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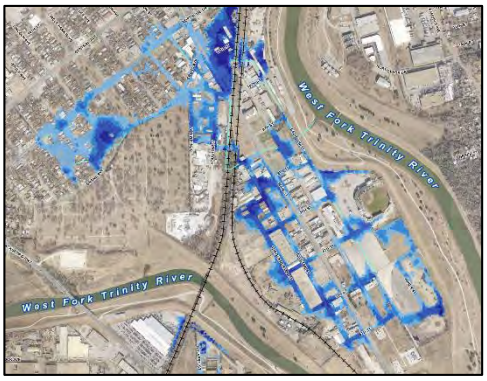

Trinity River Vision Storm Drain Master Plan
Volume I: Existing Conditions

Prepared for:

City of Fort Worth

October 2014

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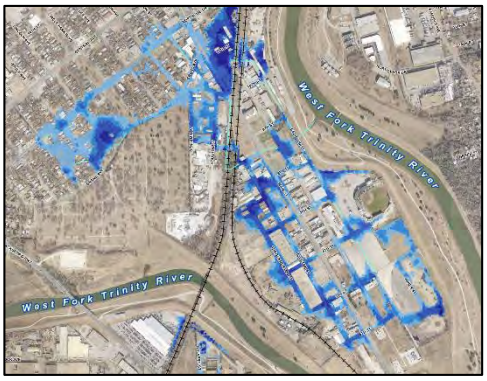

Trinity River Vision Storm Drain Master Plan
Volume I: Existing Conditions

Prepared for:

City of Fort Worth

October 2014

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SCOTT K. HUBLEY
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1.0 INTRODUCTION

1.1 AUTHORIZATION AND PURPOSE

Freese and Nichols, Inc. (FNI) was authorized to perform this project under an agreement with the TranSystems Corporation (TSC). The terms are specified in the *Subcontract Agreement Between TranSystems Corporation and Consultant for Professional Services* between FNI and TranSystems dated 2008. This project is in support of TSC's Trinity River Vision utility relocations contract with the City of Fort Worth.

The purpose of this report is to document the hydrologic and hydraulic (H&H) study that was performed for the Trinity River Vision (TRV) project. This volume of the report investigates the current conditions of the drainage in the project vicinity. Volumes II and III of this study will investigate the effects of the bridges and bypass channel construction as well as the future planned development on the drainage in the area and identify the necessary capital improvements.

All work was coordinated with the Trinity River Vision Authority (TRVA), the City of Fort Worth, the U.S. Army Corps of Engineers (USACE), and their consultants. For the purposes of drainage coordination, these entities are referred to as the TRV project partners within this report.

1.2 BACKGROUND

The TRV study area is located at the confluence of the Clear Fork and West Fork of the Trinity River in the heart of Fort Worth in Tarrant County, Texas. This area is bounded generally by the Fort Worth Stockyards to the north, University Drive to the west, I-30 to the south, and I-35 to the east. A vicinity map for the study area is shown in Figure 1. An overall project layout map is shown in Figure 2. The purpose of the TRV project is summarized on the TRVA website as follows:

> *The public improvements of this project - sometimes referred to as the "Central City Project" - include flood protection and related infrastructure. The U.S. Army Corps of Engineers has identified this area as "at risk" due to an aging levee system that was designed for a population of the 1960s. Technology has changed substantially since the levees were erected in the 1940s and a bypass channel is now the preferred method of urban flood control.*
>
> *The flood control project is the catalyst for Panther Island. Because of it, an exciting new addition to the waterfront will be a mile-and-a-half-long bypass channel running parallel to the Fort Worth & Western Railroad tracks and connecting the river west of North Main to south of White*

Settlement. This new bypass channel will allow the inadequate levees to come down, providing modern, efficient flood protection for the area, and making the river accessible for recreation. Numerous trails and open spaces will accompany the channel. Dam and isolation gates will allow the existing river to function as a calm, constant-level body of water that can be enjoyed year-round. The other tremendous addition is a small urban lake at the confluence of the Clear and West forks that will support a variety of boating and water activities.

Improved roads and bridges will provide access to the area; upgraded utilities will improve the existing infrastructure; and ecosystem enhancement will restore balance after decades of industrial use.

