67.28
S-M1	7.39	13.19	8.99	16.68
S-M2	8.02	27.78	9.64	33.83
S-M3	7.55	18.4	9.16	22.8
S-M4	8.15	73.24	9.77	89.86
S-S1	7.91	8.16	9.52	9.83
S-S2	8.3	21.7	9.92	26.17
S-S3	7.43	16.1	9.03	20.04
S-S4	8.09	41.63	9.71	50.73



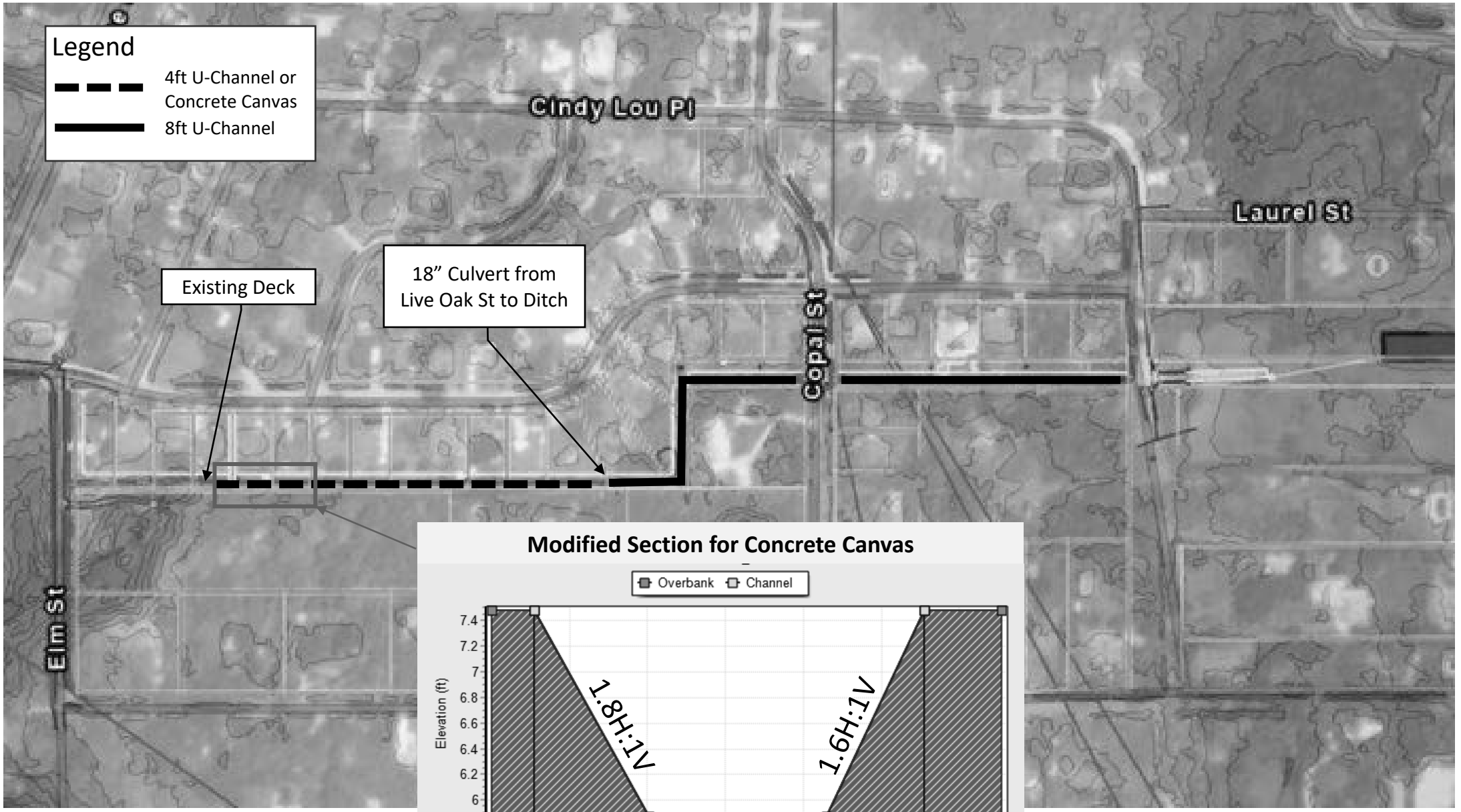
Basin Flow Locations

Proposed Conditions

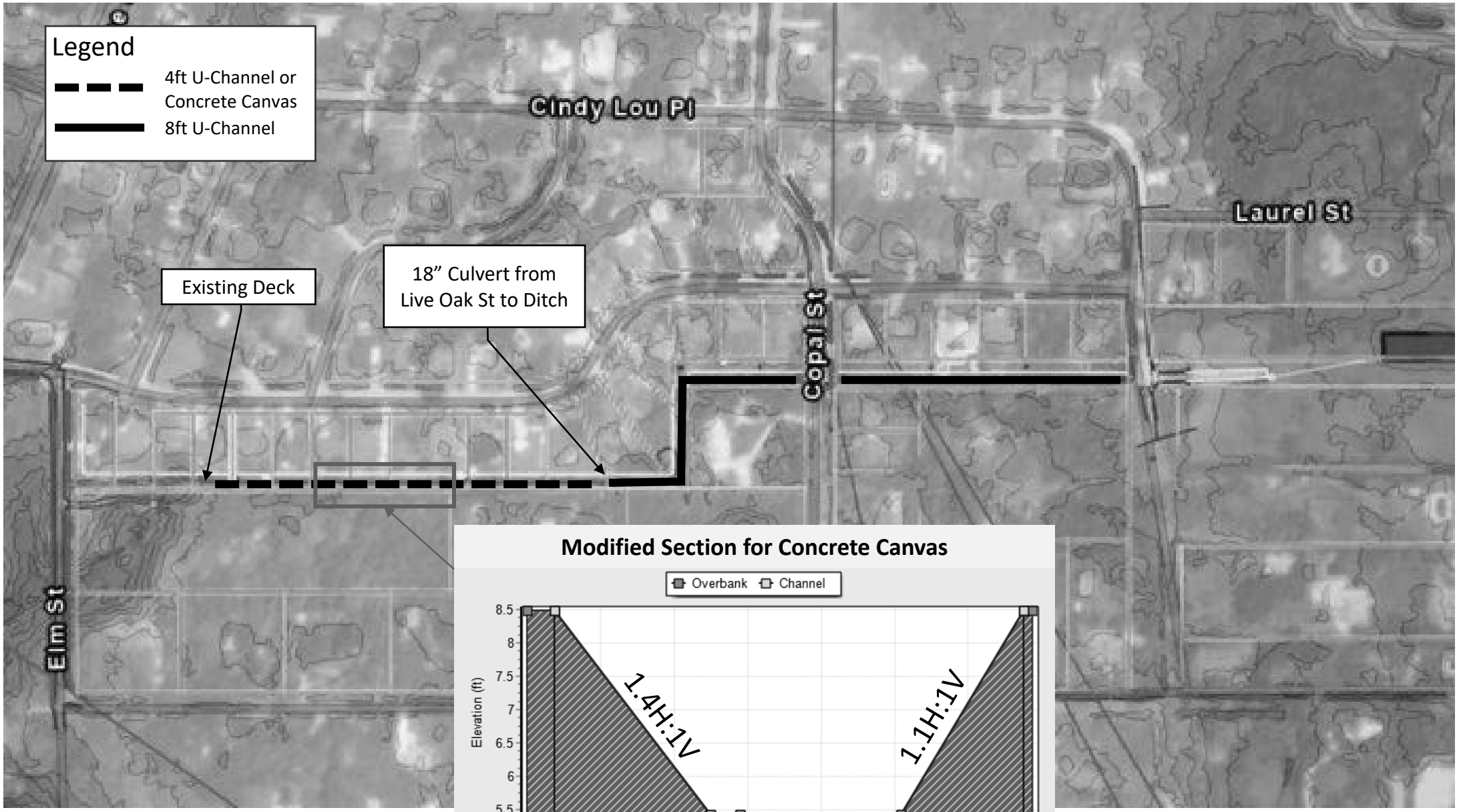
- Southern Improvements – Open Channel Options
  - Channel Improvements
    - Channel from the deck to the 18” culvert from Live Oak
      - **Option 1**: Converted to U-channel
        - Bottom Width = 4 ft
        - Length to culvert = 774 ft
        - Slope = 0.0018 ft/ft
      - **Option 2**: Cleared and lined with Concrete Canvas
        - Avg. Bottom Width = 4.7 ft
        - Length to culvert = 774 ft
        - Slope = 0.0018 ft/ft
    - 18” culvert to Esquinance St converted to concrete U-Channel
      - Bottom Width = 8 ft
      - Length to Copal St = 582 ft
      - Length to Esquinance St = 572 ft
    - Side Wall Height = Varies according to the average top bank elevation from the survey
    - Channel “conduits” in SWMM account for losses along 90° bends using entry/exit losses, coefficient = 1
  - Culverts
    - Copal St: 8’ x 3’ RCB (L = 40 ft)
      - With the current setup, the invert and street CL elevation limit the box height.
      - Inverts can be decreased further, as there is still room to lower at the outfall
    - Esquinance St to Outfall (Existing Conditions Alignment): 8’ x 3’ RCB (L = 484 ft)


South Channel Profile
Existing Deck
Copal St
Esquinance St
U-Channel
4 ft Bottom
Concrete Canvas
4.7 ft (avg.) Bottom
Slope = 0.18%
U-Channel
8 ft Bottom
1 – 8’ x 3’ RCB
1 – 8’ x 3’ RCB
Slope = 0.745%
Invert = -0.94’
Elevation (ft)
Distance
Existing Minimum Bank Elevation
Existing Channel Invert
Proposed Channel Invert

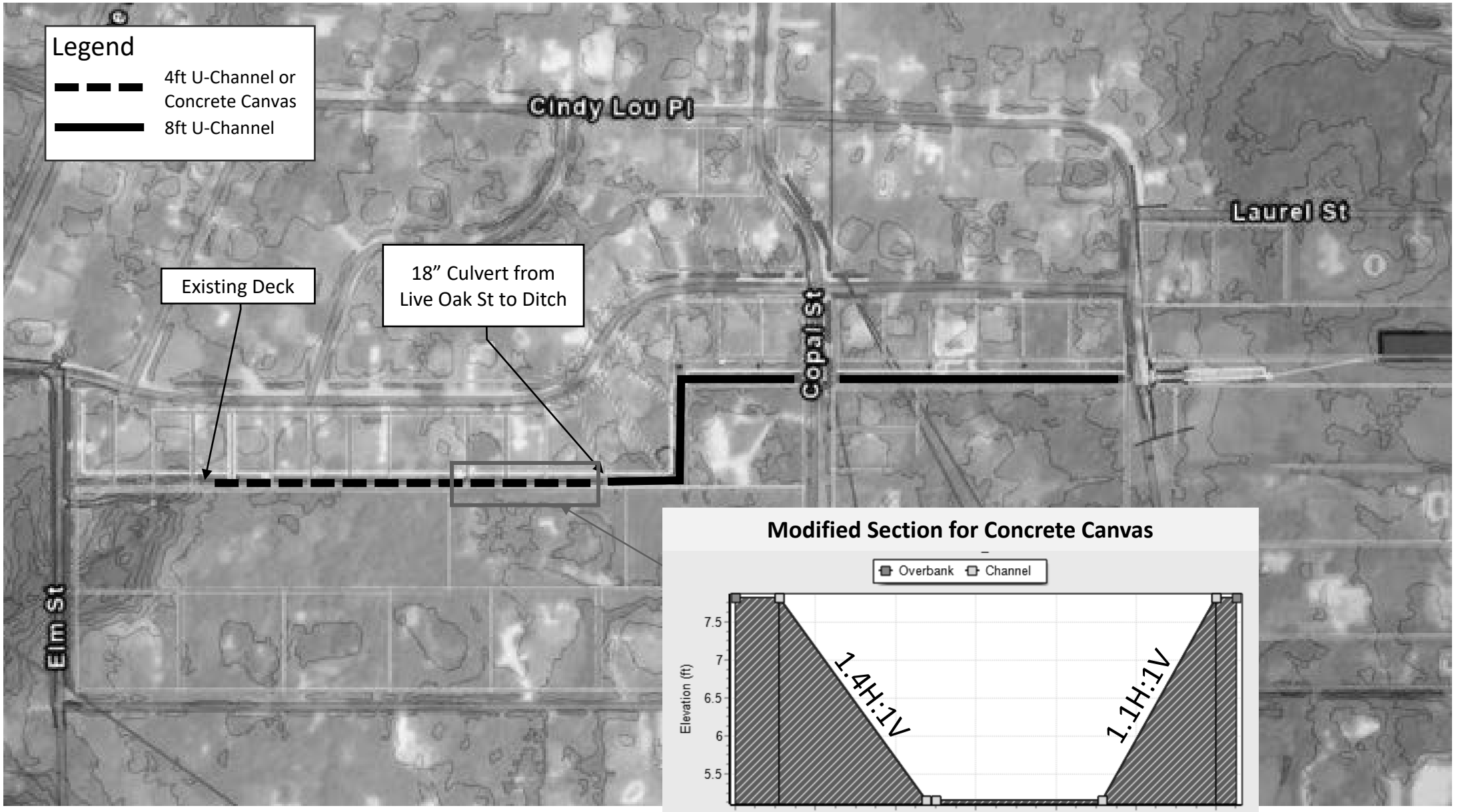
Channel Transition Location for Additional Runs



Channel Transition Location for Additional Runs

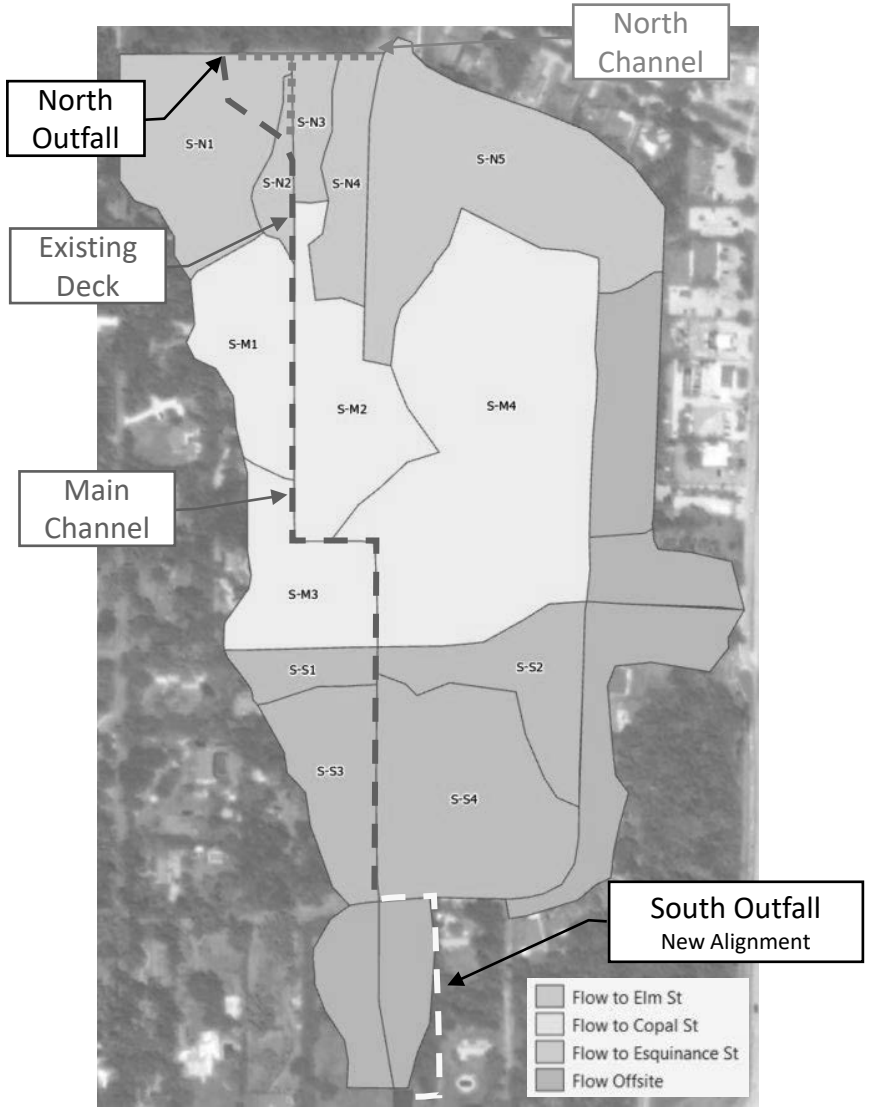


Channel Transition Location for Additional Runs

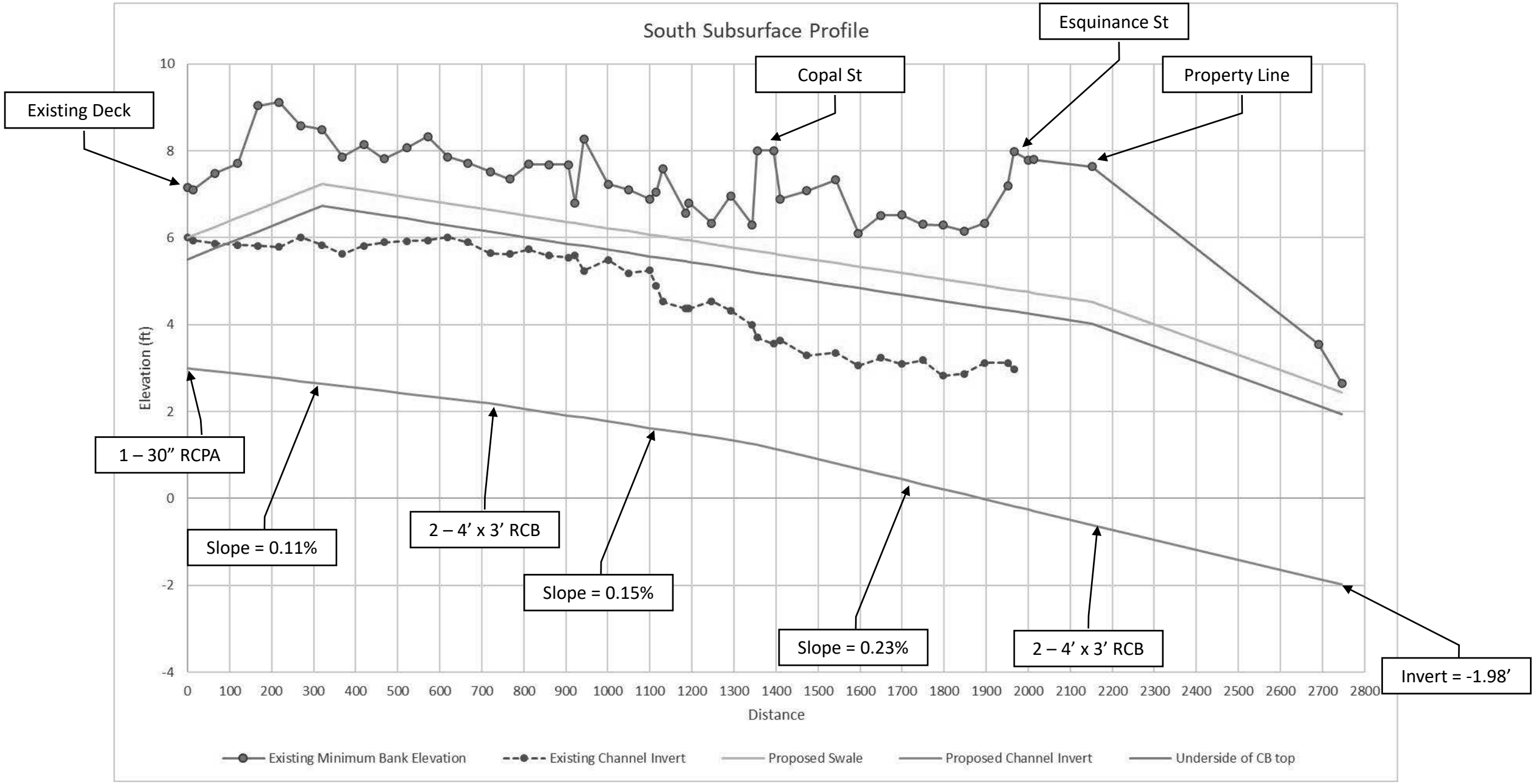


Proposed Conditions – Continued

- Southern Improvements – Subsurface Option
  - Connection to northern channel removed
  - Subsurface Improvements
    - Channel from the deck to the 18” culvert from Live Oak
      - Converted to subsurface with 1 – 30” RCPA
      - Length to culvert = 774 ft
      - Slope = 0.001 ft/ft
    - 18” culvert to Esquinance St
      - Converted to subsurface with 2 – 4’ x 3’ RCB
      - Length to Copal St = 582 ft
      - Length to Esquinance St = 572 ft
    - Esquinance St to Outfall (new alignment)
      - Length to Outfall = 780 ft
  - Subsurface “conduits” in SWMM account for losses along 90° bends using entry/exit losses, coefficient = 1



Drainage Subbasins


South Subsurface Profile
Esquinance St
Copal St
Property Line
Existing Deck
1 – 30” RCPA
Slope = 0.11%
2 – 4’ x 3’ RCB
Slope = 0.15%
Slope = 0.23%
2 – 4’ x 3’ RCB
Invert = -1.98’
Elevation (ft)
Distance
Existing Minimum Bank Elevation
Existing Channel Invert
Proposed Swale
Proposed Channel Invert
Underside of CB top

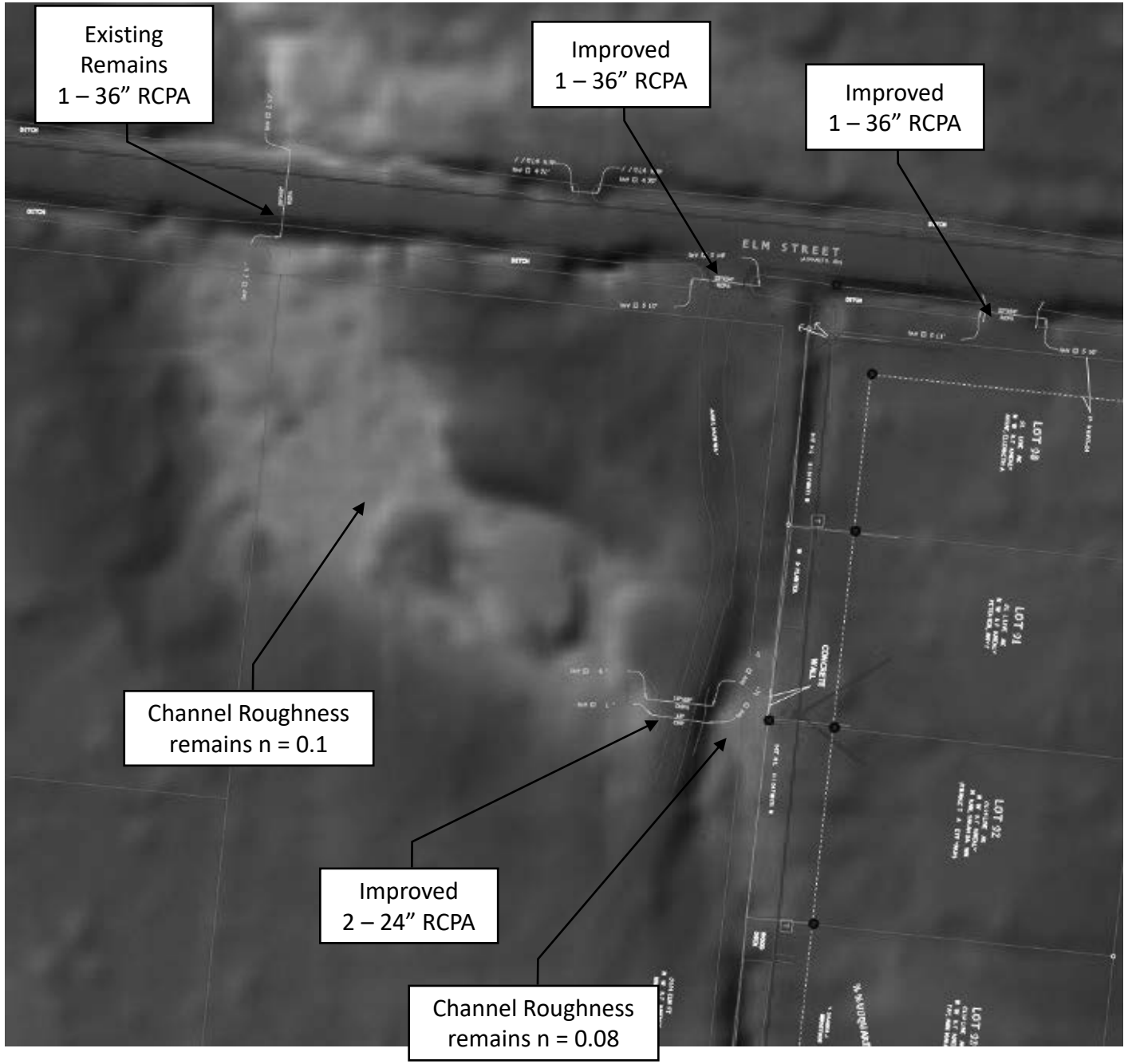
Proposed Conditions – Continued

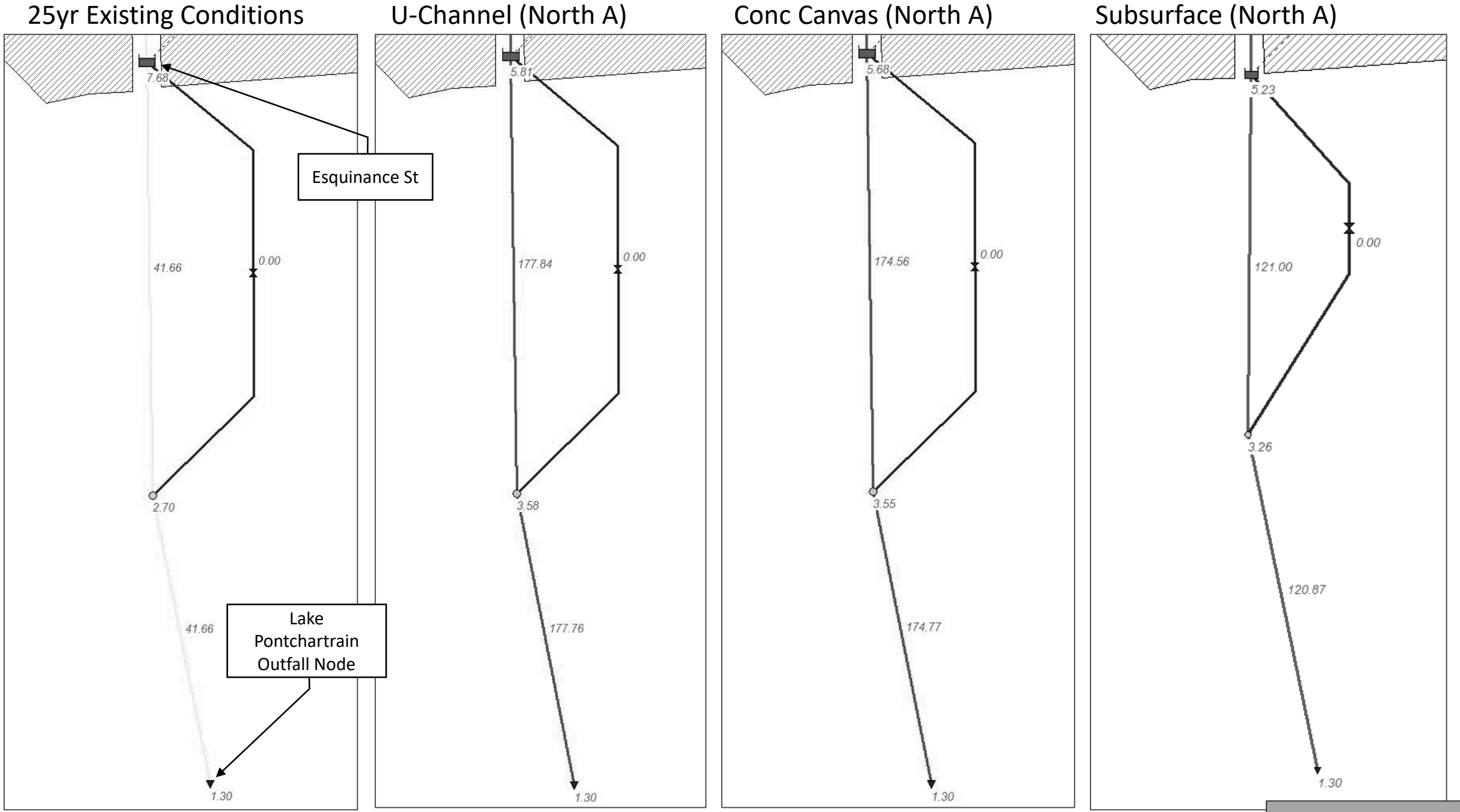
- Northern Improvements – Option A
  - Channel Improvements
    - No channel improvements have been added, roughness still varies between n = 0.08 and 0.1
  - Culverts
    - Silted-in culverts increased to 2 – 24 RCPA
    - Driveway culverts on Elm St south roadside ditch increased to 36” RCPA
- Southern Boundary
  - Increased to MHHW (1.3 ft)

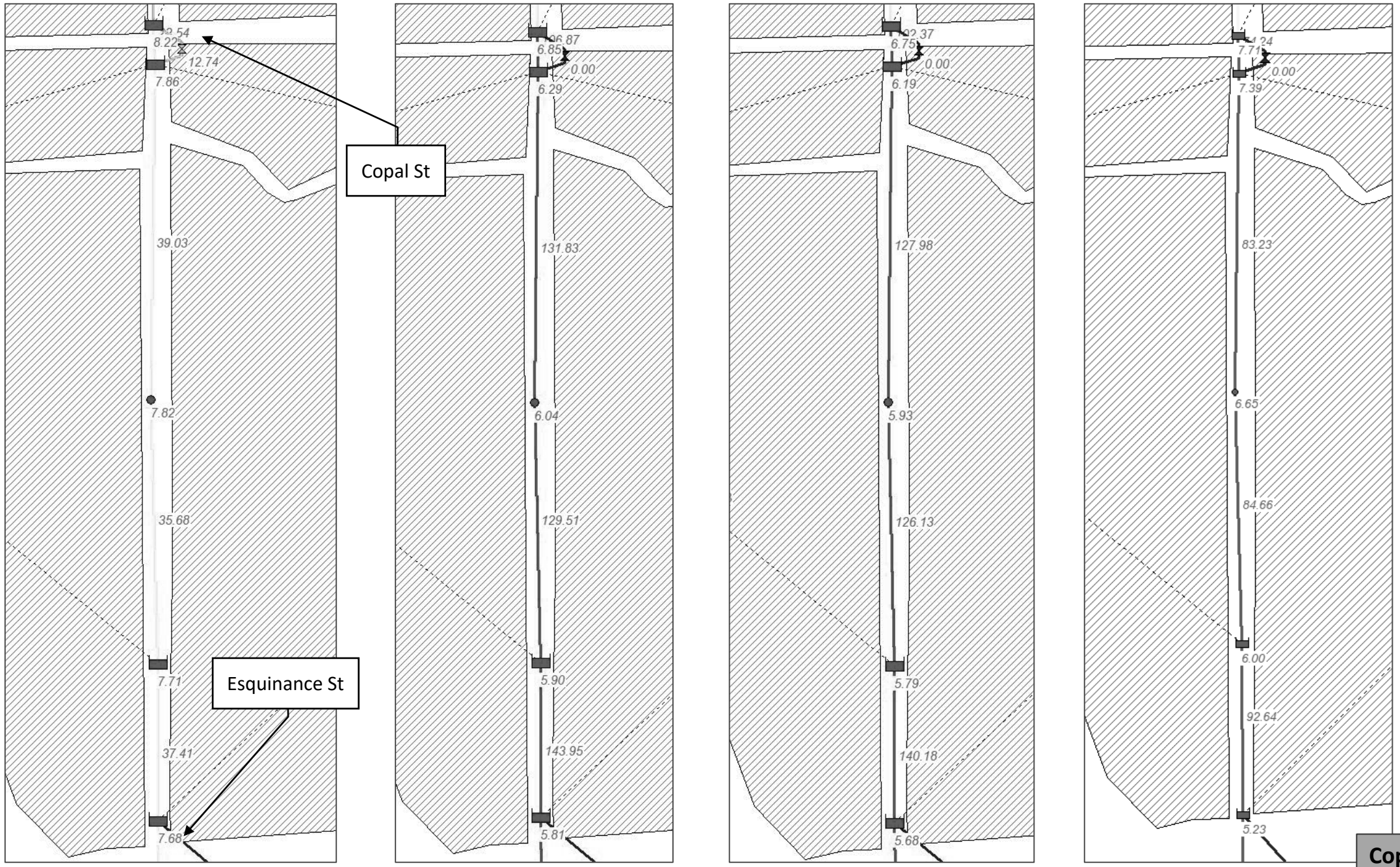
Observations

- All options show WSE reductions as compared to the existing conditions
- Open Channel Results
  - 50-yr design storm causes minor node flooding
- Subsurface Results
  - Minor node flooding occurs for both the 25-yr and 50-yr events
- North Option A Results
  - 25-yr event
    - First driveway experiences minor overtopping (0.15 ft) with 36” RCPA replacement
    - Second driveway is not overtopped

North Improvements – Option A

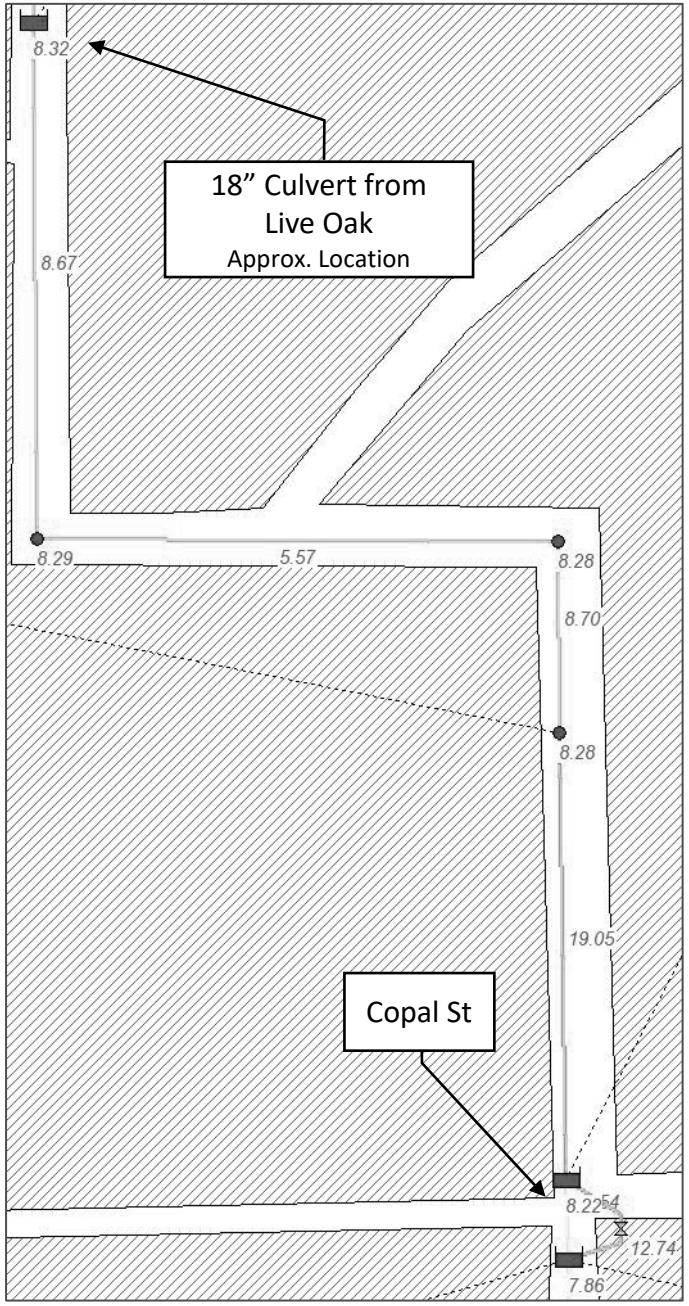



25yr Existing Conditions
U-Channel (North A)
Conc Canvas (North A)
Subsurface (North A)
Esquinance St
Lake Pontchartrain Outfall Node
7.68
41.66
0.00
2.70
41.66
1.30
5.81
177.84
0.00
3.58
177.76
1.30
5.68
174.56
0.00
3.55
174.77
1.30
5.23
0.00
121.00
3.26
120.87
1.30
Esquinance to Lake

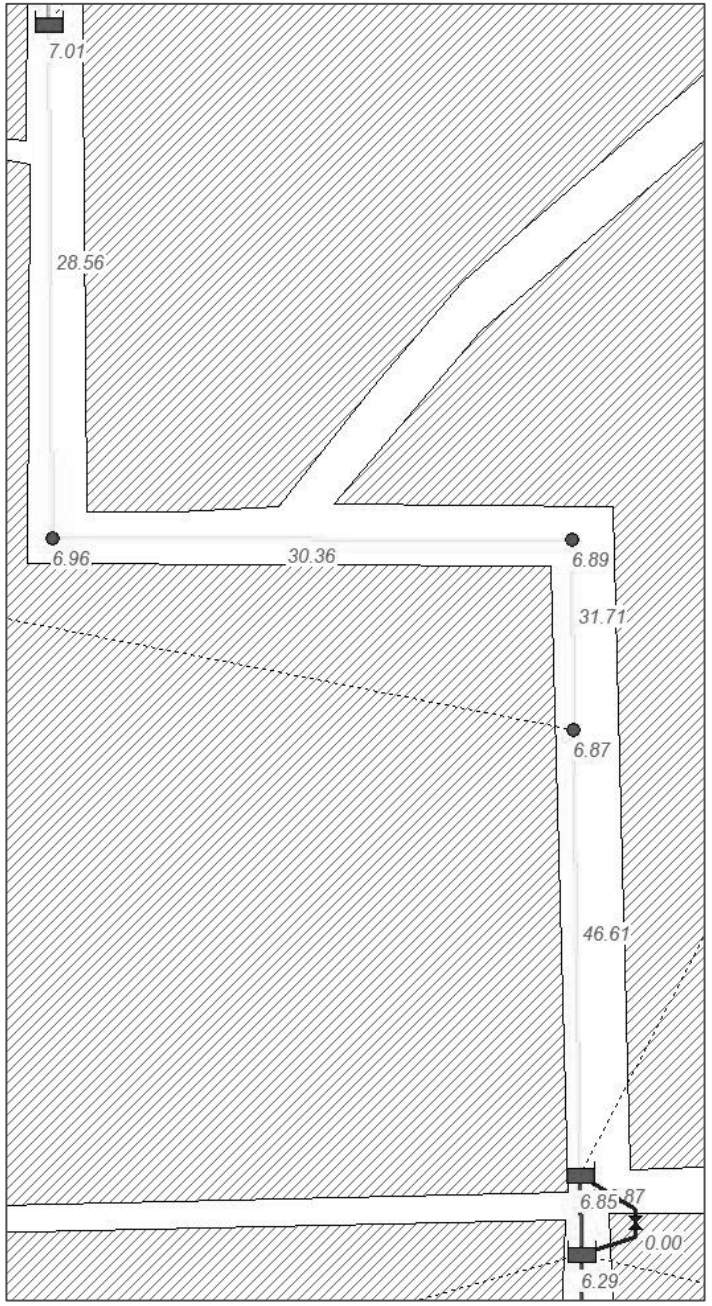

25yr Existing Conditions
U-Channel (North A)
Conc Canvas (North A)
Subsurface (North A)
Copal St
Esquinance St
8.22
12.74
7.86
39.03
7.82
35.68
7.71
37.41
7.68
6.85
0.00
6.29
131.83
6.04
129.51
5.90
143.95
5.81
6.75
0.00
6.19
127.98
5.93
126.13
5.79
140.18
5.68
7.71
0.00
7.39
83.23
6.65
84.66
6.00
92.64
5.23
Copal to Esquinance