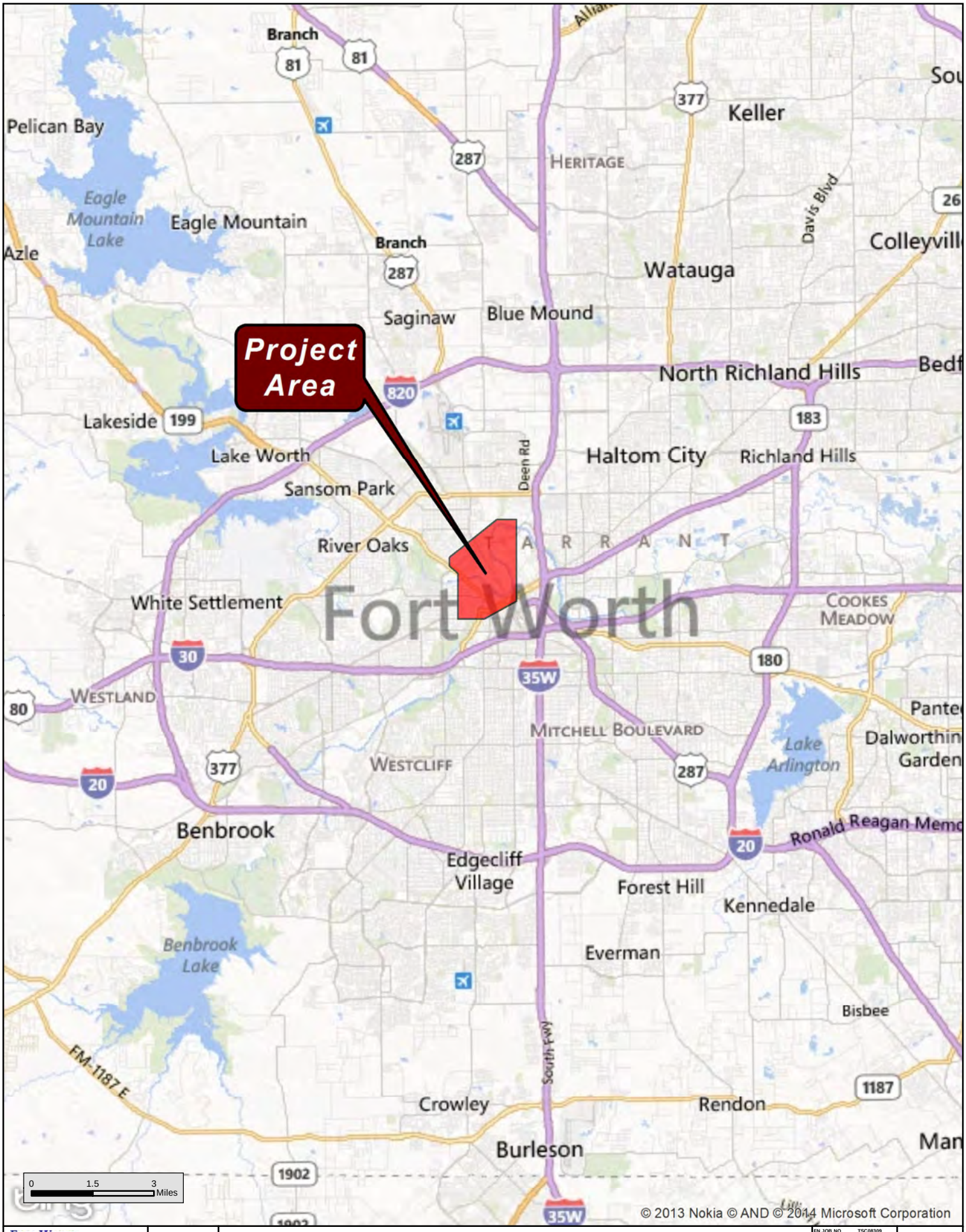
This area was previously studied by Woolpert and CDM as part of the TRV preliminary planning efforts and environmental impact statement. Their findings are summarized in a report titled *Drainage Study, Fort Worth Central City Project* dated December, 2005 (hereafter referred to as the Woolpert report). In general the findings presented in this report are consistent with and more detailed than those presented in the Woolpert report.

1.3 LIMITS OF STUDY

Four major storm drain systems were identified for study during this phase: the Greenleaf system, the Henderson system, the Bazaar system, and the North Main Street system. The North Main Street system can be further divided into the Grand Avenue system, the South Calhoun system, the North Calhoun system, and the Cemetery system. Stormwater management issues outside the drainage boundaries of these four major systems were not considered during this phase of study.

1.4 METHODOLOGY OVERVIEW

Hydrologic and hydraulic modeling was performed using the InfoWorks SD version 14.0 software, produced by Innovyze. The City of Fort Worth has adopted InfoWorks SD as the standard modeling software for storm drain watershed studies conducted on their behalf. InfoWorks SD is a fully dynamic simulation engine integrated with a two-dimensional (2D) engine to accurately model overland flow patterns concurrent with closed pipe hydraulics. Hydrologic computations were also performed within InfoWorks SD. The hydrologic and hydraulic modeling procedures are discussed in greater detail in the following sections.



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Trinity River Vision
Vicinity Map

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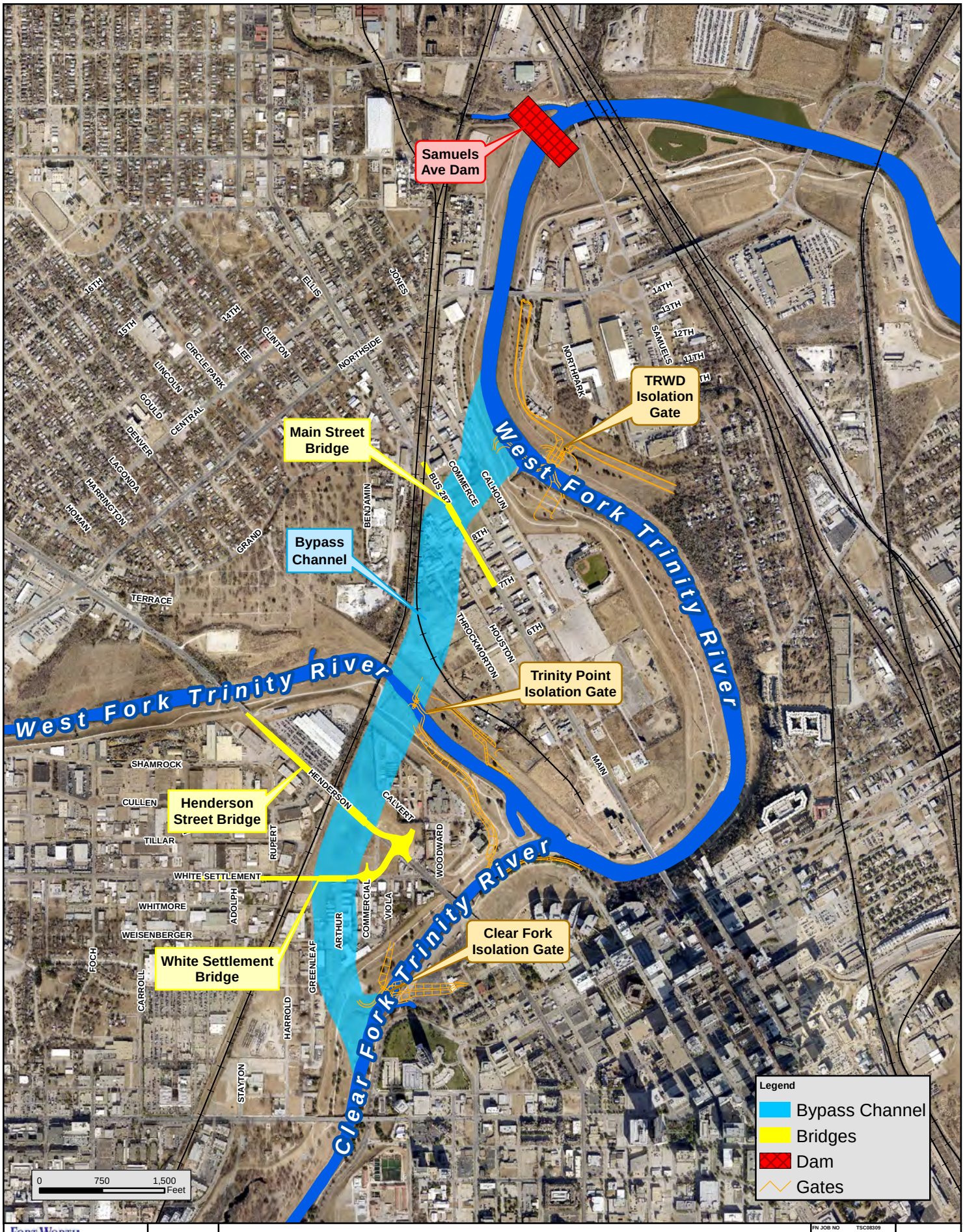
Figure 1