90° channel bends to Copal

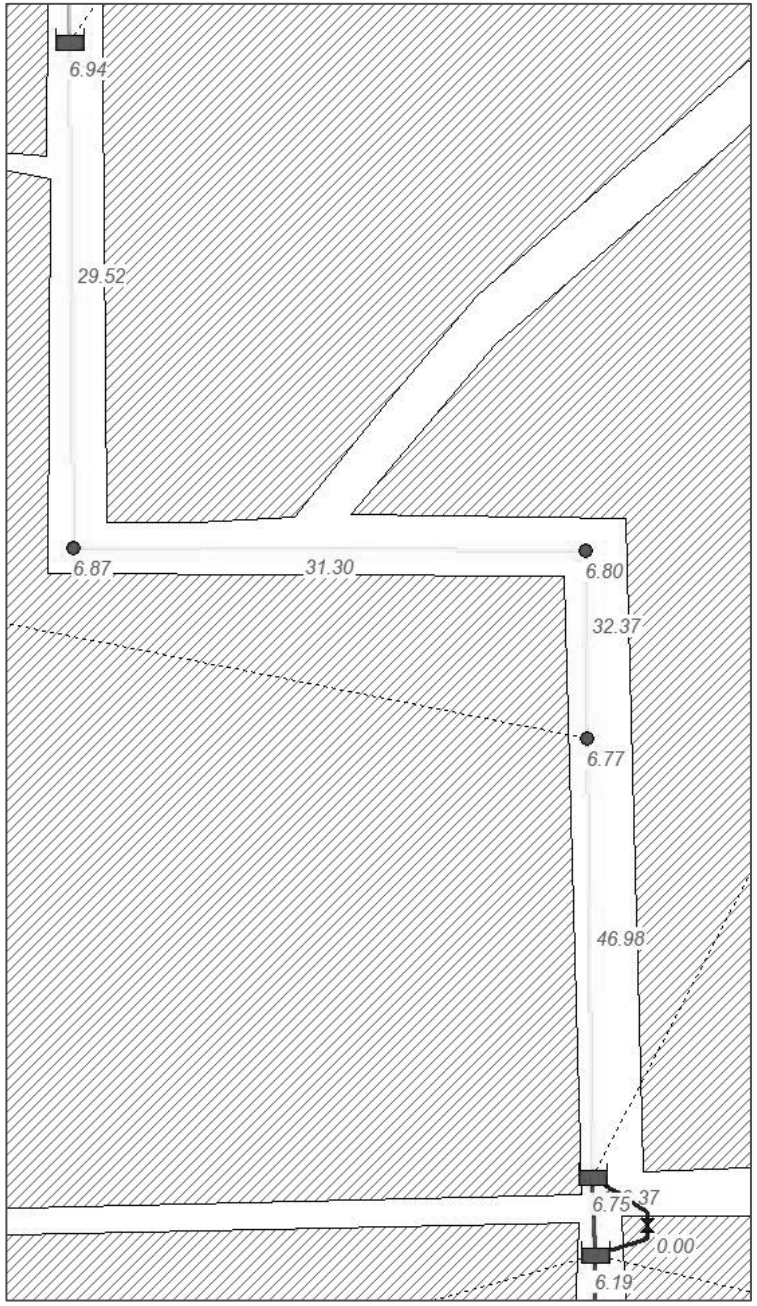
25yr Existing Conditions



U-Channel (North A)

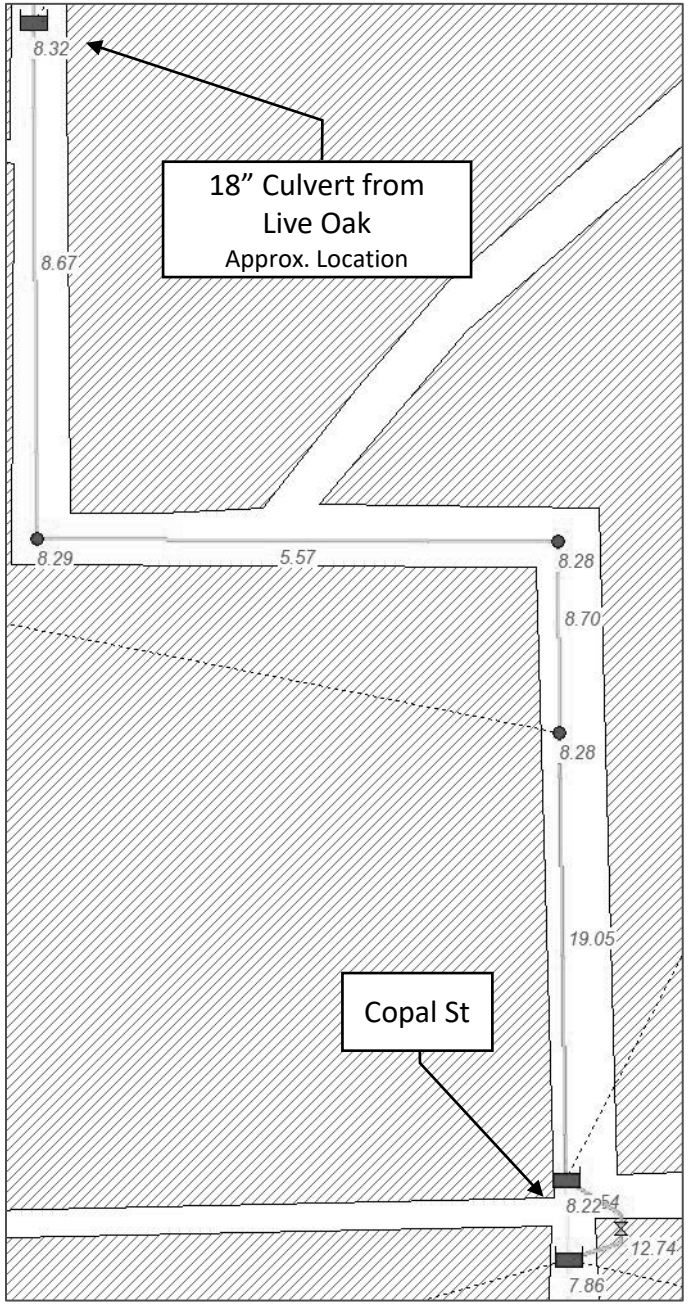


Conc Canvas (North A)

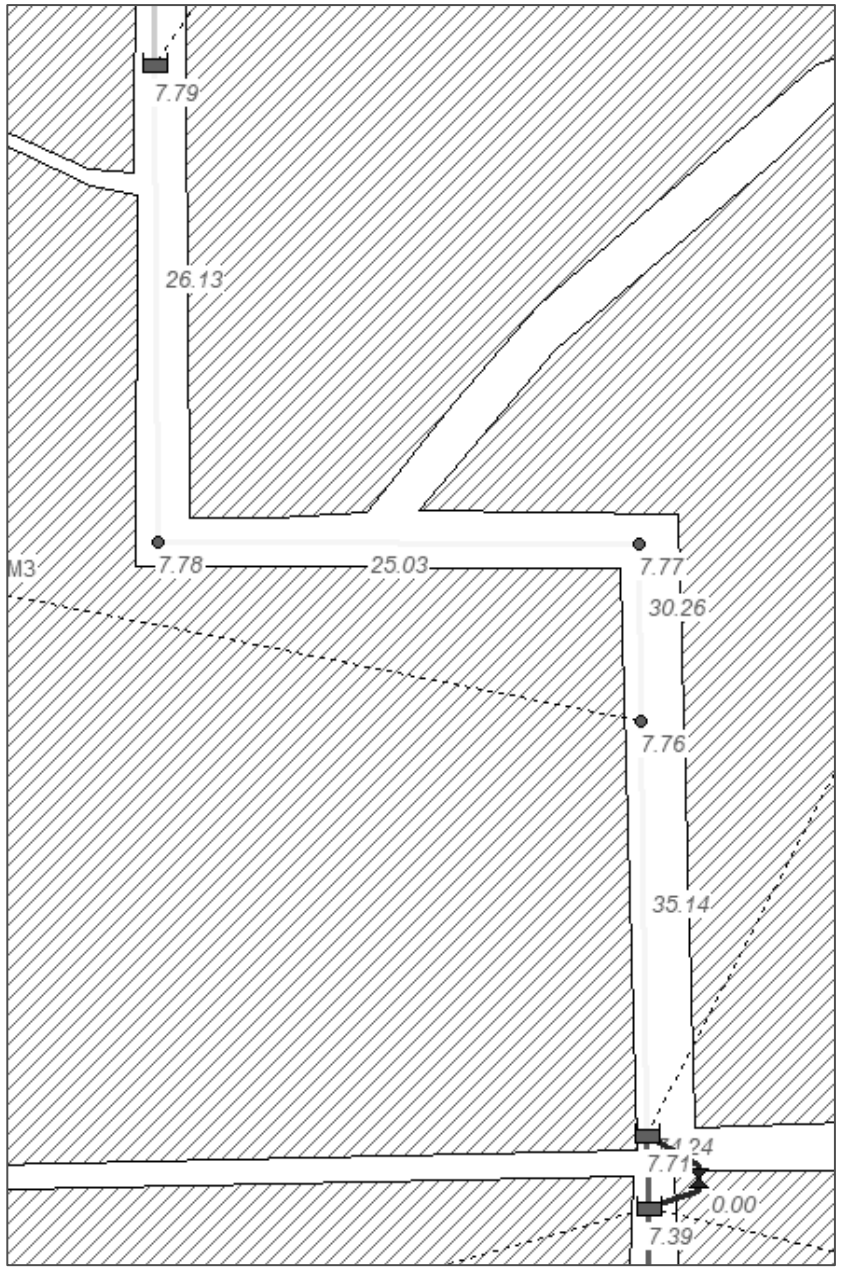


90° channel bends to Copal

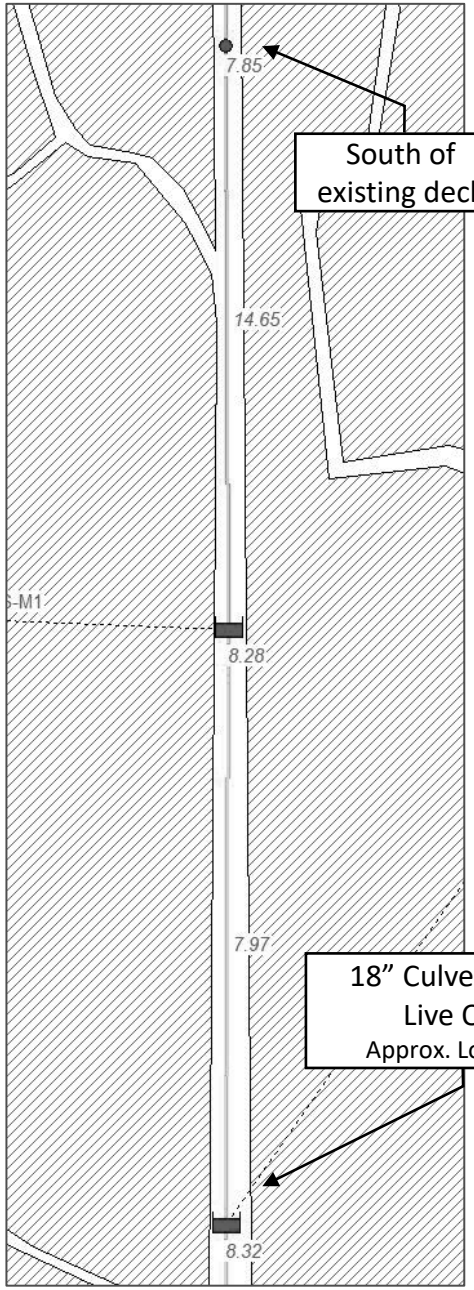
25yr Existing Conditions



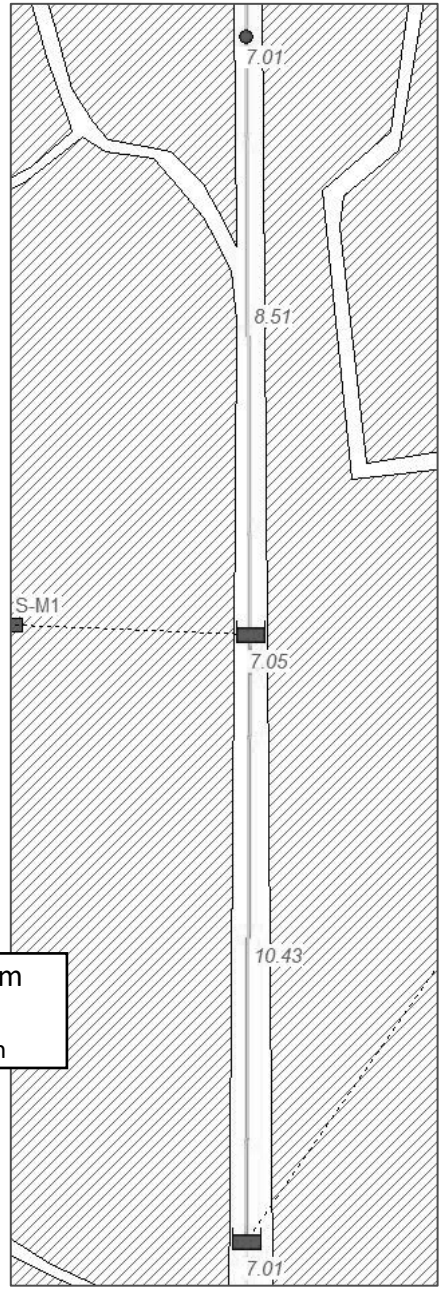
Subsurface (North A)



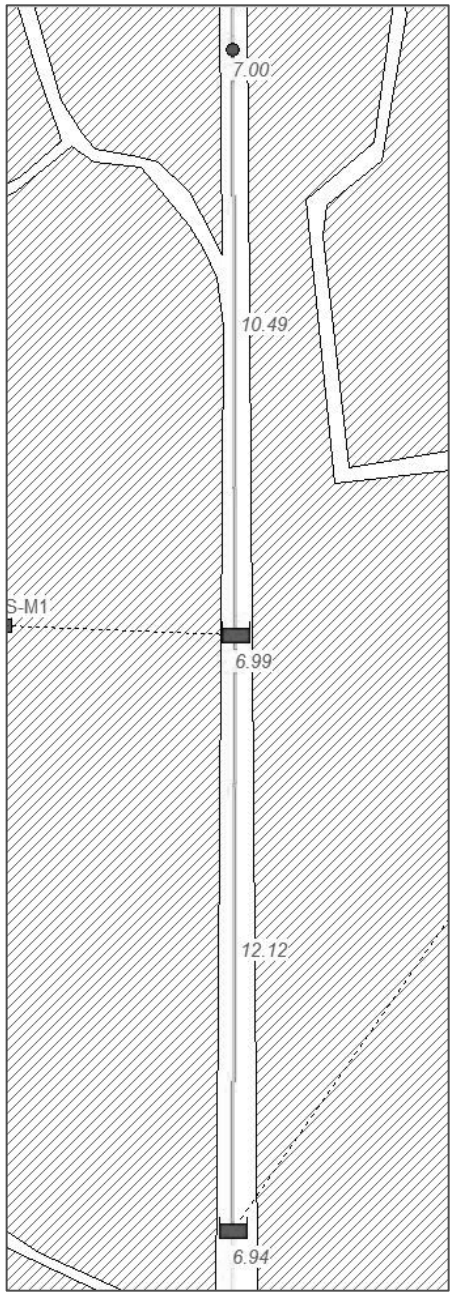
25yr Existing Conditions



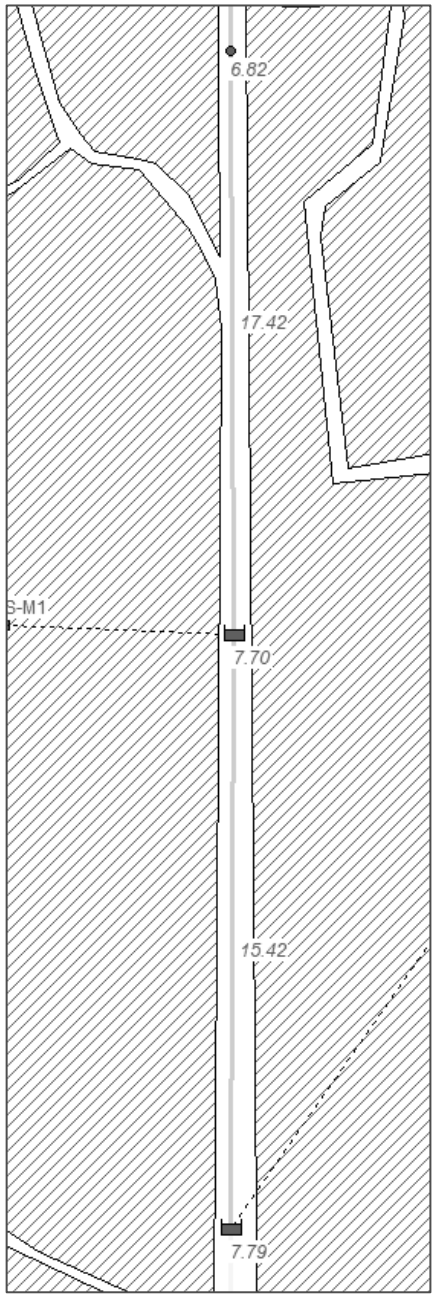
U-Channel (North A)



Conc Canvas (North A)

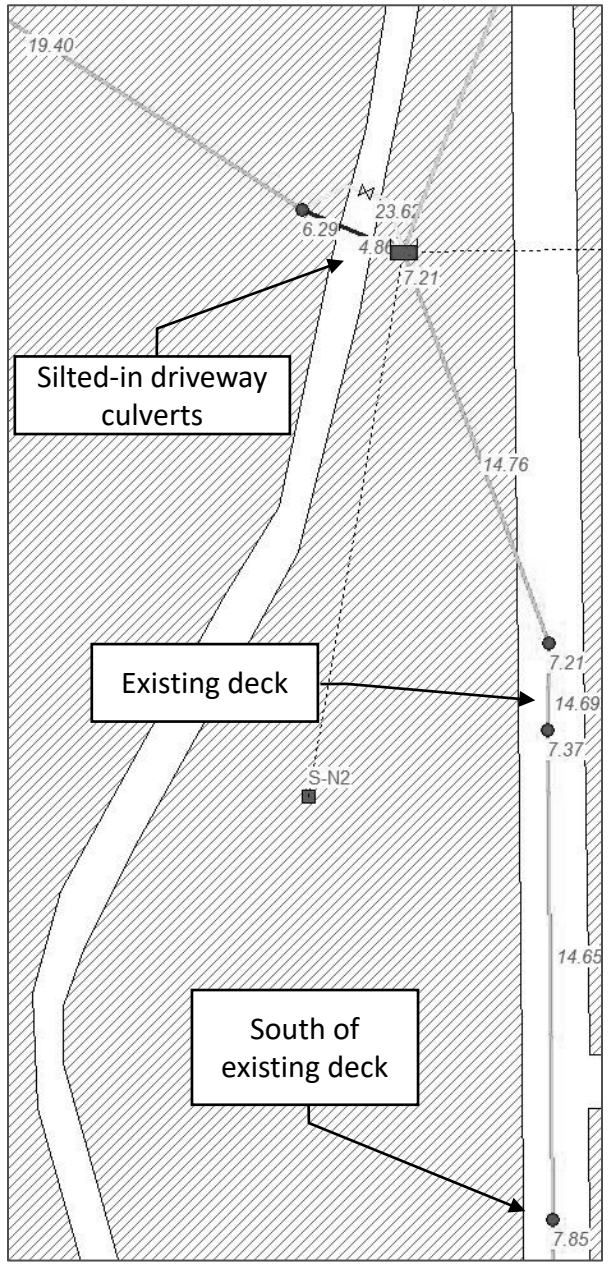


Subsurface (North A)

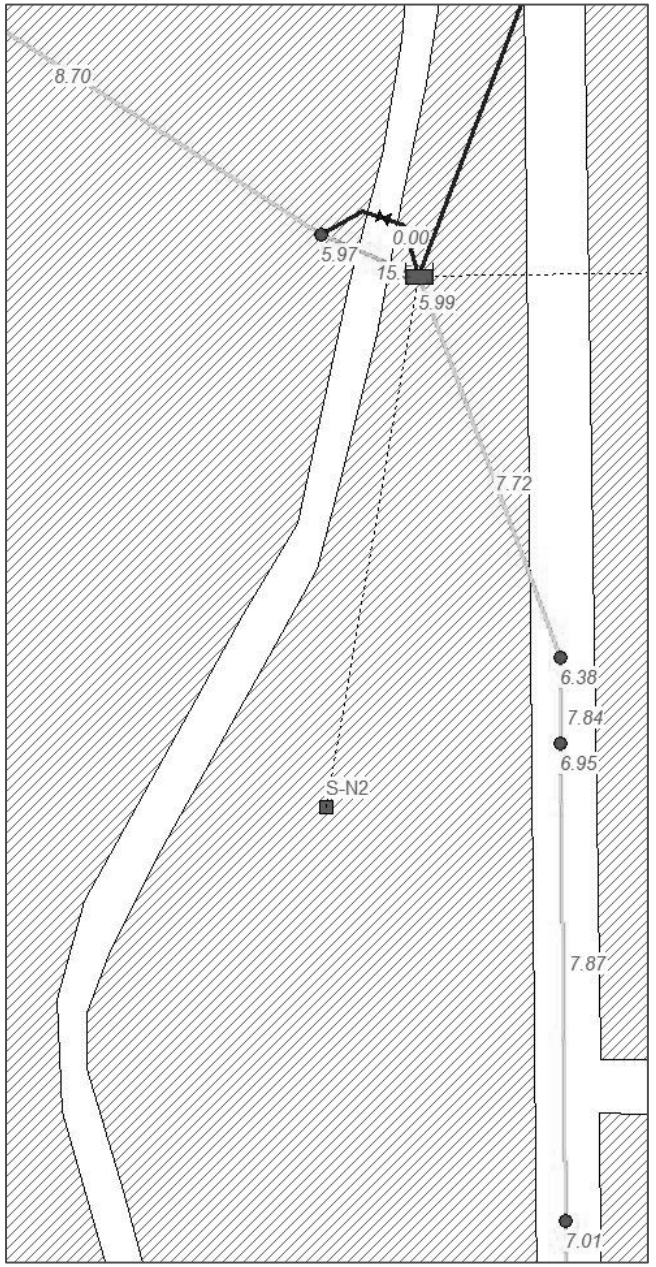


South of deck to 18” culvert

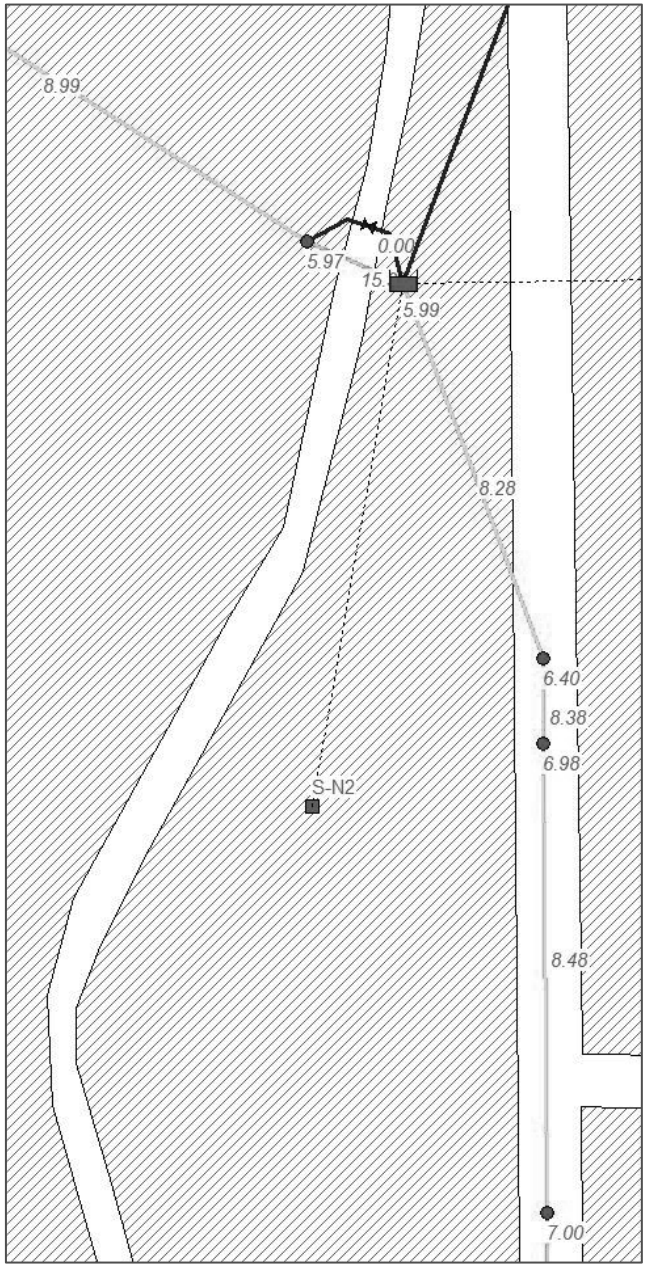
25yr Existing Conditions



U-Channel (North A)

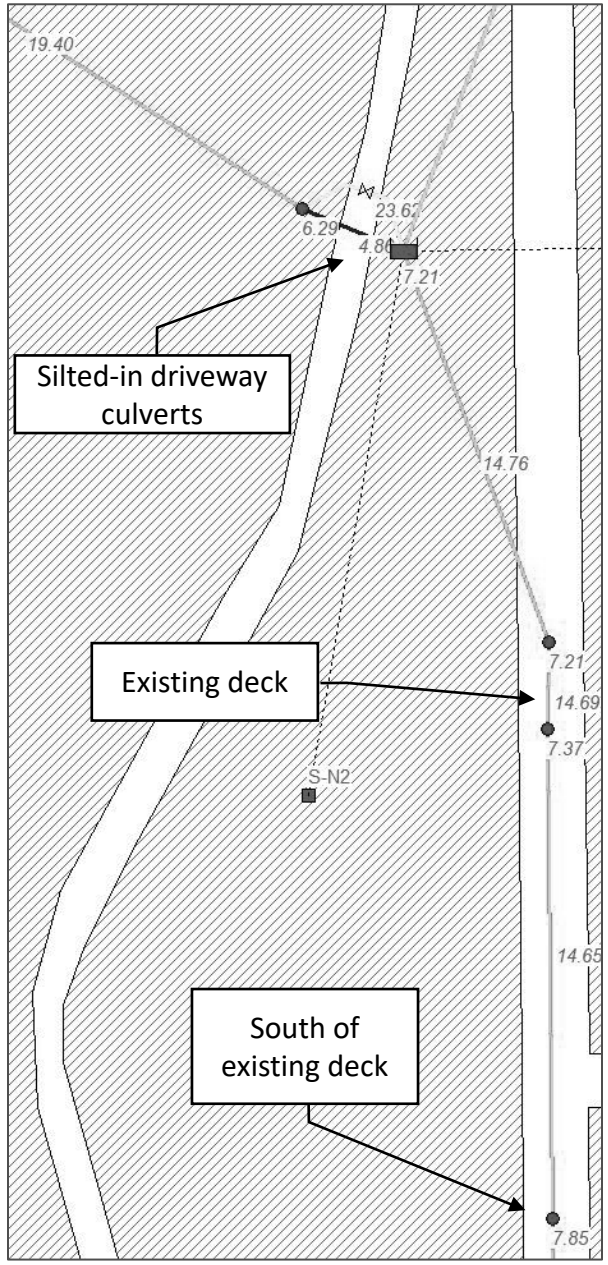


Conc Canvas (North A)

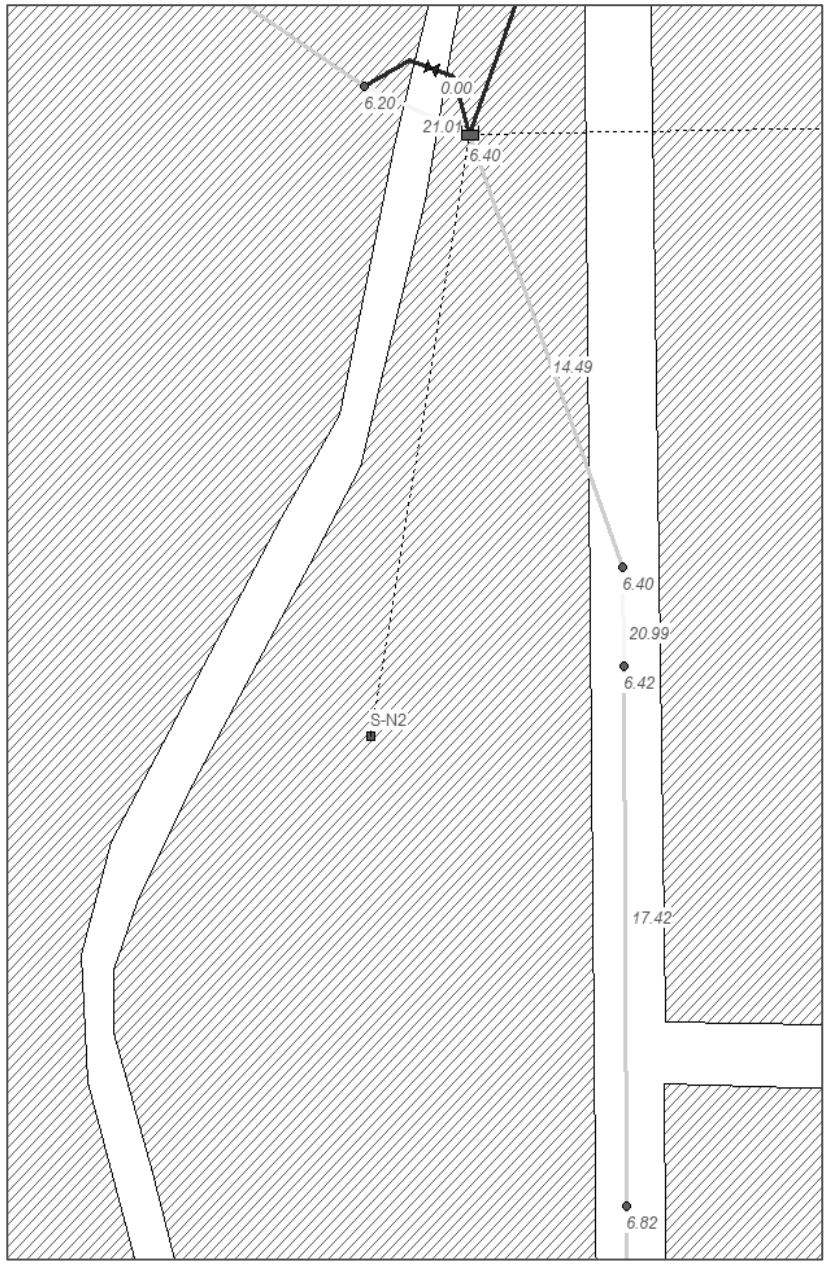


Driveway culverts to south side of deck

25yr Existing Conditions

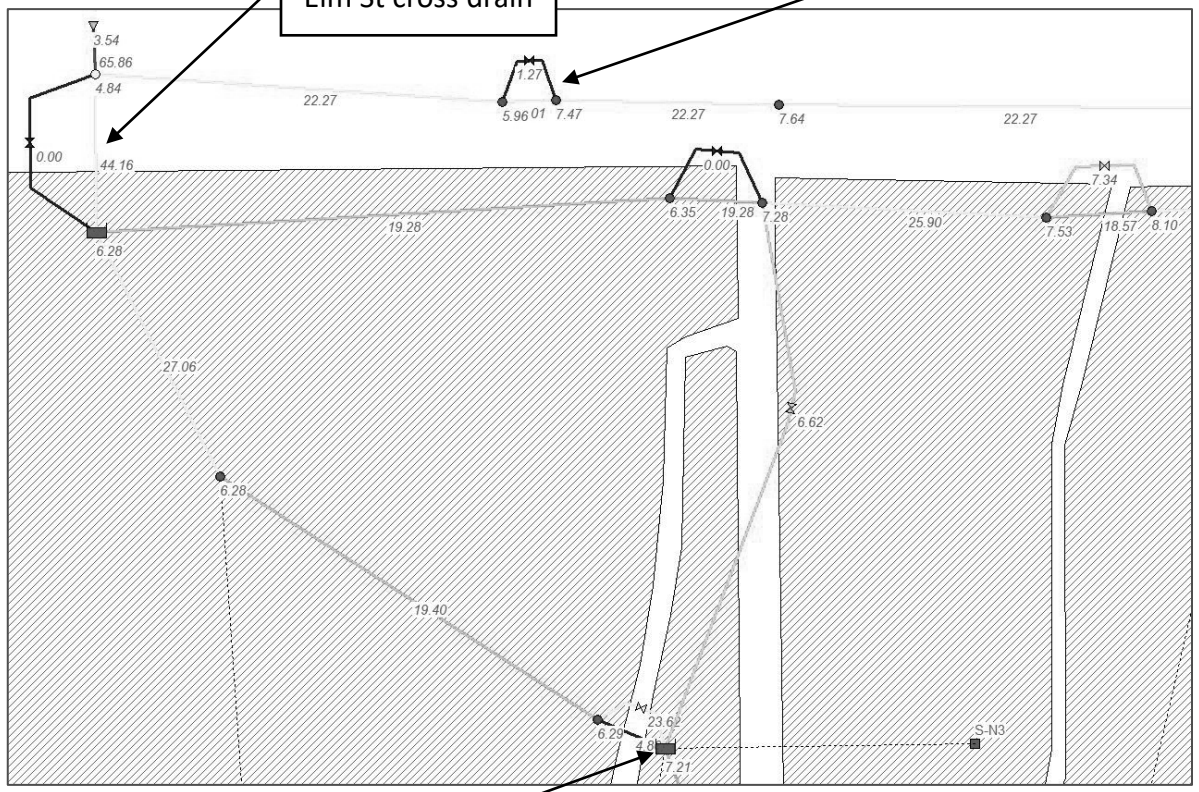


Subsurface (North A)

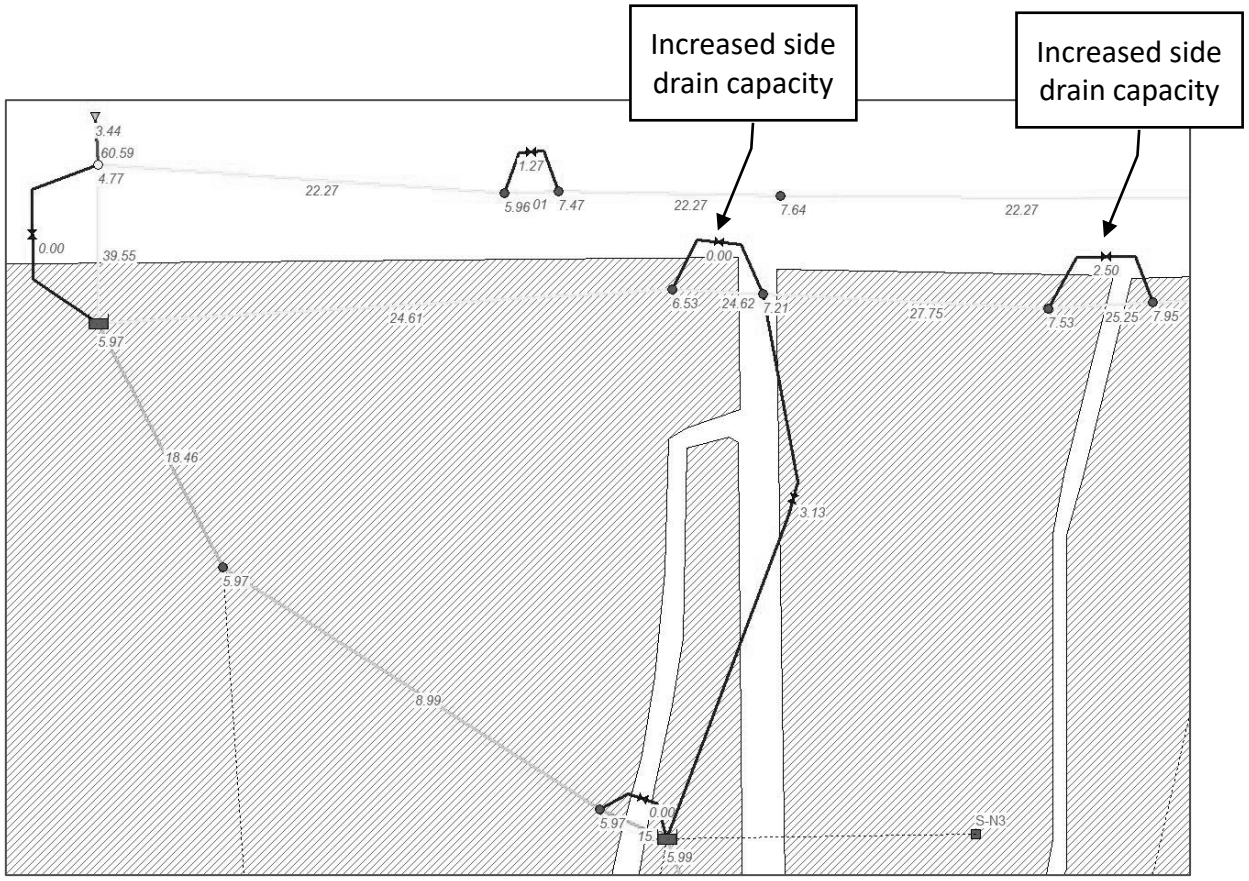


Driveway culverts to south side of deck

25yr Existing Conditions

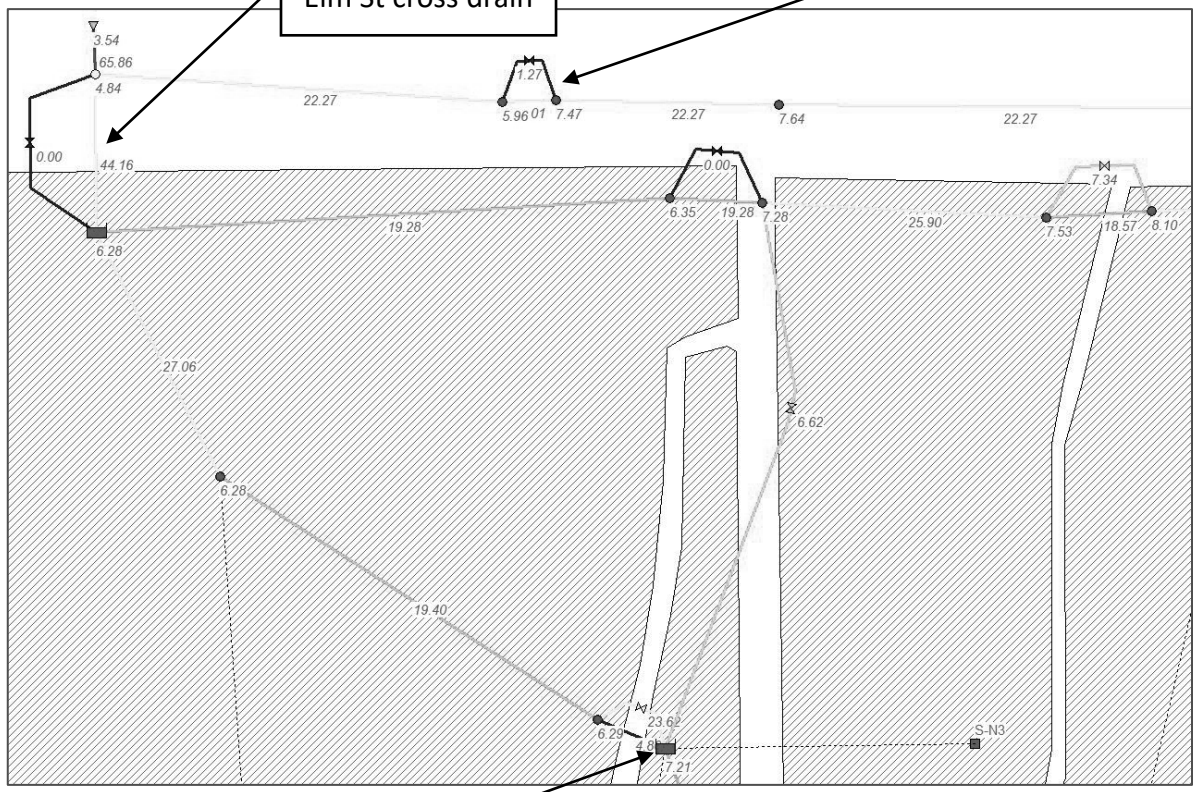


U-Channel (North A)