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Trinity River Vision
Project Overview Map

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Figure 2

2.0 CURRENT CONDITIONS

Extensive data collection was performed to catalogue the existing storm drain systems in the project area. Detailed hydrologic and hydraulic models were developed to analyze the existing conditions of the drainage system. The hydrologic and hydraulic modeling process is discussed in detail below.

2.1 DATA SOURCES

Multiple data sources were used to compile an accurate model of the existing storm drain systems. Each element within the InfoWorks SD model was flagged by data source to help track the model building process while also indicating a level of confidence for each element.

2.1.1 Field Survey

Extensive field survey of the existing storm drain systems within the project area, including Level A subsurface utility engineering (SUE) in some locations, was performed by Gorrondona and Associates, Inc. (GAI). GAI provided horizontal and vertical location data for all storm drain manholes and outfalls, flowlines and opening lengths for all inlets, size and type of all storm drain lines, and sketches and electronic photographs at the surface along the corridor of each system. The original submittal of this data was provided to FNI on July 30, 2008. Subsequent submittals by GAI were received on September 17, October 2, and October 30, 2008.

2.1.2 Record Drawings and Construction Plans

Historical construction plans for the project area were retrieved from the City of Fort Worth Engineering Vault. The available plan sets range in date from 1920 to 1957 and are summarized in Table 1 on the next page. The data contained in the construction plans (line sizes, alignments, elevations, etc.) was found to be in good agreement with the data collected during the field survey process. This correlation proved useful for including data from construction plans in areas of the storm drain system that were inaccessible. Note that several of the historical construction plans indicate the use of arch pipes which were field verified by the survey crew. The City provided FNI with a full set of arch pipe details and standards which were used to accurately input the correct shapes into the hydraulic model.

In addition, the Tarrant Regional Water District (TRWD) Operation and Maintenance (O&M) Manual for the Fort Worth Floodway project included sketches of each outfall drainage structure that were also used for reference.

Table 1 – Inventory of Construction Plans

File Number	Plan Title	Date
G-30	N. Commerce St Storm Sewer	1920
S-0608	Grand Avenue Storm Sewer	1926
S-1213	North Main Drainage System	1940
S-1214	North Main Drainage System	1940
S-2205	White Settlement Drainage System	1941
S-611	Extension to Greenleaf Storm Sewer	1949
G-109	Valley View Storm Sewer	1951
S-312	Dakota St Lateral	1951
S-1310	Nebraska St Lateral	1951
K-6	Twelfth Street	1957

2.1.3 USACE Project Survey Data

Project specific survey data was provided to all TRV project partners for use in conjunction with the TRV project. This dataset included high-resolution aerial images, 1-foot aerial topography, and utility research data.

2.1.4 Woolpert Datasets

Woolpert included a CD containing XPSWMM models and GIS datasets with their report submittal. These datasets were used for comparison purposes upon completion of data population.

2.2 HYDROLOGY

2.2.1 Synthetic Design Storms

Precipitation depths were defined according to the *City of Fort Worth iSWM Criteria Manual for Site Development and Construction* dated August 1, 2012. Because InfoWorks SD does not have a synthetic rainfall generator for balanced frequency storms, the hyetographs were calculated within HEC-HMS and imported to InfoWorks SD. The 24-hour synthetic design storms were calculated for the 2-, 5-, 10-, 25-, 50-, and 100-year events (with 50-, 20-, 10-, 4-, 2-, and 1-percent annual exceedance probabilities, respectively).

2.2.2 Drainage Area Delineation

Drainage areas were delineated to each inlet based on the 1-foot topography data provided by USACE. A total of 269 subcatchments were delineated. The total drainage areas for each major drainage system are summarized in Table 2 and shown in Figure 3. The detailed drainage areas for each inlet are shown in Exhibit 1. The Greenleaf and Henderson systems outfall into the Clear Fork of the Trinity River immediately upstream of the confluence with the West Fork. The Bazaar/16W system outfalls into the West Fork of the Trinity River immediately upstream of the confluence with the Clear Fork. The North Main Street system outfalls into the West Fork of the Trinity River immediately downstream of the TRWD channel dam across from the TRWD offices.