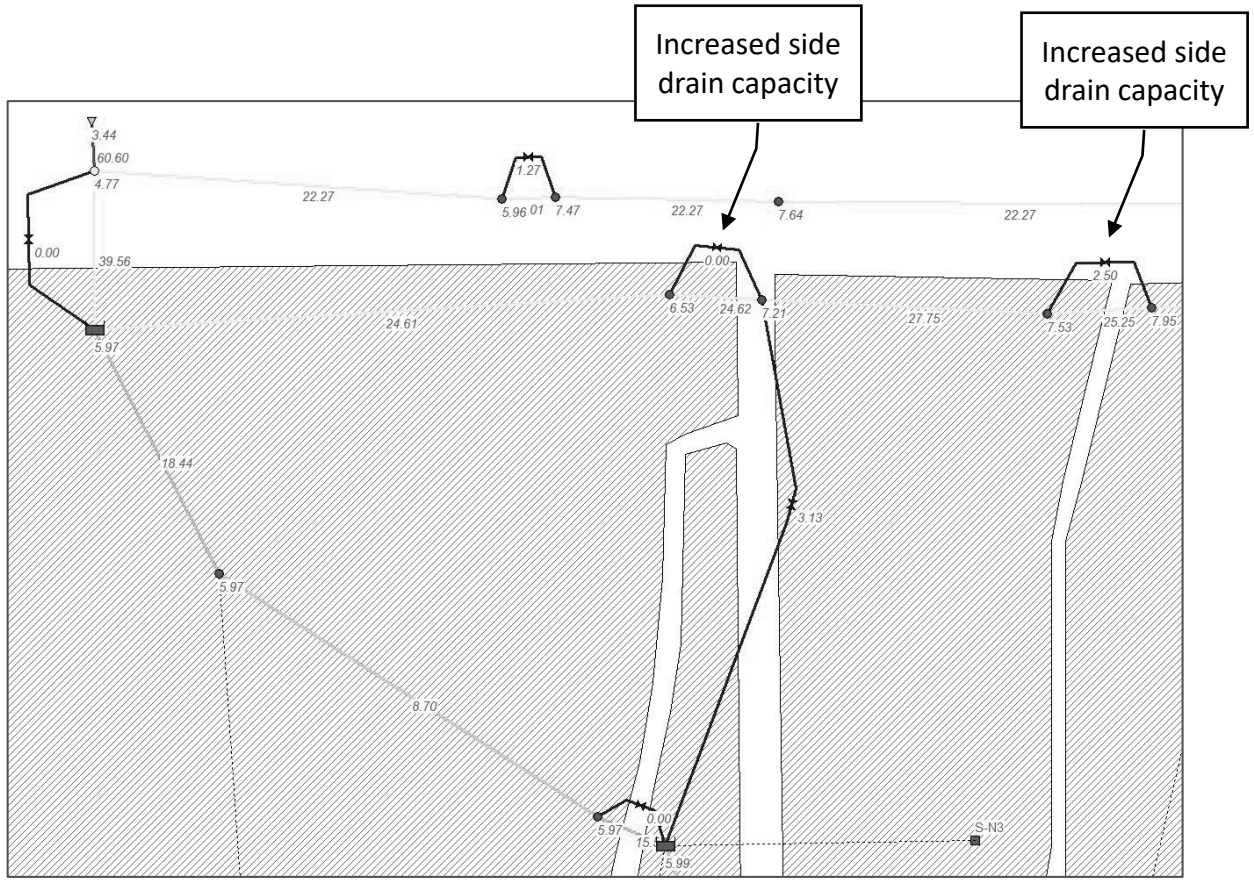


Elm St cross drain to driveway culverts

25yr Existing Conditions

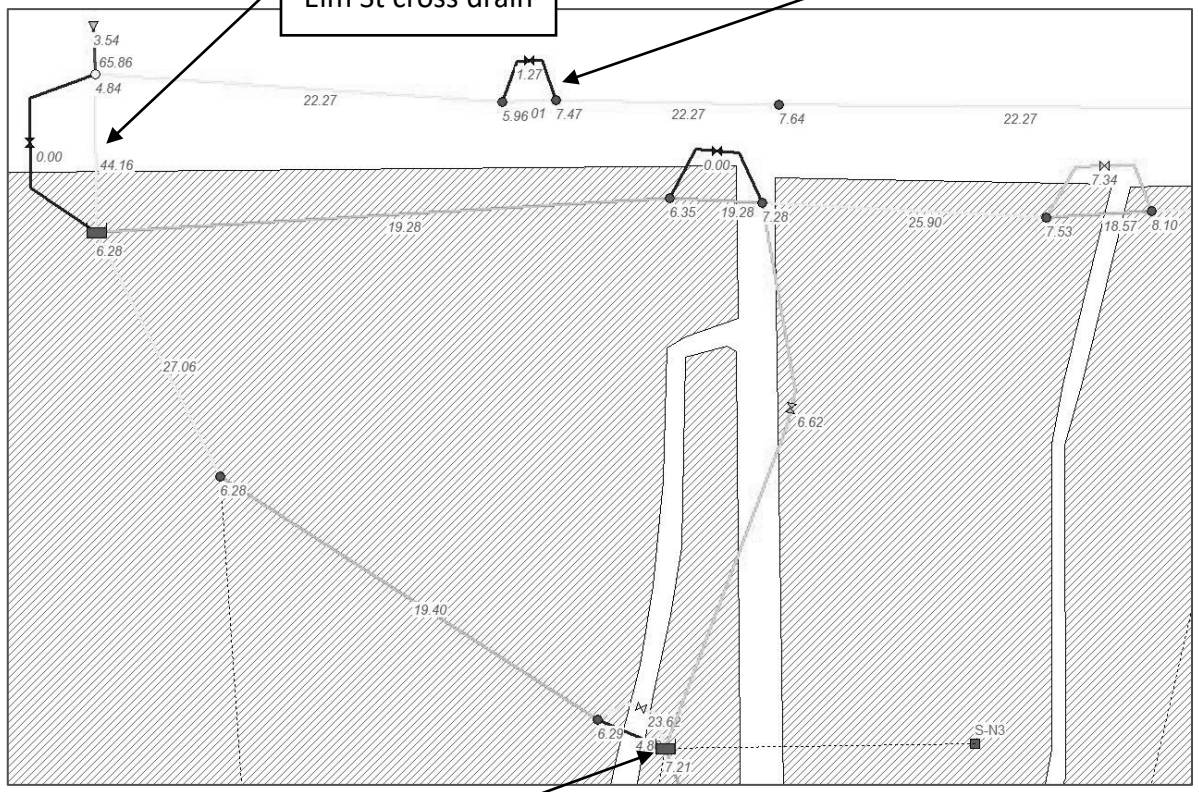


Conc Canvas (North A)

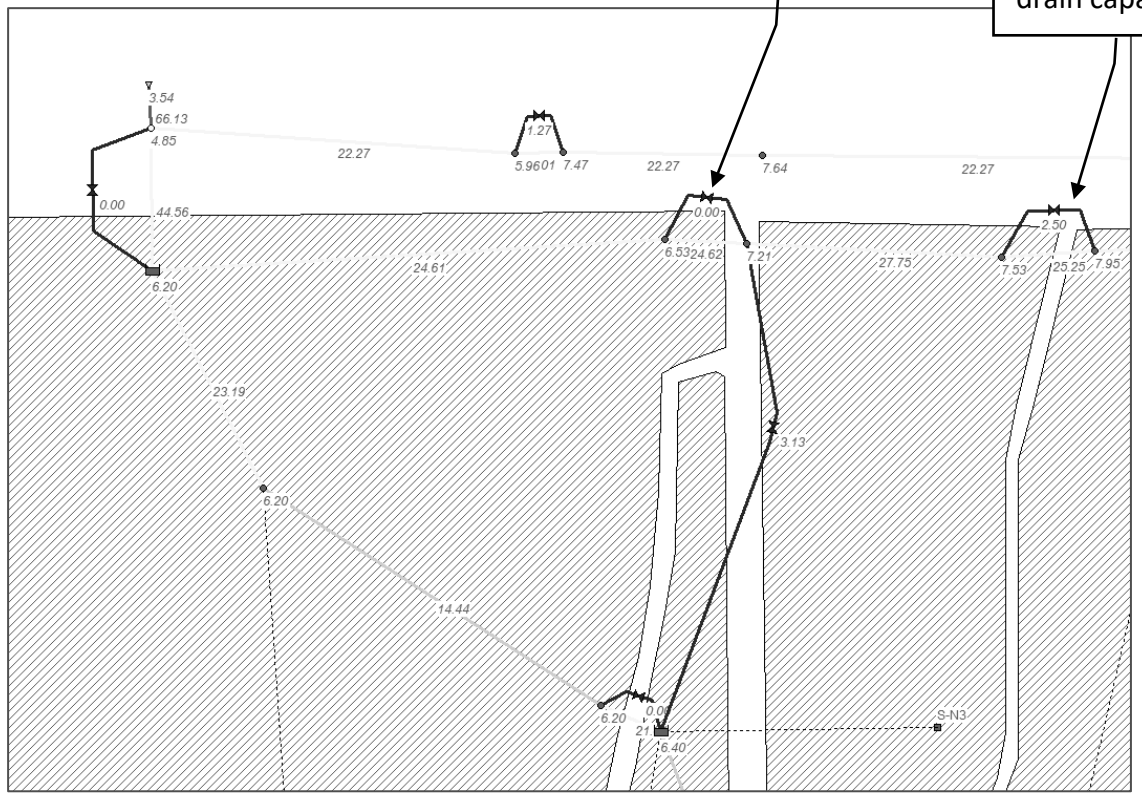


Elm St cross drain to driveway culverts

25yr Existing Conditions

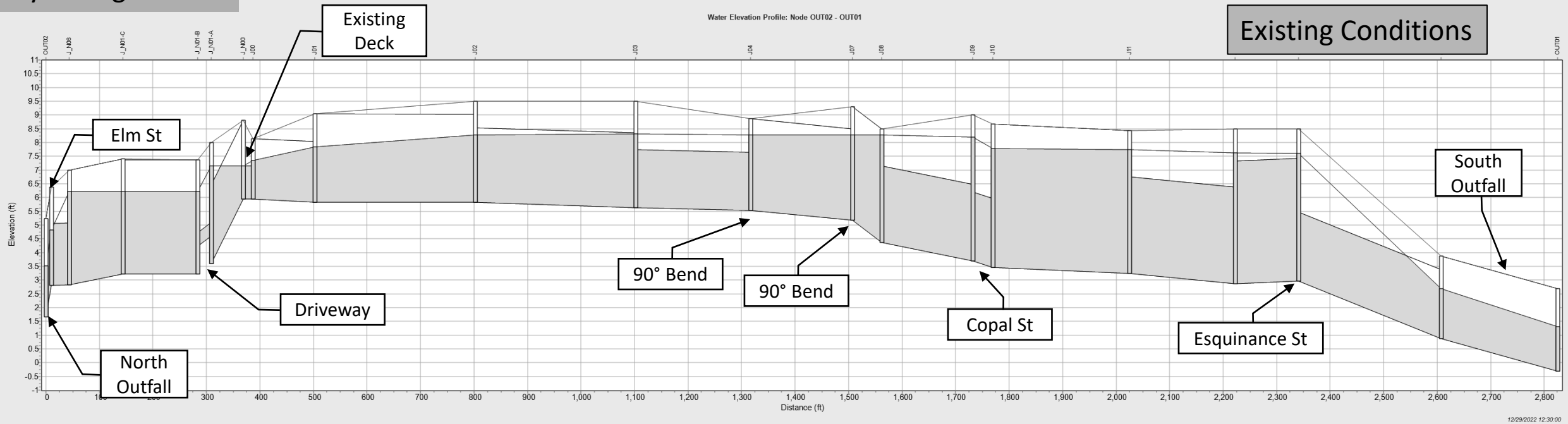


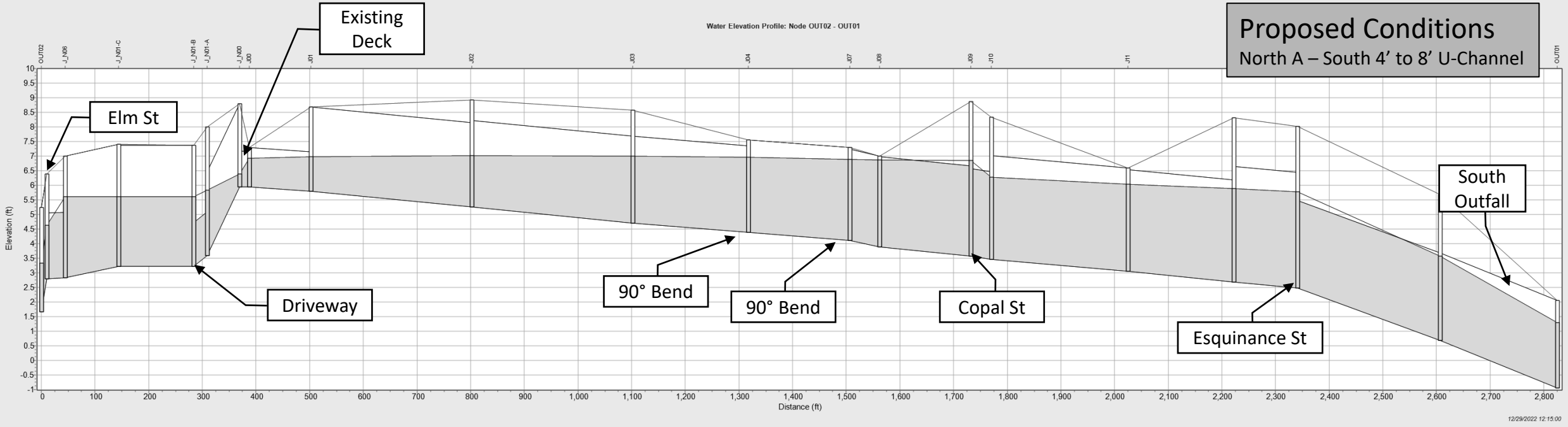
Subsurface (North A)