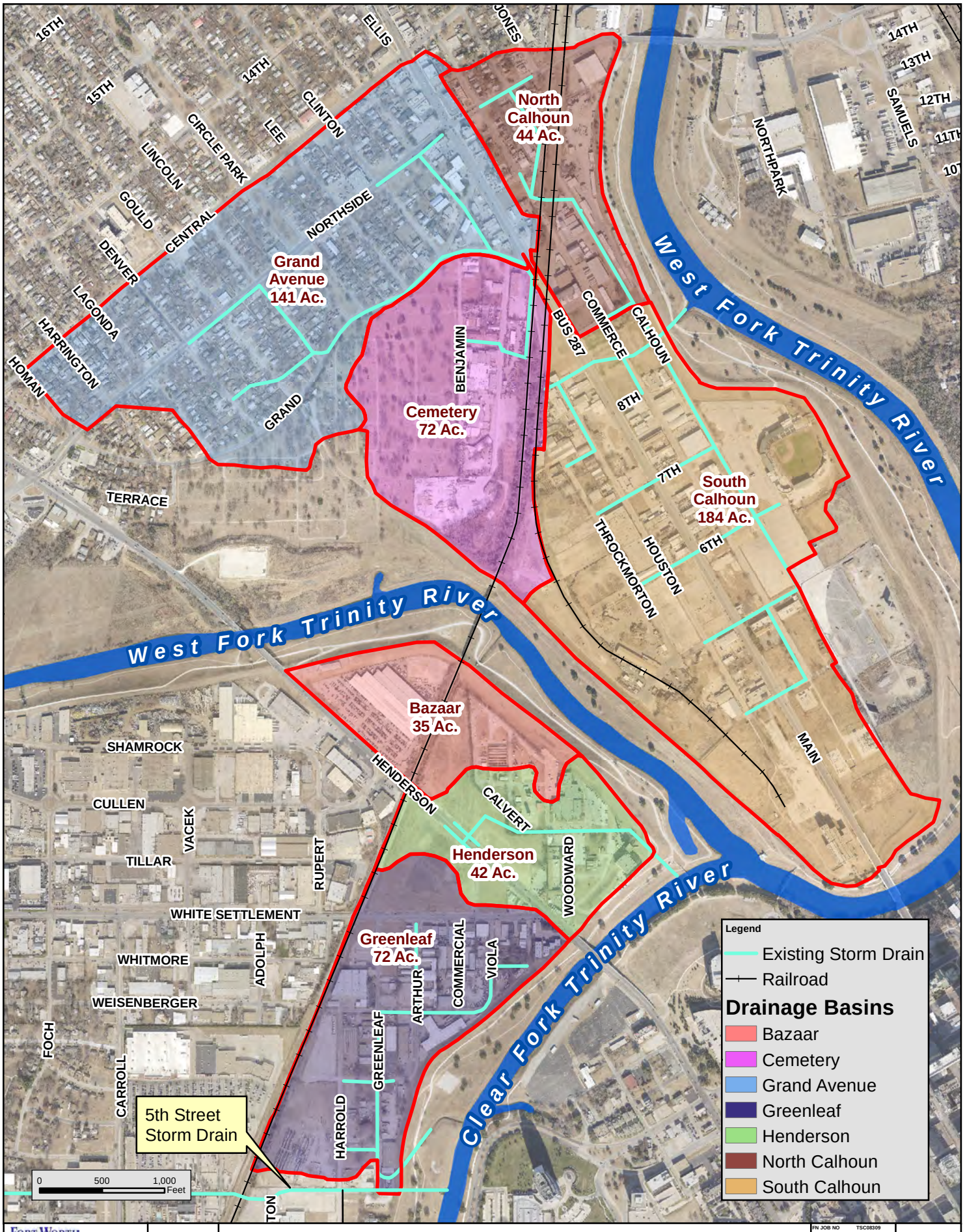
Table 2 – Major Drainage Systems

System	TRWD Outfall No.	Drainage Area (Ac)
Greenleaf	**24c**	**72**
Henderson	**25c**	**42**
Bazaar	**16w**	**35**
Main Street	**26w**	**441**
South Calhoun	26w	184
North Calhoun	26w	44
Grand Ave	26w	141
Cemetery	26w	72

2.2.3 Loss Estimation and Runoff Routing

Runoff hydrographs for each subcatchment were calculated in InfoWorks SD using the Storm Water Management Model (SWMM) hydrologic methodology for fully-developed watershed conditions. Loss calculations were performed according to the Natural Resources Conservation Service (NRCS) curve number method. Composite soil curve numbers were calculated based on the "open space" land use designations, and impervious values were assigned according to the City of Fort Worth developed conditions land use zoning file provided by the City. The City provided land use information in GIS shapefile format. The land use map is shown in Figure 4. Routing was performed by the SWMM methodology with a Manning's n value of 0.030 for pervious areas and 0.011 for impervious areas. The subcatchment width was defined as the subcatchment area divided by the subcatchment length. The subcatchment length was defined as the longest overland flowpath in each subcatchment.

In order to replicate the SWMM hydrology within InfoWorks SD, FNI created two runoff surfaces for the model. The first runoff surface was impervious and used a fixed runoff percentage of 100%, meaning that no loss calculations were performed. This represents the SWMM assumption that impervious area is directly connected to the drainage system without incurring any initial losses. The second runoff surface was pervious and used curve numbers for loss calculations and SWMM for routing. The loss and transform calculations were then performed on each runoff surface and combined to obtain a total runoff hydrograph for each subcatchment. The soil curve number and percent impervious tables are included in Appendix A. The runoff surfaces are summarized in Appendix B.