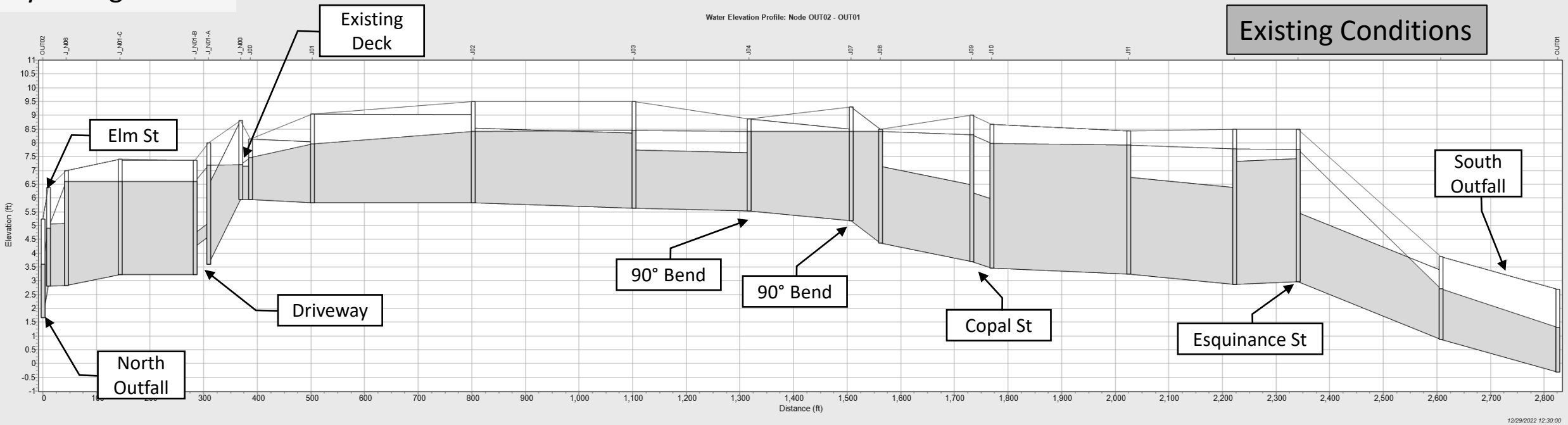
Elm St cross drain to driveway culverts

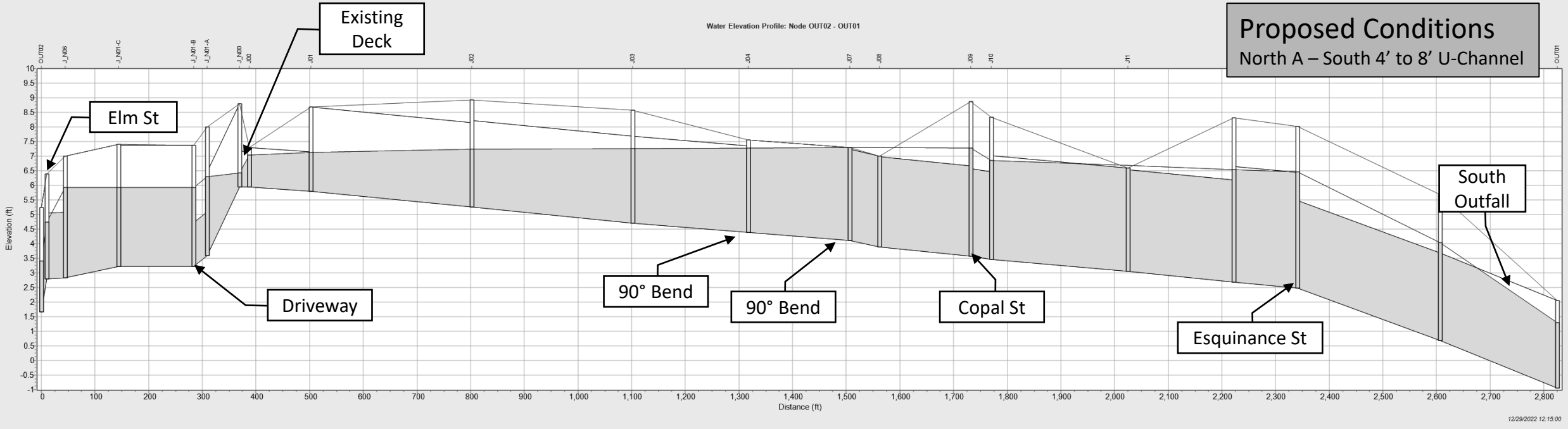
25-yr Design Storm



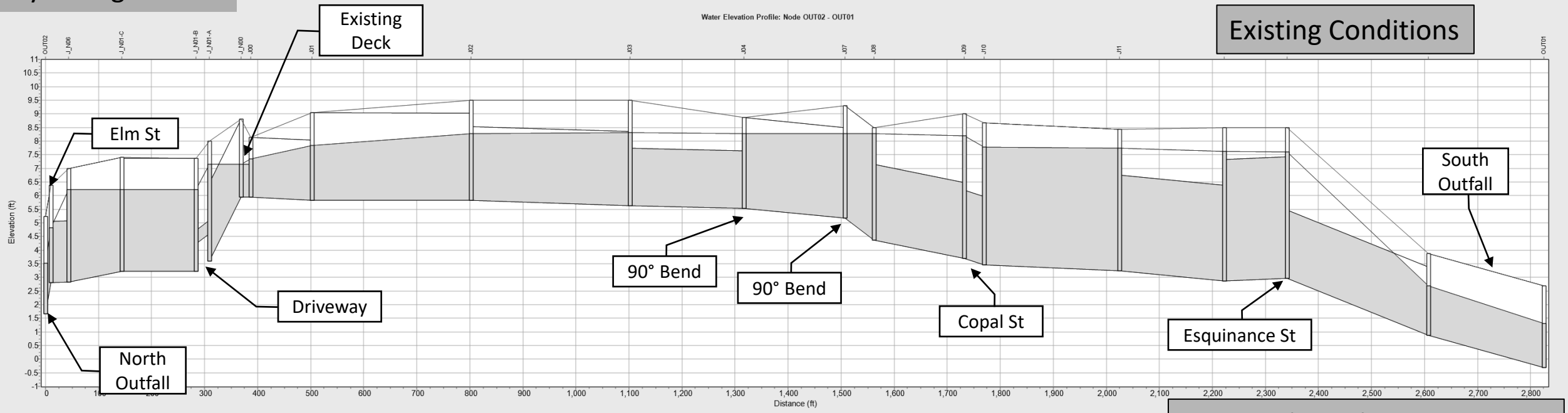


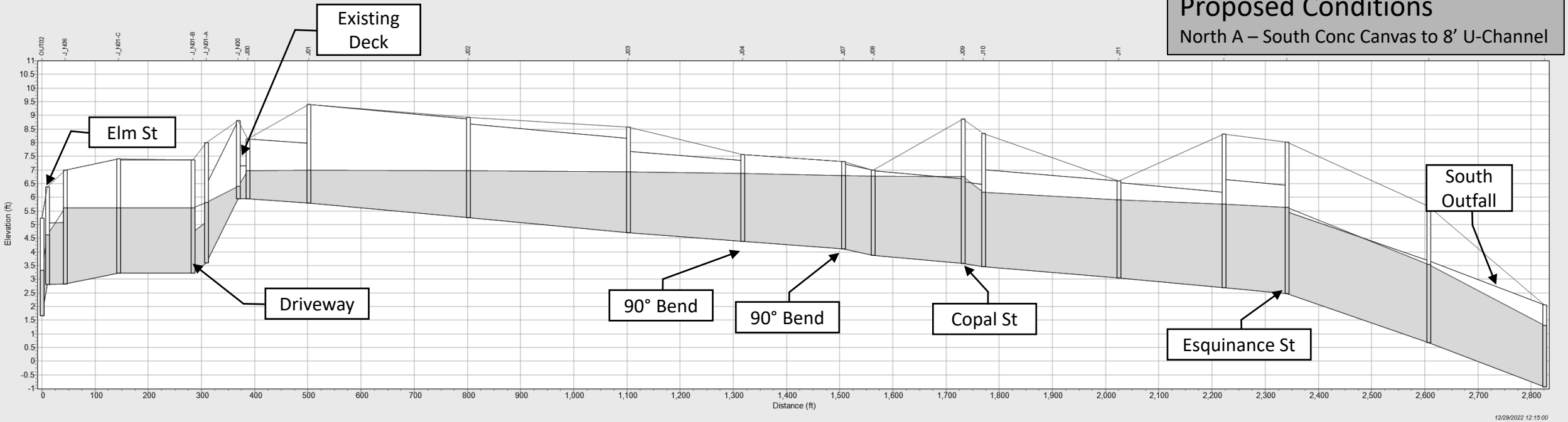
50-yr Design Storm





25-yr Design Storm





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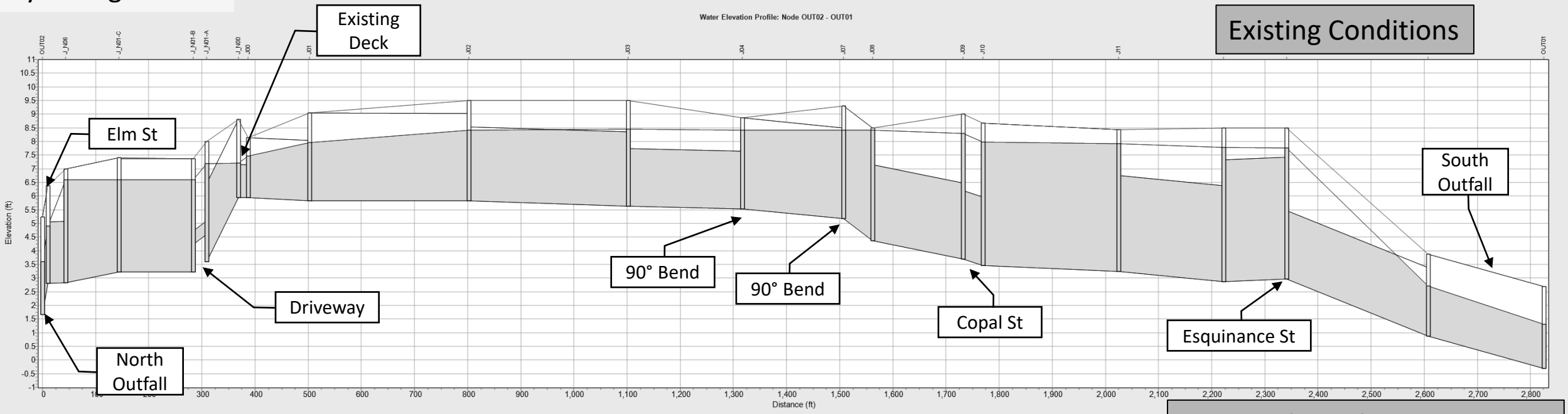
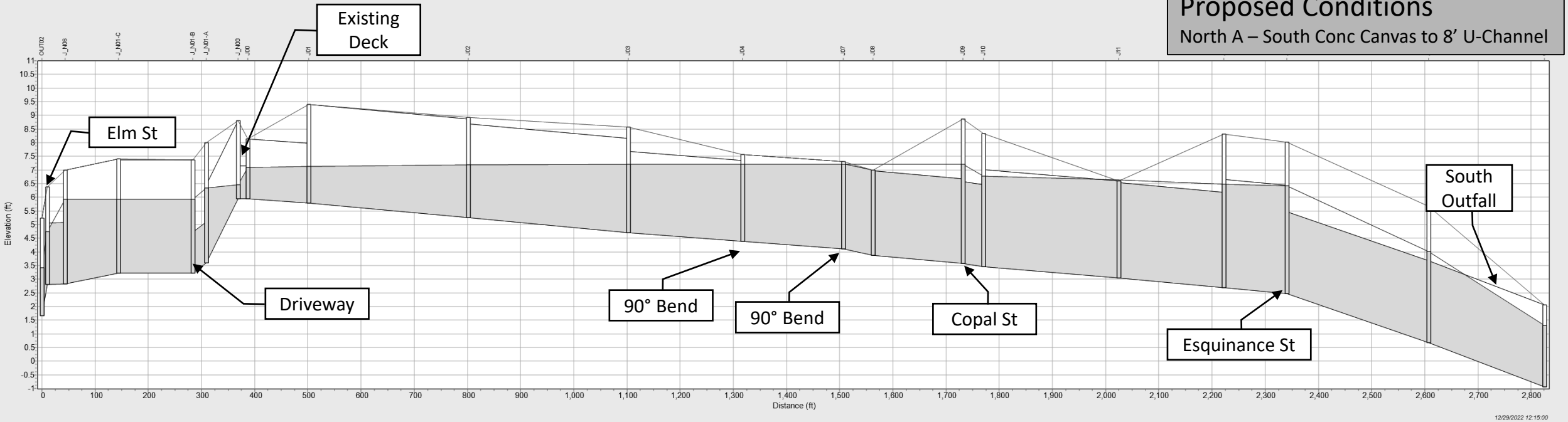
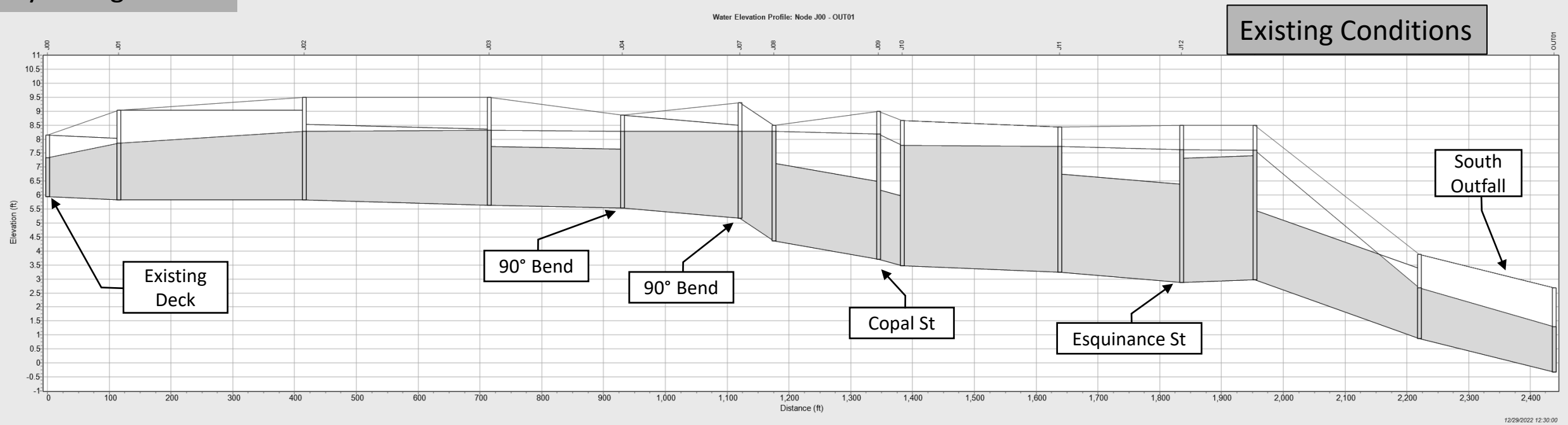
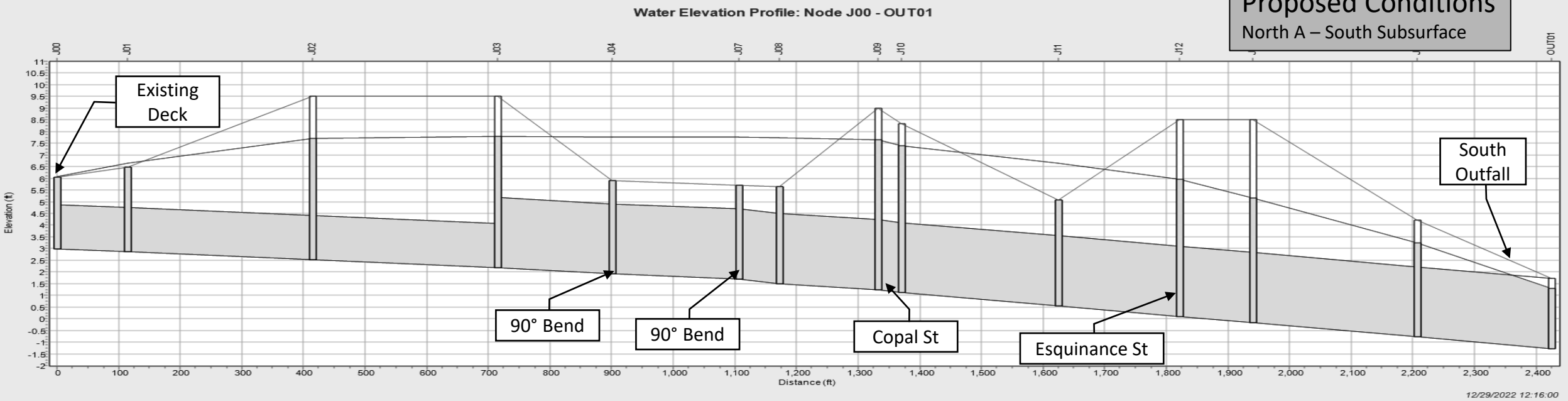
50-yr Design Storm



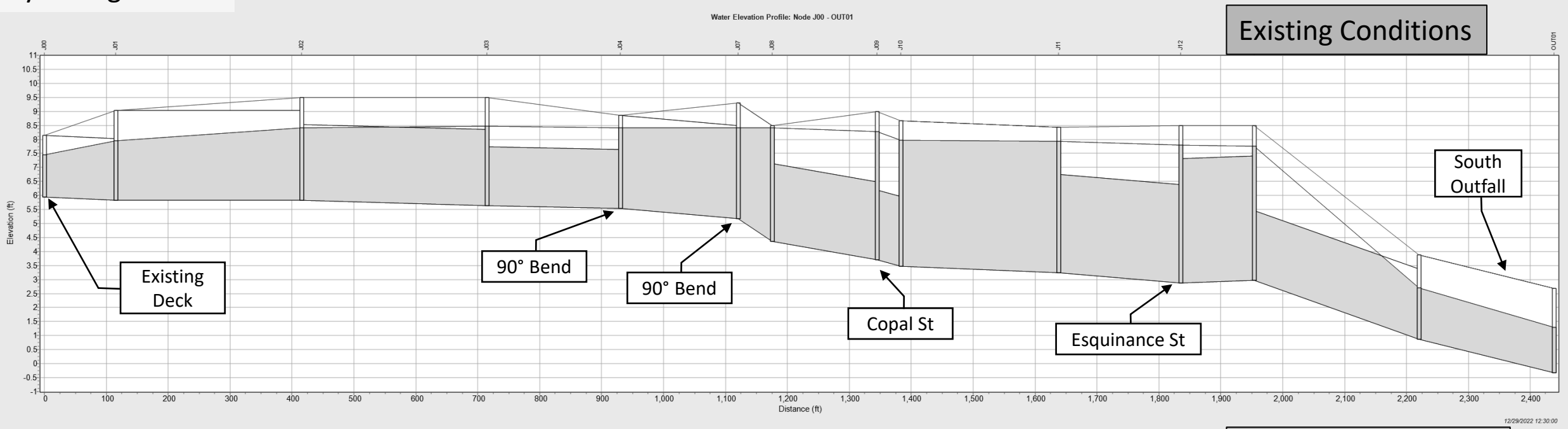


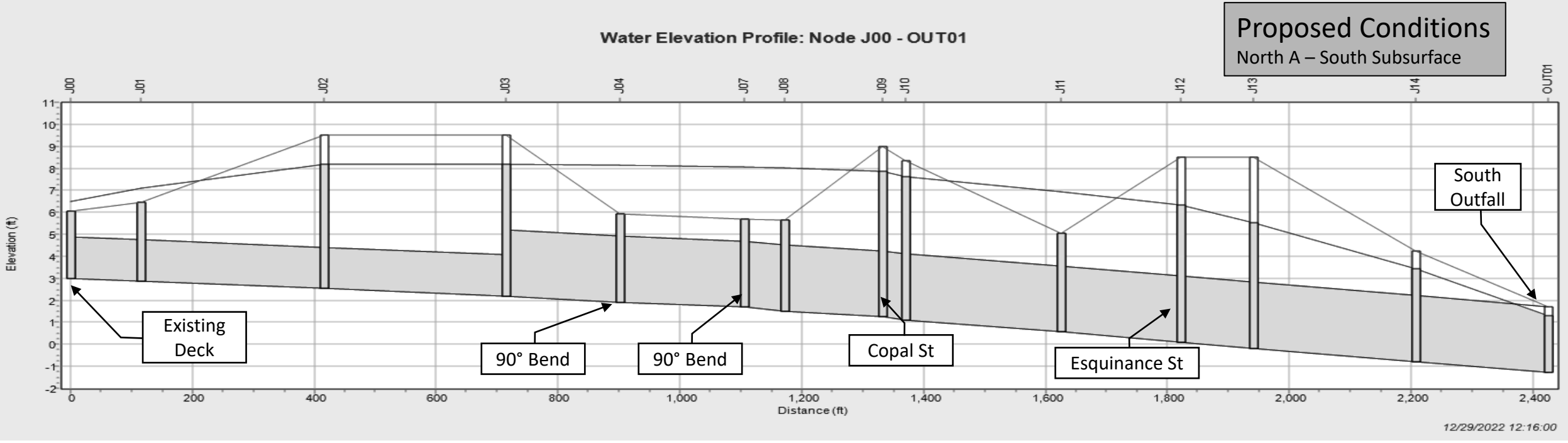
25-yr Design Storm





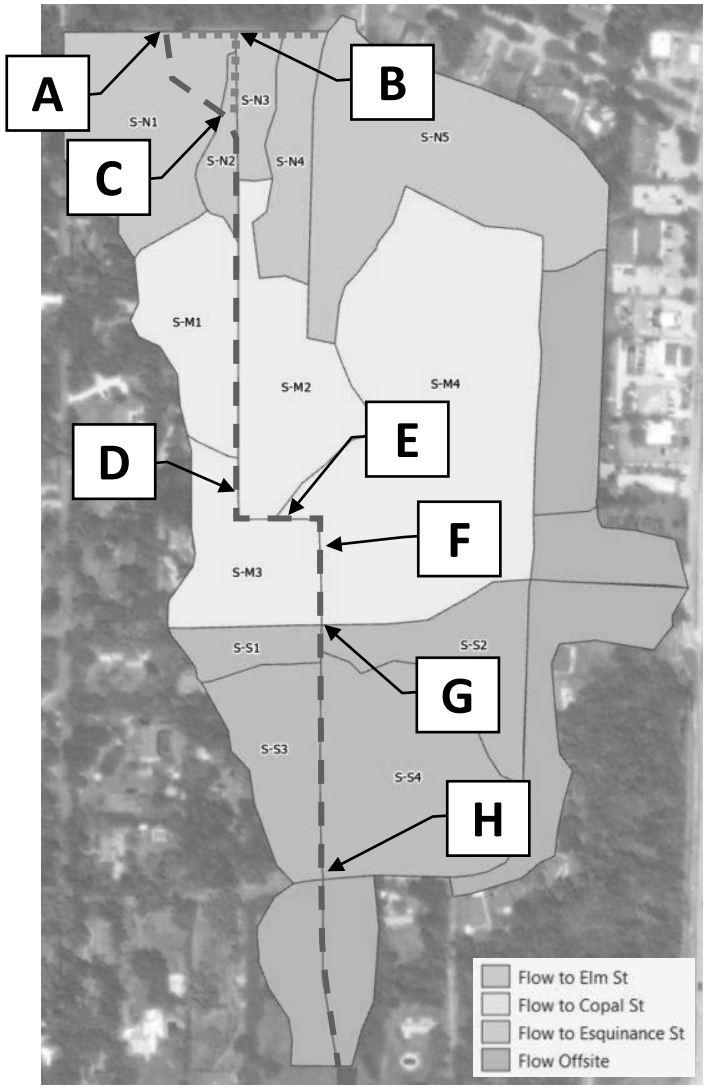
50-yr Design Storm





Model Results – Channel Locations

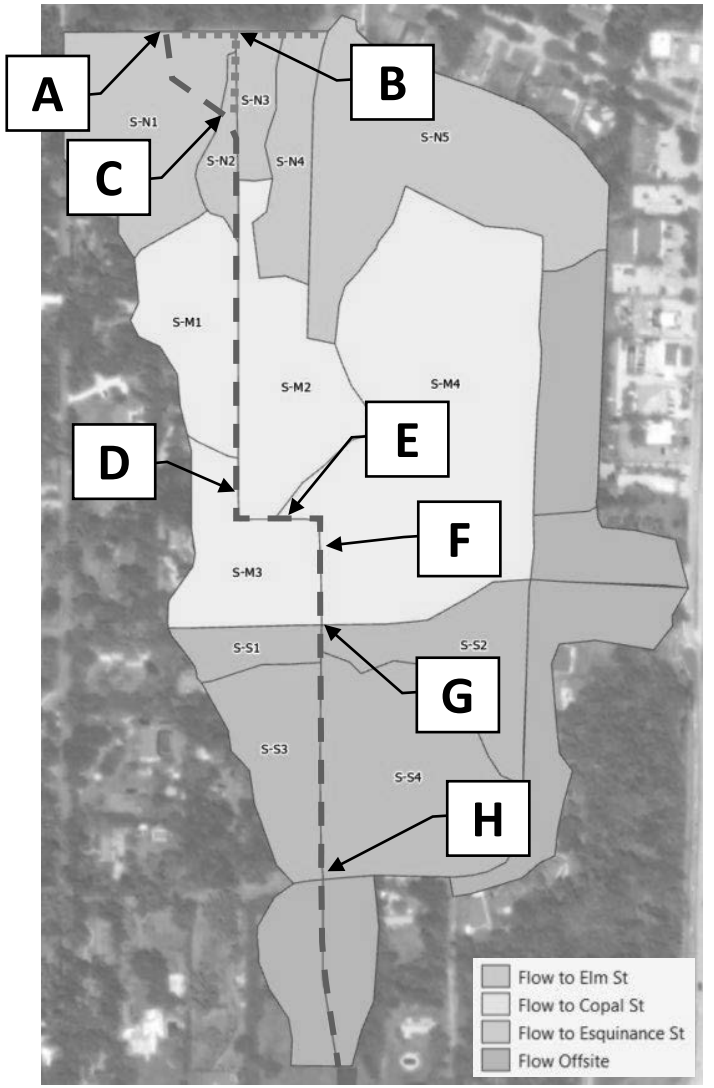
- Design storms
  - Results are provided for the 25-yr and 50-yr events
- Key locations
  - A – Northern outfall (cross drain)
  - B – Elm St driveway culvert
  - C – Culverts along channel storage
  - D – Main channel upstream of 90°
  - E – Main channel 90°
  - F – Main channel downstream of 90°
  - G – Cross drain at Copal St
  - H – Cross drain at Esquinance St