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Trinity River Vision
Drainage Area Map

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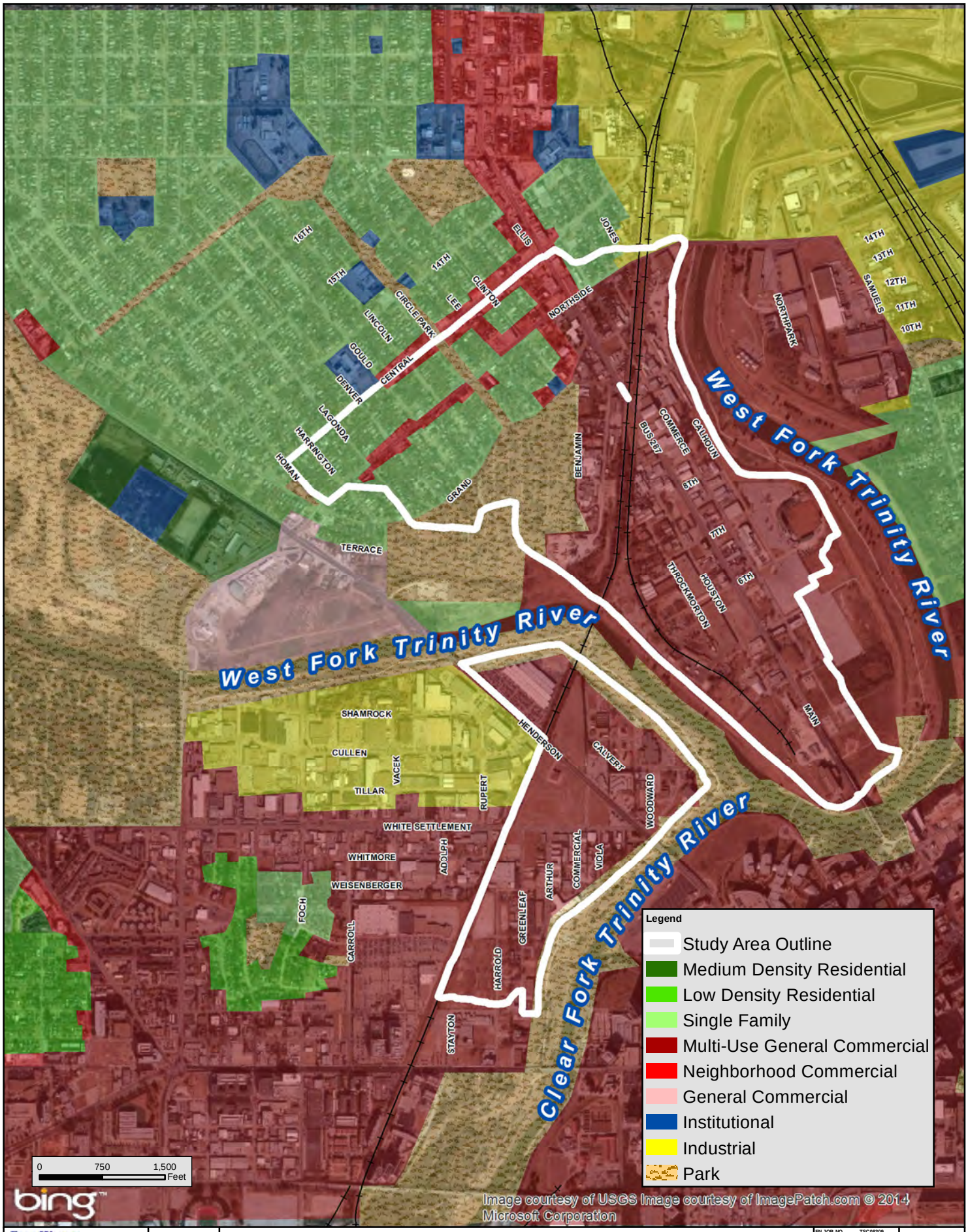
Figure 3



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Land Use Map

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Figure 4

2.3 HYDRAULICS

2.3.1 Storm Drain Analysis

Dynamic storm drain and overland flow routing were performed within InfoWorks SD. A two-dimensional (2D) mesh was created from the 1-foot topographic information provided by the USACE. Building footprints are built into the mesh and are represented as voids where water is not allowed to flow.

Subcatchments drain to 2D nodes, which are connected to the drainage system via weir links to represent inlets. The 2D nodes are the connection between the 1D hydraulic model (underground pipe system) and the 2D hydraulic model (overland flow). Water is able to flow in and out of 2D nodes over time as the capacity in the underground pipe system allows.

An inlet may behave as a weir (partially submerged flow) or an orifice (fully submerged) depending on the ratio of the headwater to the height of the opening of the inlet. Both situations have different hydraulic equations. During a storm event, the inlet may behave in either way, acting as weir at the beginning of the storm and transitioning to orifice if the headwater is high enough to totally submerge the opening. As a result, a simple definition of the conduit as weir or orifice may not be valid throughout the simulation of large storms. InfoWorks SD allows weirs to have a “ceiling” that triggers the calculation to switch to an orifice equation when flow reaches a given elevation, which provides an accurate representation of the inlet capacity.

Each existing storm drain system has an iron flap gate at its outfall, preventing backflow from the Trinity River from entering the storm drain system. These flap gates create additional headlosses in the storm drain because of their significant weight. These headlosses were modeled within InfoWorks SD with the standard flap valve network element. The headloss results for this element were reviewed and were found to be consistent with manufacturer’s recommendations for estimating headlosses.

Summary tables of the existing nodes, links, weirs, and subcatchments are included in Appendix C. Digital copies of the models are included on the disc in Appendix E.