Result Extraction Locations

Model Results – Channel Locations

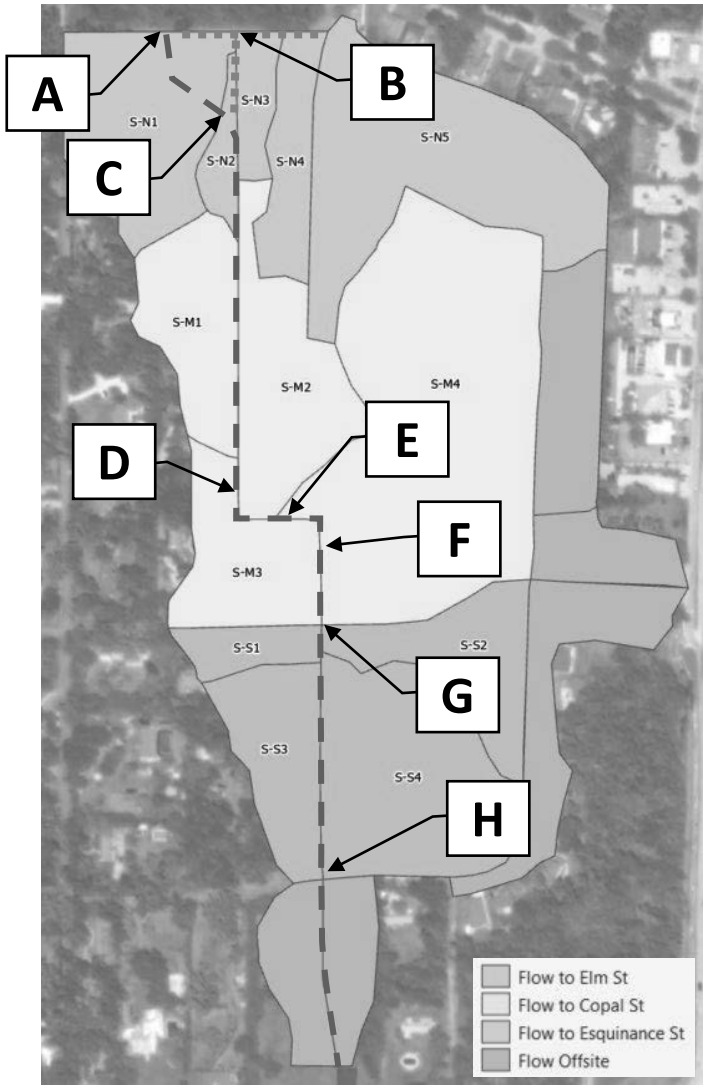
Existing Conditions								
Location ID	**Design Storm**							
	25-yr (**9.74 in**)				50-yr (**11.4 in**)			
	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE
A	44.16	NO Road C/L @ 6.75’	6.28	4.84	49.23	NO Road C/L @ 6.75’	6.66	4.92
B	19.28	NO Driveway @ 7.97’	7.28	6.35	19.72	NO Driveway @ 7.97’	7.31	6.67
C	4.86	YES Driveway @ 6.85’	7.21	6.29	4.88	YES Driveway @ 6.85’	7.27	6.66
D	8.67	No Weir	8.32	8.29	8.25	No Weir	8.47	8.42
E	5.57	No Weir	8.29	8.28	5.78	No Weir	8.42	8.41
F	8.7	No Weir	8.28	8.28	8.57	No Weir	8.41	8.41
G	22.54	YES Road C/L @ 8.01’	8.22	7.86	21.85	YES Road C/L @ 8.01’	8.31	8.11
H	41.66	NO Road C/L @ 7.98’	7.68	2.7	42.62	NO Road C/L @ 7.98’	7.9	2.72



Result Extraction Locations

Model Results – Channel Locations

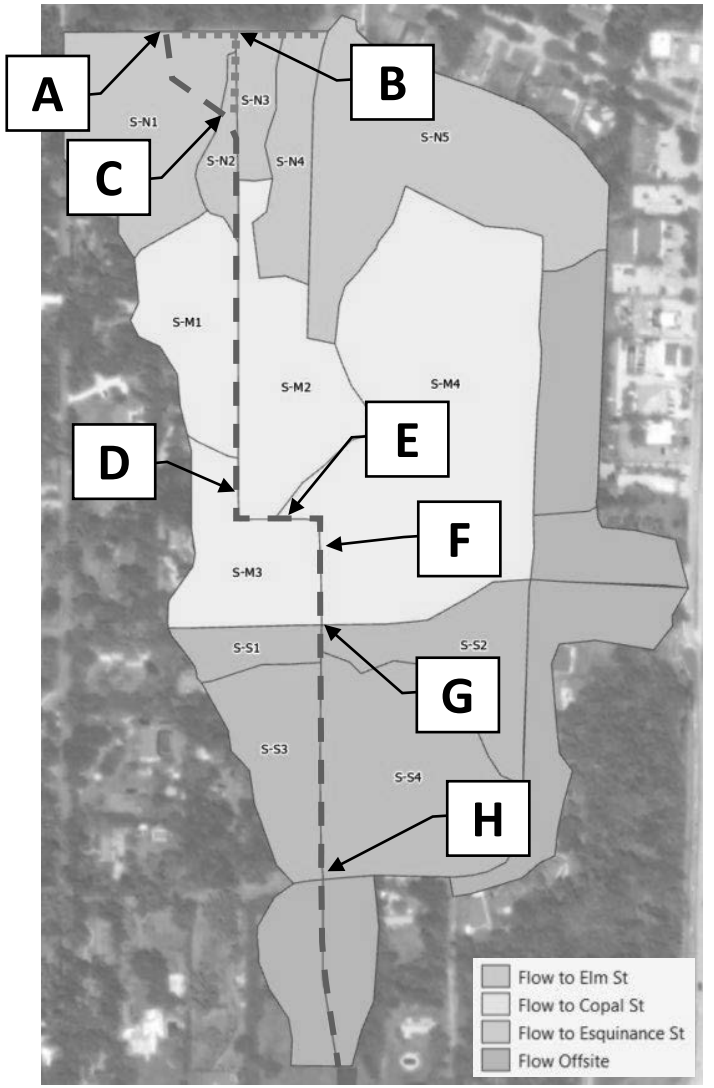
Proposed Conditions – U-channel (4 ft to 8 ft)								
Location ID	**Design Storm**							
	25-yr (**9.74 in**)				50-yr (**11.4 in**)			
	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE
A	39.56	NO Road C/L @ 6.75’	5.97	4.77	45.94	NO Road C/L @ 6.75’	6.41	4.87
B	24.62	NO Driveway @ 7.97’	7.21	6.53	25.34	NO Driveway @ 7.97’	7.24	6.56
C	15.58	NO Driveway @ 6.85’	5.99	5.97	20.1	NO Driveway @ 6.85’	6.58	6.41
D	28.56	No Weir	7.01	6.96	37.59	No Weir	7.33	7.3
E	30.36	No Weir	6.96	6.89	39.4	No Weir	7.3	7.29
F	31.71	No Weir	6.89	6.87	40.7	No Weir	7.29	7.29
G	106.87	NO Road C/L @ 8.01’	6.85	6.29	113.88	NO Road C/L @ 8.01’	7.29	6.85
H	177.84	NO Road C/L @ 7.98’	5.81	3.58	185.95	NO Road C/L @ 7.98’	6.52	4.05



Result Extraction Locations

Model Results – Channel Locations

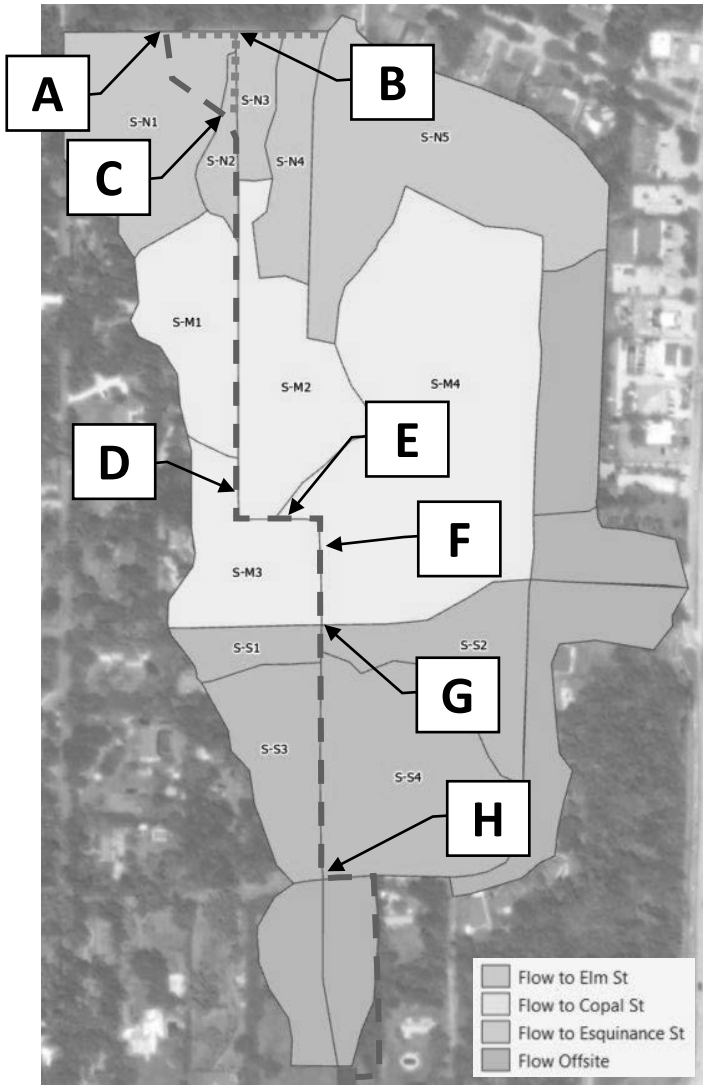
Proposed Conditions – Concrete Canvas & U-channel (8 ft)								
Location ID	**Design Storm**							
	25-yr (**9.74 in**)				50-yr (**11.4 in**)			
	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE
A	39.55	NO Road C/L @ 6.75’	5.97	4.77	46.15	NO Road C/L @ 6.75’	6.42	4.87
B	24.62	NO Driveway @ 7.97’	7.21	6.53	25.34	NO Driveway @ 7.97’	7.24	6.56
C	15.39	NO Driveway @ 6.85’	5.99	5.97	21.13	NO Driveway @ 6.85’	6.62	6.42
D	29.52	No Weir	6.94	6.87	35.54	No Weir	7.27	7.24
E	31.3	No Weir	6.87	6.8	37.49	No Weir	7.24	7.23
F	32.37	No Weir	6.8	6.77	38.71	No Weir	7.23	7.23
G	102.37	NO Road C/L @ 8.01’	6.75	6.19	111.56	NO Road C/L @ 8.01’	7.22	6.79
H	174.56	NO Road C/L @ 7.98’	5.68	3.55	185.16	NO Road C/L @ 7.98’	6.48	4.03



Result Extraction Locations

Model Results – Channel Locations

Proposed Conditions – Subsurface								
Location ID	**Design Storm**							
	25-yr (**9.74 in**)				50-yr (**11.4 in**)			
	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE	Peak Flow (cfs)	Overtopped	U/S WSE	D/S WSE
A	44.56	NO Road C/L @ 6.75’	6.20	4.85	48.43	NO Road C/L @ 6.75’	6.50	4.91
B	24.62	NO Driveway @ 7.97’	7.21	6.53	25.34	NO Driveway @ 7.97’	7.24	6.56
C	21.01	NO Driveway @ 6.85’	6.40	6.20	22.67	NO Driveway @ 6.85’	6.75	6.50
D	26.13	No Weir	7.79	7.78	29.23	No Weir	8.18	8.13
E	25.03	No Weir	7.78	7.77	30.96	No Weir	8.13	8.07
F	30.26	No Weir	7.77	7.76	32.70	No Weir	8.07	8.04
G	74.24	NO Road C/L @ 8.01’	7.71	7.39	81.47	NO Road C/L @ 8.01’	7.98	7.63
H	121.00	NO Road C/L @ 7.98’	5.23	3.26	129.34	NO Road C/L @ 7.98’	5.76	3.53



Result Extraction Locations

APPENDIX B

EXHIBITS SHOWING WSE RESULTS FROM MODEL

WATER SURFACE ELEVATION SUMMARY TABLE Existing Conditions			
	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-M4-A	7.76	8.02	7.86
S-M4-B	7.87	8.11	8.03
S-M4-C	7.88	8.12	7.85
S-M4-D	7.89	8.13	8.04
S-M4-E	8.19	8.42	8.41
S-M4-F	8.22	8.46	8.53
S-M4-G	9.22	9.29	10.21
S-M4-H	8.03	8.26	7.76
S-M4-I	8.10	8.31	8.03
S-M4-J	8.32	8.53	9.83
S-M4-K	9.00	9.47	9.80
S-M2-A	7.88	8.15	N/A
S-M2-B	8.10	8.34	8.10
S-M2-C	8.13	8.37	8.10
S-M2-D	8.12	8.36	8.52
S-M2-E	8.04	8.28	7.88
S-M2-F	8.16	8.39	8.35
S-M2-G	8.10	8.32	7.99
North-A	7.90	7.99	9.08
North-B	8.22	8.40	7.72
North-C	8.24	8.44	8.05
North-D	8.24	8.44	8.25
North-E	7.95	8.04	8.89
North-F	8.10	8.25	8.73
North-G	8.19	8.37	8.69
North-H	8.22	8.40	8.48
North-I	8.24	8.44	8.27
North-J	8.29	8.51	8.35
North-K	8.29	8.52	8.58
North-L	8.32	8.55	8.45
North-M	9.05	9.26	8.57
North-N	9.05	9.26	8.67
OFFSITE 1-A	4.47	4.50	9.11
OFFSITE 1-B	7.82	8.05	8.02
OFFSITE 1-C	9.50	9.61	10.05

WATER SURFACE ELEVATION SUMMARY TABLE Existing Conditions - Main Channel				
	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.42	5.99	6.63	6.75
2	6.83	6.98	7.21	7.97
3	7.02	7.10	7.21	6.85
4	7.88	8.15	8.48	N/A
5	7.85	8.13	8.46	N/A
6	7.84	8.12	8.45	N/A
7	7.76	8.02	8.20	8.01
8	7.11	7.36	7.74	7.98

LEGEND:

- EXISTING STORM PIPES
- EXISTING DITCH
- EXISTING CATCH BASIN
- FLOW DIRECTION
- WATER SURFACE EL. NODE [A]

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

SHEET NUMBER 01

PARISH	PARISH PROJECT	STATE PROJECT	MINDEN PROJECT
N/A	N/A	N/A	2022.0013

DESIGNED	DETAILED	REVIEWED	DATE
K. BEYER	K. BEYER		X/XX/XXXX
CHECKED	CHECKED	ITR	SERIES
–	–		OF –

STATE OF LOUISIANA
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ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

EXISTING CONDITIONS

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE
Existing Conditions - Main Channel

	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.42	5.99	6.63	6.75
2	6.83	6.98	7.21	7.97
3	7.02	7.10	7.21	6.85
4	7.88	8.15	8.48	N/A
5	7.85	8.13	8.46	N/A
6	7.84	8.12	8.45	N/A
7	7.76	8.02	8.20	8.01
8	7.11	7.36	7.74	7.98

WATER SURFACE ELEVATION SUMMARY TABLE
Existing Conditions

	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-S2-A	7.26	7.50	7.77
S-S2-B	7.29	7.54	7.97
S-S2-C	7.32	7.57	7.85
S-S2-D	7.92	8.21	8.08
S-S2-E	7.98	8.26	8.26
S-S2-F	7.31	7.55	7.75
S-S2-G	7.38	7.64	7.64
S-S4-A	7.11	7.36	7.67
S-S4-B	7.37	7.64	7.77
S-S4-C	7.40	7.67	7.78
S-S4-D	7.59	7.89	8.24
S-S4-E	7.42	7.69	7.75
S-S4-F	7.44	7.71	7.64
OFFSITE 2-A	4.35	4.38	8.40
OFFSITE 2-B	7.78	8.01	8.03
OFFSITE 2-C	8.83	9.02	8.43

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

LEGEND:
EXISTING STORM PIPES
EXISTING DITCH
EXISTING CATCH BASIN
FLOW DIRECTION
WATER SURFACE EL. NODE A

SHEET NUMBER 02

PARISH	N/A	STATE PROJECT	N/A
PARISH PROJECT	N/A	MINDEN PROJECT	2022.0013
DESIGNED	K. BEYER	REVIEWED	
CHECKED	K. BEYER	ITR	
DETAILED		DATE	X/XX/XXXX
CHECKED		SERIES	01

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ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

EXISTING CONDITIONS

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE Proposed Conditions - Main Channel Only			
	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-M4-A	4.86	5.68	7.86
S-M4-B	6.36	6.83	8.03
S-M4-C	6.58	7.05	7.85
S-M4-D	7.21	7.59	8.04
S-M4-E	7.84	8.13	8.41
S-M4-F	7.92	8.22	8.53
S-M4-G	9.22	9.29	10.21
S-M4-H	7.09	7.52	7.76
S-M4-I	7.47	7.87	8.03
S-M4-J	8.28	8.47	9.83
S-M4-K	8.97	9.44	9.80
S-M2-A	4.91	5.76	N/A
S-M2-B	7.40	7.77	8.10
S-M2-C	7.51	7.88	8.10
S-M2-D	7.57	7.82	8.52
S-M2-E	7.15	7.57	7.88
S-M2-F	7.73	7.97	8.35
S-M2-G	7.45	7.85	7.99
North-A	7.89	7.98	9.08
North-B	8.18	8.38	7.72
North-C	8.20	8.41	8.05
North-D	8.20	8.41	8.25
North-E	7.93	8.04	8.89
North-F	8.08	8.23	8.73
North-G	8.16	8.35	8.69
North-H	8.20	8.38	8.48
North-I	8.20	8.40	8.27
North-J	8.24	8.46	8.35
North-K	8.25	8.46	8.58
North-L	8.27	8.51	8.45
North-M	9.05	9.25	8.57
North-N	9.05	9.25	8.67
OFFSITE 1-A	4.40	4.45	9.11
OFFSITE 1-B	7.21	7.58	8.02
OFFSITE 1-C	9.50	9.61	10.05

WATER SURFACE ELEVATION SUMMARY TABLE Proposed Conditions - Main Channel Only				
	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.03	5.54	6.18	6.75
2	6.81	6.97	7.13	7.97
3	5.03	5.58	6.31	6.85
4	4.91	5.76	6.81	N/A
5	4.91	5.75	6.79	N/A
6	4.90	5.73	6.76	N/A
7	4.86	5.68	6.66	8.01
8	3.93	4.52	5.09	7.98

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

LEGEND:
EXISTING STORM PIPES
EXISTING DITCH
EXISTING CATCH BASIN
PROPOSED IMPROVEMENTS
WATER SURFACE EL. NODE A

SHEET NUMBER 03

PARISH	PARISH PROJECT	STATE PROJECT	MINDEN PROJECT
N/A	N/A	N/A	2022.0013

DESIGNED	DETAILED	REVIEWED	DATE
K. BEYER	K. BEYER		X/XX/XXXX
CHECKED	CHECKED	ITR	SERIES
_	_		0F _

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ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

PROPOSED CONDITIONS MAIN CHANNEL ONLY

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE
Proposed Conditions - Main Channel Only

	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.03	5.54	6.18	6.75
2	6.81	6.97	7.13	7.97
3	5.03	5.58	6.31	6.85
4	4.91	5.76	6.81	N/A
5	4.91	5.75	6.79	N/A
6	4.90	5.73	6.76	N/A
7	4.86	5.68	6.66	8.01
8	3.93	4.52	5.09	7.98

WATER SURFACE ELEVATION SUMMARY TABLE
Proposed Conditions - Main Channel Only

	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-S2-A	4.60	5.34	7.77
S-S2-B	5.31	5.45	7.97
S-S2-C	5.68	5.74	7.85
S-S2-D	7.59	7.93	8.08
S-S2-E	7.93	8.18	8.26
S-S2-F	7.11	7.16	7.75
S-S2-G	7.15	7.21	7.64
S-S4-A	3.93	4.52	7.67
S-S4-B	6.25	6.56	7.77
S-S4-C	6.32	6.69	7.78
S-S4-D	7.45	7.65	8.24
S-S4-E	6.59	6.84	7.75
S-S4-F	6.73	6.96	7.64
OFFSITE 2-A	4.30	4.35	8.40
OFFSITE 2-B	7.20	7.57	8.03
OFFSITE 2-C	8.78	8.99	8.43

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

LEGEND:
EXISTING STORM PIPES
EXISTING DITCH
EXISTING CATCH BASIN
PROPOSED IMPROVEMENTS
WATER SURFACE EL. NODE A

SHEET NUMBER 04

PARISH	N/A	STATE PROJECT	N/A
PARISH PROJECT	N/A	FEDERAL PROJECT	2022.0013
DESIGNED	K. BEYER	REVIEWED	
CHECKED	_	ITR	
DETAILED	K. BEYER	DATE	X/XX/XXXX
CHECKED	_	SERIES	01

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ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

PROPOSED CONDITIONS MAIN CHANNEL ONLY

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE Proposed Conditions - Scenario A			
	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-M4-A	4.84	5.70	7.86
S-M4-B	6.33	6.82	8.03
S-M4-C	6.55	7.03	7.85
S-M4-D	7.28	7.67	8.04
S-M4-E	7.87	8.16	8.41
S-M4-F	7.94	8.24	8.53
S-M4-G	9.22	9.29	10.21
S-M4-H	7.11	7.53	7.76
S-M4-I	7.49	7.88	8.03
S-M4-J	8.29	8.47	9.83
S-M4-K	8.97	9.44	9.80
S-M2-A	4.92	5.79	N/A
S-M2-B	7.43	7.79	8.10
S-M2-C	7.54	7.91	8.10
S-M2-D	7.57	7.84	8.52
S-M2-E	7.17	7.58	7.88
S-M2-F	7.75	8.00	8.35
S-M2-G	7.48	7.86	7.99
North-A	7.89	7.98	9.08
North-B	8.18	8.38	7.72
North-C	8.20	8.41	8.05
North-D	8.27	8.41	8.25
North-E	7.93	8.04	8.89
North-F	8.08	8.23	8.73
North-G	8.16	8.35	8.69
North-H	8.21	8.38	8.48
North-I	8.20	8.41	8.27
North-J	8.25	8.46	8.35
North-K	8.25	8.46	8.58
North-L	8.27	8.51	8.45
North-M	9.05	9.25	8.57
North-N	9.05	9.25	8.67
OFFSITE 1-A	4.31	4.38	9.11
OFFSITE 1-B	7.28	7.67	8.02
OFFSITE 1-C	9.50	9.61	10.05

WATER SURFACE ELEVATION SUMMARY TABLE Scenario A - Main Channel				
	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.03	5.54	6.19	6.75
2	6.81	6.97	7.13	7.97
3	5.02	5.58	6.33	6.85
4	4.90	5.78	6.84	N/A
5	4.90	5.77	6.82	N/A
6	4.88	5.75	6.79	N/A
7	4.84	5.70	6.70	8.01
8	3.90	4.53	5.14	7.98

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

LEGEND:
- EXISTING STORM PIPES
- EXISTING DITCH
- EXISTING CATCH BASIN
- PROPOSED IMPROVEMENTS
- WATER SURFACE EL. NODE [A]

SHEET NUMBER 05

PARISH	PARISH PROJECT	STATE PROJECT	MUNICIPAL PROJECT
N/A	N/A	N/A	2022.0013

DESIGNED	DETAILED	REVIEWED	DATE
K. BEYER	K. BEYER		X/XX/XXXX
CHECKED	CHECKED	ITR	SERIES
_	_		0F_

STATE OF LOUISIANA
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION, BIDDING, RECORDATION, CONVEYANCES OR AS THE BASIS FOR THE ISSUANCE OF A PERMIT.
ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

INTERIOR IMPROVEMENTS – SCENARIO A

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE
Scenario A - Main Channel

	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.03	5.54	6.19	6.75
2	6.81	6.97	7.13	7.97
3	5.02	5.58	6.33	6.85
4	4.90	5.78	6.84	N/A
5	4.90	5.77	6.82	N/A
6	4.88	5.75	6.79	N/A
7	4.84	5.70	6.70	8.01
8	3.90	4.53	5.14	7.98

WATER SURFACE ELEVATION SUMMARY TABLE
Proposed Conditions - Scenario A

	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-S2-A	4.58	5.36	7.77
S-S2-B	4.60	5.40	7.97
S-S2-C	5.87	5.93	7.85
S-S2-D	7.89	8.16	8.08
S-S2-E	7.94	8.20	8.26
S-S2-F	7.11	7.17	7.75
S-S2-G	7.15	7.21	7.64
S-S4-A	3.90	4.53	7.67
S-S4-B	3.98	4.69	7.77
S-S4-C	5.70	5.80	7.78
S-S4-D	7.49	7.73	8.24
S-S4-E	6.59	6.70	7.75
S-S4-F	6.73	6.85	7.64
OFFSITE 2-A	3.90	3.93	8.40
OFFSITE 2-B	7.27	7.65	8.03
OFFSITE 2-C	8.78	8.99	8.43

PLAN
SCALE IN FEET
60' 30' 0' 60' 120' 180'

LEGEND:
EXISTING STORM PIPES
EXISTING DITCH
EXISTING CATCH BASIN
PROPOSED IMPROVEMENTS
WATER SURFACE EL. NODE [A]

SHEET NUMBER 06

PARISH	N/A
PARISH PROJECT	N/A
STATE PROJECT	N/A
MINNDEN PROJECT	2022.0013
DESIGNED	K. BEYER
CHECKED	K. BEYER
DETAILED	
CHECKED	
REVIEWED	
ITR	
DATE	X/XX/XXXX
SERIES	07

STATE OF LOUISIANA
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION, BIDDING, RECORDATION, CONVEYANCE, SALES OR AS THE BASIS FOR THE ISSUANCE OF A PERMIT.
ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

INTERIOR IMPROVEMENTS – SCENARIO A

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE Proposed Conditions - Scenario B			
	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-M4-A	5.05	5.96	7.86
S-M4-B	5.48	6.13	8.03
S-M4-C	5.78	6.65	7.85
S-M4-D	6.99	7.40	8.04
S-M4-E	7.73	8.06	8.41
S-M4-F	7.83	8.16	8.53
S-M4-G	9.22	9.29	10.21
S-M4-H	5.88	6.21	7.76
S-M4-I	7.12	7.39	8.03
S-M4-J	8.28	8.45	9.83
S-M4-K	8.97	9.43	9.80
S-M2-A	5.15	6.06	N/A
S-M2-B	5.26	6.37	8.10
S-M2-C	6.61	6.74	8.10
S-M2-D	7.57	7.57	8.52
S-M2-E	6.29	6.31	7.88
S-M2-F	7.40	7.45	8.35
S-M2-G	6.98	7.20	7.99
North-A	7.89	7.98	9.08
North-B	8.17	8.37	7.72
North-C	8.19	8.39	8.05
North-D	8.19	8.39	8.25
North-E	7.93	8.03	8.89
North-F	8.08	8.23	8.73
North-G	8.15	8.34	8.69
North-H	8.17	8.37	8.48
North-I	8.19	8.39	8.27
North-J	8.22	8.44	8.35
North-K	8.22	8.44	8.58
North-L	8.26	8.50	8.45
North-M	9.04	9.25	8.57
North-N	9.04	9.25	8.67
OFFSITE 1-A	4.26	4.34	9.11
OFFSITE 1-B	7.00	7.41	8.02
OFFSITE 1-C	9.50	9.61	10.05

WATER SURFACE ELEVATION SUMMARY TABLE Scenario B - Main Channel				
	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.09	5.60	6.26	6.75
2	6.81	6.96	7.13	7.97
3	5.09	5.66	6.44	6.85
4	5.12	6.06	7.20	N/A
5	5.11	6.04	7.17	N/A
6	5.09	6.02	7.14	N/A
7	5.05	5.96	7.03	8.01
8	4.05	4.64	5.27	7.98

SHEET NUMBER 07

PARISH	PARISH PROJECT	STATE PROJECT	MINDEN PROJECT
N/A	N/A	N/A	2022.0013

DESIGNED	DETAILED	REVIEWED	DATE
K. BEYER	K. BEYER	ITR	X/XX/XXXX
CHECKED	CHECKED		SERIES
–	–		OF –

STATE OF LOUISIANA
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION, BIDDING, RECORDATION, CONVEYANCES OR AS THE BASIS FOR THE ISSUANCE OF A PERMIT.
ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

INTERIOR IMPROVEMENTS – SCENARIO B

Intracoastal Consultants

WATER SURFACE ELEVATION SUMMARY TABLE
Scenario B - Main Channel

	10 YEAR	25 YEAR	100 YEAR	
NODE ID	Max HGL	Max HGL	Max HGL	Street EL
1	5.09	5.60	6.26	6.75
2	6.81	6.96	7.13	7.97
3	5.09	5.66	6.44	6.85
4	5.12	6.06	7.20	N/A
5	5.11	6.04	7.17	N/A
6	5.09	6.02	7.14	N/A
7	5.05	5.96	7.03	8.01
8	4.05	4.64	5.27	7.98

WATER SURFACE ELEVATION SUMMARY TABLE
Proposed Conditions - Scenario B

	10 YEAR	25 YEAR	
NODE ID	Max HGL	Max HGL	Street EL
S-S2-A	4.76	5.56	7.77
S-S2-B	4.78	5.85	7.97
S-S2-C	5.87	5.95	7.85
S-S2-D	7.89	8.16	8.08
S-S2-E	7.94	8.20	8.26
S-S2-F	7.11	7.17	7.75
S-S2-G	7.15	7.21	7.64
S-S4-A	4.05	4.64	7.67
S-S4-B	4.13	4.77	7.77
S-S4-C	5.70	5.80	7.78
S-S4-D	7.49	7.73	8.24
S-S4-E	6.59	6.70	7.75
S-S4-F	6.73	6.85	7.64
OFFSITE 2-A	3.89	3.91	8.40
OFFSITE 2-B	7.00	7.40	8.03
OFFSITE 2-C	8.76	8.98	8.43

SHEET NUMBER 08

PARISH: N/A	PARISH PROJECT: N/A	STATE PROJECT: N/A	HIMGDEN PROJECT: 2022.0013
DESIGNED: K. BEYER	DETAILED: K. BEYER	REVIEWED:	DATE: X/XX/XXXX
CHECKED: _	CHECKED: _	ITR:	SERIES: OF _

STATE OF LOUISIANA
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION, BIDDING, RECORDATION, CONVEYANCE, SALES OR AS THE BASIS FOR THE ISSUANCE OF A PERMIT.
ENGINEER:
KEVIN S. BEYER, P.E.
LICENSE NUMBER: 37112

NO.	DATE	REVISION DESCRIPTION	BY

OLD GOLDEN SHORES DRAINAGE IMPROVEMENTS
PHASE II – INTERIOR DRAINAGE IMPROVEMENTS
FOR
HIGH TIDE CONSULTANTS & CITY OF MANDEVILLE
ST. TAMMANY PARISH, LOUISIANA

INTERIOR IMPROVEMENTS – SCENARIO B

Intracoastal Consultants

APPENDIX C

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Engineer's Opinion of Probable Construction Cost 8.28.23
City of Mandeville
Old Golden Shores Drainage Improvements
Phases 1-3

Opinion of Probable Cost					
ITEM		**ESTIMATED QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
PHASE 1					
MOBILIZATION		1	EA	$25,000.00	$25,000.00
REMOVAL OF CONCRETE ROADWAY		425	SY	$18.00	$7,650.00
TREE REMOVAL		10	EA	$2,500.00	$25,000.00
EXPLORATORY EXCAVATION		2	LS	$6,000.00	$12,000.00
STRUCTURAL EXCAVATION		385	CY	$25.00	$9,625.00
EROSION CONTROL SYSTEMS		1	LS	$30,000.00	$30,000.00
CLASS II BASE COURSE		100	CY	$75.00	$7,500.00
TRAFFIC MAINTENANCE ASPHALT		75	SY	$75.00	$5,625.00
CB-01		1	EA	$5,500.00	$5,500.00
BOX INLET		2	EA	$4,000.00	$8,000.00
CONFLICT BOX (LARGER THAN 24" PIPE)		1	EA	$8,500.00	$8,500.00
CONCRETE PAVEMENT (8" THICK)		425	SY	$125.00	$53,125.00
MAINTENANCE OF TRAFFIC		1	LS	$5,000.00	$5,000.00
SAWCUTTING		300	INFT	$4.00	$1,200.00
FLOWABLE FILL		250	CY	$300.00	$75,000.00
24" CMP		60	LF	$150.00	$9,000.00
36" RCPA		180	LF	$335.00	$60,300.00
3'X6' BOX		495	LF	$600.00	$297,000.00
3'X8' BOX		0	LF	$650.00	$0.00
JUNCTION BOX/BEND		1	EA	$10,000.00	$10,000.00
BEDDING MATERIAL		150	CY	$130.00	$19,500.00
RIP RAP/STONE REVETMENT		125	SY	$125.00	$15,625.00
SODDING		2,000	SY	$7.50	$15,000.00
UTILITY COORDINATION/RELOCATION		1	LS	$20,000.00	$20,000.00
BULKHEAD PENETRATION		1	LS	$50,000.00	$50,000.00
				Subtotal	**$775,150.00**
				20% Contingency	**$155,030.00**
				PHASE 1 SUB TOTAL	**$930,180.00**

Opinion of Probable Cost					
ITEM		**ESTIMATED QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
PHASE 2					
MOBILIZATION		1	EA	$30,000.00	$30,000.00
REMOVAL OF CONCRETE ROADWAY		175	SY	$18.00	$3,150.00
TREE REMOVAL		20	EA	$2,500.00	$50,000.00
EXPLORATORY EXCAVATION		2	LS	$6,000.00	$12,000.00
STRUCTURAL EXCAVATION		600	CY	$25.00	$15,000.00
EROSION CONTROL SYSTEMS		1	LS	$20,000.00	$20,000.00
CLASS II BASE COURSE		55	CY	$75.00	$4,125.00
TRAFFIC MAINTENANCE ASPHALT		160	SY	$75.00	$12,000.00
CB-01		3	EA	$5,500.00	$16,500.00
CB-02		3	EA	$6,500.00	$19,500.00
BOX INLET		5	EA	$4,000.00	$20,000.00
CONFLICT BOX (LARGER THAN 24" PIPE)		2	EA	$8,500.00	$17,000.00
CONCRETE PAVEMENT (8" THICK)		175	SY	$125.00	$21,875.00
MAINTENANCE OF TRAFFIC		1	LS	$5,000.00	$5,000.00
SAWCUTTING		800	INFT	$2.00	$1,600.00
FLOWABLE FILL		50	CY	$300.00	$15,000.00
30" RCPA		0	LF	$275.00	$0.00
36" RCPA		153	LF	$335.00	$51,255.00
3'X6' BOX		615	LF	$600.00	$369,000.00
BEDDING MATERIAL		235	CY	$130.00	$30,550.00
RIP RAP/STONE REVETMENT		100	SY	$125.00	$12,500.00
SODDING		3,000	SY	$7.50	$22,500.00
UTILITY COORDINATION/RELOCATION		1	LS	$30,000.00	$30,000.00
REMOVE & REPLACE RESIDENTIAL FENCING		400	LF	$75.00	$30,000.00
				Subtotal	**$808,555.00**
				20% Contingency	**$161,711.00**
				PHASE 2 SUB TOTAL	**$970,266.00**

Opinion of Probable Cost					
ITEM		**ESTIMATED QUANTITY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
PHASE 3					
MOBILIZATION		1	EA	$30,000.00	$30,000.00
TREE REMOVAL		25	EA	$2,500.00	$62,500.00
EROSION CONTROL SYSTEMS		1	LS	$30,000.00	$30,000.00
CB-01		8	EA	$5,500.00	$44,000.00
BOX INLET		6	EA	$4,000.00	$24,000.00
CONFLICT BOX (LARGER THAN 24" PIPE)		2	EA	$8,500.00	$17,000.00
MAINTENANCE OF TRAFFIC		1	LS	$5,000.00	$5,000.00
30" RCPA		945	LF	$295.00	$278,775.00
42" RCPA		160	LF	$325.00	$52,000.00
3'X6' CONCRETE BOX CULVERT		585	LF	$600.00	$351,000.00
BEDDING MATERIAL		285	CY	$125.00	$35,625.00
SODDING		4,300	SY	$7.50	$32,250.00
UTILITY COORDINATION/RELOCATION		1	LS	$20,000.00	$20,000.00
REMOVE & REPLACE RESIDENTIAL FENCING		1200	LF	$75.00	$90,000.00
				Subtotal	**$1,072,150.00**
				20% Contingency	**$214,430.00**
				PHASE 3 SUB TOTAL	**$1,286,580.00**

Total Estimated Construction Costs **$3,187,026.00**

APPENDIX D

EXHIBIT SHOWING PROPOSED PHASED IMPROVEMENTS

8.28.2023

Not For Construction

PLAN

SCALE IN FEET

100 50 0 100 200 300

LA One Call 811

LA One Call CALL 811 BEFORE YOU DIG 800-272-3020

REVISION	BY

HIGH TIDE CONSULTANTS LLC
434 N. COLUMBIA ST, SUITE 200A
COVINGTON, LA 70433
www.hightidela.com

SIGNATURE:

DATE:

STAMP

OLD GORDEN SHORES DRAINAGE

DRAWN KRG
CHECKED RCG
ISSUED DATE 12/XX/22
ISSUED FOR REVIEW
PROJECT NO. 22-290
FILE 22-290 Pipe Exhibit
SHEET PLAN