2.3.2 Tailwater Conditions

Two types of tailwater scenarios were considered: unsteady (time-varying) and steady (non-time-varying). After extensive coordination and discussion with TRV project partners, FNI chose to represent existing downstream boundary conditions using a steady tailwater scenario. This steady tailwater for all existing storm events was developed using prevailing river discharges provided by the USACE. These discharges

were input to the existing conditions HEC-RAS model of the Trinity River to develop steady tailwaters for each outfall location. For additional details, refer to the *TRVA Storm Drain Tailwater Design Assumptions* memorandum dated February 21, 2012 in Appendix D.

2.4 RESULTS

As indicated previously, hydraulic models of the existing storm drain systems were generated to determine existing flooding conditions as well as to serve as a base for preparing proposed conditions analyses. Hydraulic simulations were performed for the 2-, 5-, 10-, 25-, 50-, and 100-year events. These analyses indicate that the existing storm drain system in the study area is severely undersized for current land use conditions and design criteria. Widespread flooding is expected for storms as frequent as a 2-year storm event. Exhibit 1 shows the storm drain capacity by frequency event. Exhibits 2 through 7 shows the extents of flooding in each storm event. The results of the analysis are summarized by major drainage basin below. Because many of the systems experience flooding in the more frequent storms, this discussion focuses primarily on the 2-year event.

2.4.1 Greenleaf Basin

The Greenleaf basin is generally bounded by Henderson Street to the north, the Clear Fork of the Trinity River to the east, the Fort Worth and Western Railroad (FWWR) to the west, and 5th Street to the south. The basin is very flat with an average elevation of approximately 538’ and not more than a 5-foot variation in natural ground throughout the basin based on the 1-foot contour data provided by USACE. The current land use is characterized by commercial and light industrial areas. The Greenleaf trunk line extends from its “fish hook” outfall in the Clear Fork of the Trinity River, north along Greenleaf Street and then extends along Kansas and Arthur Streets. Laterals along Dakota and Nebraska Streets help drain the basin. The model indicates that the trunk line performs adequately during the 2-year event. However, flooding is experienced along Viola, Austin, and Harrold Streets in the 2-year event as well as the following intersections: Greenleaf Street and Kansas Street; Arthur Street and White Settlement Road; and Kansas Street and Commercial Street. The depths of flooding range from only a few inches to nearly 1 foot on White Settlement Road.

There is potential for surface flooding to overflow into the Greenleaf basin from the adjacent 5th Street basin to the south. The 5th Street storm drain system has not yet been studied in detail, but the City of Fort Worth plans to begin a study of this system in 2015. The findings of this future study will clarify

whether flooding from the 5th Street system has any impact on flooding the Greenleaf basin. Flooding in the Greenleaf basin is discussed further in Volume II of this report.

2.4.2 Henderson Basin

The Henderson basin is generally bounded by Henderson Street to the south, the FWWR to the west, and the West and Clear Forks of the Trinity River to the north and east. Elevations in this basin range from 532 to 540. The current land use is characterized by commercial and light industrial areas. The Henderson trunk line extends from its outfall to the Clear Fork of the Trinity River west along Calvert Street to Henderson Street. Flooding is experienced in the Henderson basin during the 2-year event at the low point on Henderson Street, at the intersection of Woodward and Calvert, and at the low areas on the Fort Worth Police Academy property. Flooding depths range from a few inches up to 1 foot on Henderson Street.

2.4.3 Bazaar Basin

The Bazaar basin is generally bounded by the West Fork of the Trinity River to the north and east and by Henderson Street to south and west. It is directly north of the Henderson Basin. The Bazaar basin is bisected by the FWWR tracks. Elevations in this basin range from 526 to 553. The current land use is characterized by commercial and light industrial areas. There is a large sump area that collects drainage from both sides of the tracks that outfalls to the West Fork of the Trinity River. There are no internal storm drains in this basin other than a culvert under the FWWR tracks. The model results indicate widespread shallow flooding across the basin. In high return interval events, runoff overflows from the Henderson basin and runs across the area. The runoff collects in the sump area and exceeds the top banks of the sump in high return intervals.

2.4.4 South Calhoun Basin

The South Calhoun basin is generally bounded by 9th Street to the north, the FWWR to the northwest, and the West Fork of the Trinity River to the east, south, and west. Elevations in the basin range from 530 to 540. The current land use is characterized by commercial and light industrial areas. The South Calhoun trunk line runs north along Calhoun Street to 8th Street where it joins the remainder of the North Main system before outfalling into the West Fork of the Trinity River. Laterals along 4th, 5th, 6th, and 7th Streets serve the majority of the drainage basin. The model indicates that flooding is experienced in the 2-year event along Houston, Throckmorton, 4th, 5th, 6th, and 7th Streets and in the LaGrave Field parking lots. In general, the flooding is more severe in the upstream portions of this drainage system. Flooding depths range from a few inches to over 1 foot in some areas.

2.4.5 North Calhoun Basin

The North Calhoun basin is generally bounded by 9th Street to the south, the West Fork of the Trinity River to the east, North Main Street to the west, and Northside Drive to the north. The FWWR bisects the basin from southwest to northeast. Elevations in the basin are somewhat higher and more varied, ranging from 530 to 558. The current land use is characterized by commercial and light industrial areas in the lower basin, but includes some residential development in the upper reaches of the basin. The North Calhoun trunk line runs south along Calhoun Street to 8th Street where it joins the remainder of the North Main system before outfalling into the West Fork of the Trinity River. The model indicates widespread flooding during the 2-year event, primarily upstream of the FWWR. Flooding depths range from a few inches to nearly 2 feet.

2.4.6 Grand Avenue Basin

The Grand Avenue system is generally bounded by Central Avenue to the north, Grand Avenue to the south and west, and North Main Street to the east. Elevations in this basin are much higher, ranging from 538 to 610. The current land use is characterized primarily by single family residential areas. The Grand Avenue system runs along Grand Avenue and then outfalls into an open channel adjacent to the FWWR. It then passes through culverts under the FWWR and enters the North Main system via an open culvert headwall. The model indicates flooding along Grand Avenue, Northside Drive, and North Houston, Lincoln, Denver, and Gould Streets. Flooding depths during a 2-year event range from a few inches to nearly 1.5 feet in some areas.

2.4.7 Cemetery Basin

The Cemetery basin is generally bounded by the FWWR to the east, the West Fork of the Trinity River to the south, Grand Avenue to the north, and a natural ridge that runs through the Oakwood Cemetery to the west. Elevations in this basin range from 532 to 574. The current land use is split between light industrial and open space (cemetery). The basin drains primarily overland, joins the Grand Avenue flow at the east edge of the basin, then passes through culverts under the FWWR and enters the North Main system. The model indicates that flooding is experienced during the 2-year event along Benjamin and Houston Streets and in the low areas adjacent to the FWWR.

3.0 SUMMARY AND DISCUSSION

Dynamic hydrologic and hydraulic models for the North Main Street, Henderson, and Greenleaf drainage systems were developed in InfoWorks SD. Extensive data collection was performed to catalogue the existing storm drain system in the project area that dates to the 1920s in some areas. Field survey, record drawings, construction plans, aerial topographic survey, and previous models were each utilized as data sources for the model.

Hypothetical frequency storms were developed for the 2-, 5-, 10-, 25-, 50-, and 100-year events. Drainage areas were delineated using 1-foot topographic data to each inlet in the study area. The SWMM hydrology methodology was utilized to determine runoff hydrographs for each storm event. The runoff flows were dynamically routed through the drainage system using a 1D simulation engine for the pipe system and a 2D simulation engine for overland flow. Steady-state river levels based on the prevailing discharge at each storm drain outfall were developed to analyze the impact of the tailwater conditions on the storm drain systems.

It was determined that the existing drainage system lacks capacity to meet current design criteria and is severely undersized. Volumes II and III of this study investigate and recommend proposed improvements associated with TRV project components and future development.

Trinity River Vision Storm Drain Relocation

Existing Conditions

Exhibit 1

Drainage Basin
- Bazaar
- Cemetery
- Grand Avenue
- Greenleaf
- Henderson
- North Calhoun
- South Calhoun

Node Surcharge
- 2 Year
- 5 Year
- 10 Year
- 25 Year
- > 25 Year

Pipe Capacity
- < 2 Year
- < 5 Year
- < 10 Year
- < 25 Year
- > 25 Year

- Railroad
- Trinity River
- Bypass Channel
- Drainage Basin
- Subcatchments
- Roadway

N W E S

0 500 1,000 Feet

1:6,000

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Inundation Mapping - 2-yr Event

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Exhibit

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Inundation Mapping - 5-yr Event

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Inundation Mapping - 25-yr Event

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Exhibit

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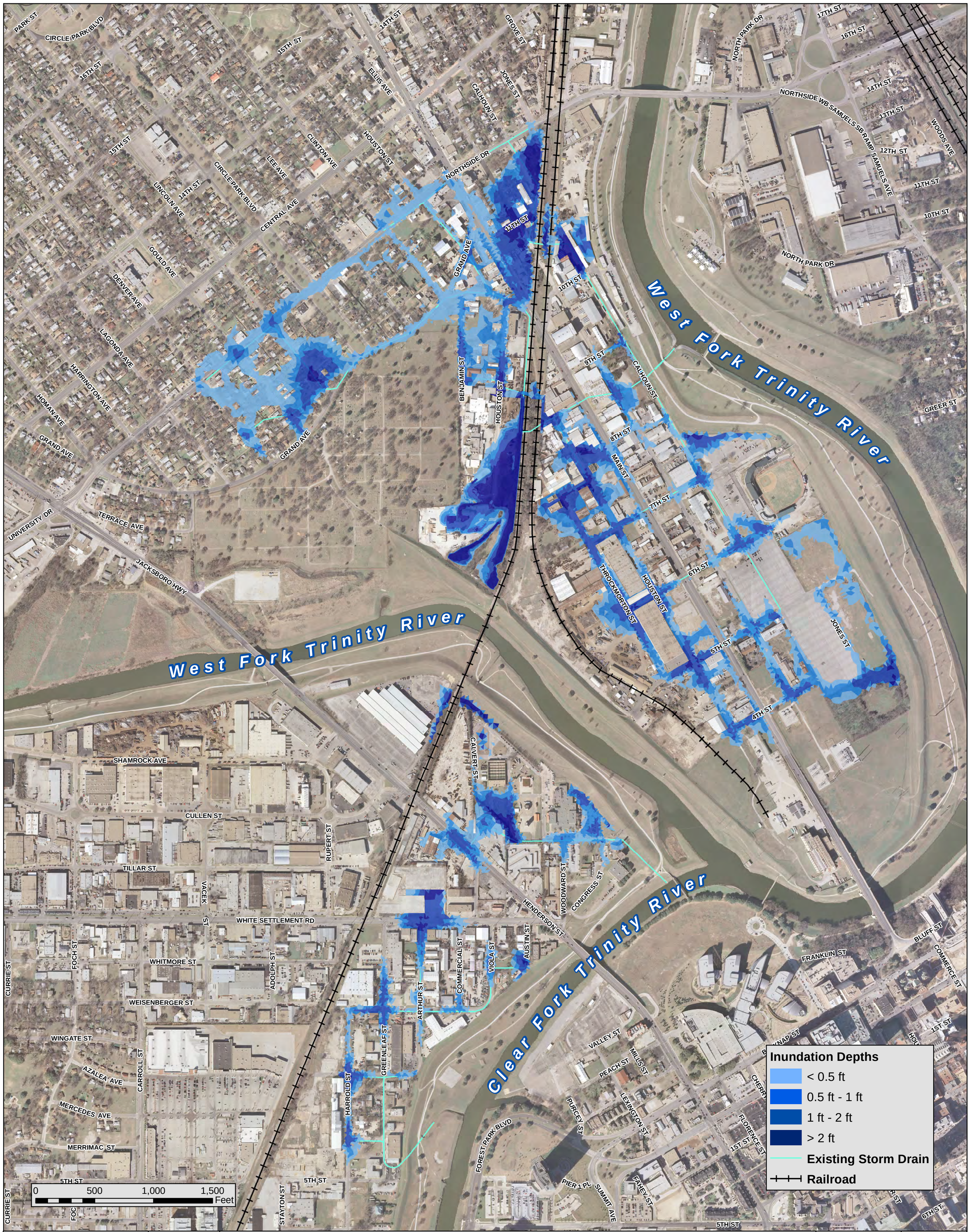

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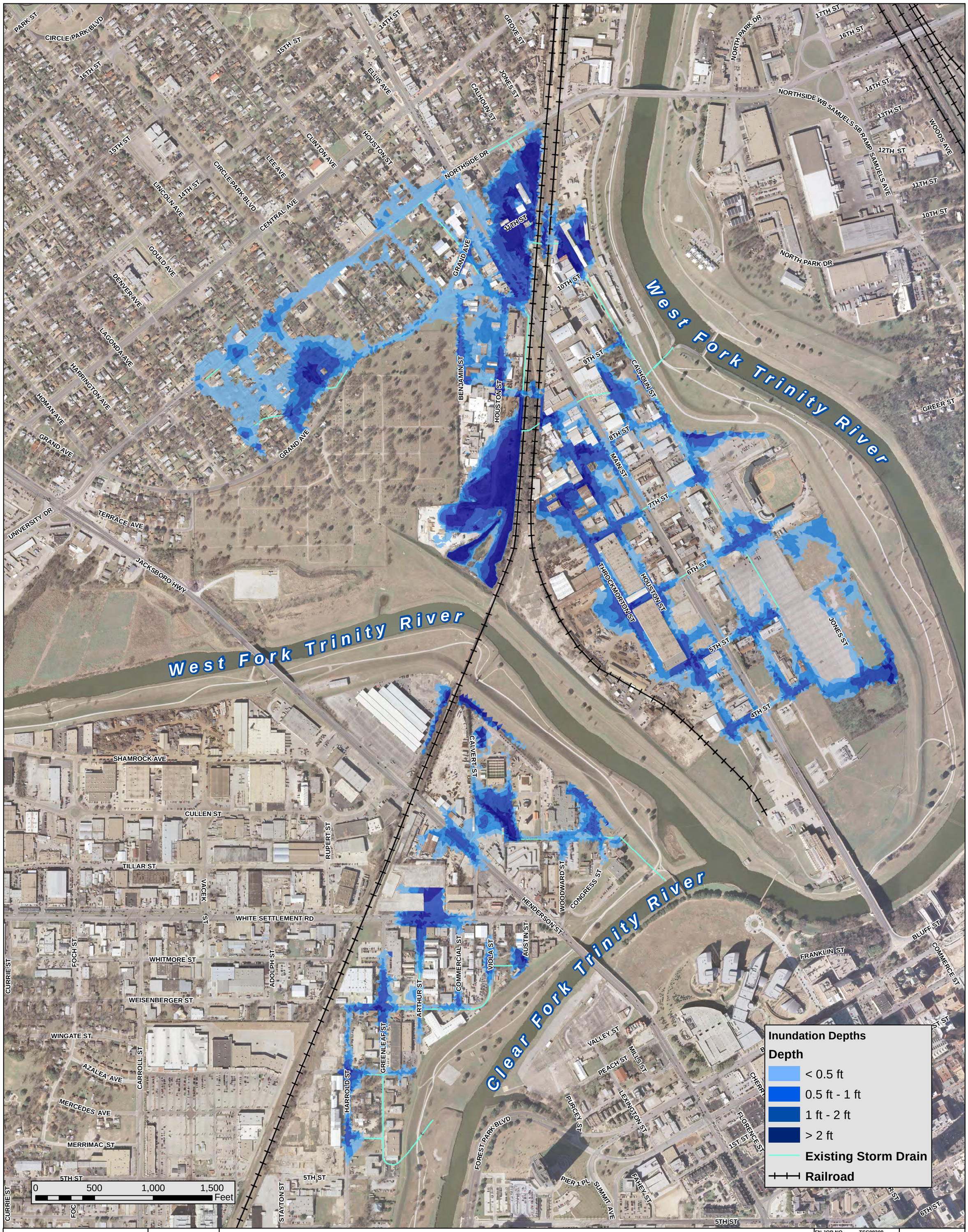
6



FORT WORTH
Tran Systems
500 West Seventh Street - Suite 1100
Fort Worth, TX 76102
817-339-8950
Freese and Nichols
4055 International Plaza Suite 200
Fort Worth, Texas 76109-4895
817-735-7300

N W E S

Trinity River Vision

Inundation Mapping - 100-yr Event

FN JOB NO	TSC08309
DATE	October 2015
SCALE	1" = 500'
DESIGNED	SKH
DRAFTED	AJP
FILE	H:\STORMWATER\FINAL_EXHIBITS\Phase1a Report\Inundation Maps\100-yr Inundation 18x24.mxd

Exhibit

7

Appendix A
Curve Number and Percent Impervious Tables

Curve Number Table

	Soil Type			
Land Use	*A*	*B*	*C*	*D*
Open Space Fair	49	69	79	84

Percent Impervious Table

Ultimate Land Use Designation	LU Code	Percent Impervious
General Commercial	GC	96
Institutional	INST	96
Light Industrial	LI	96
Mixed Use General Commercial	MUGC	96
Neighborhood Commercial	NC	96
Private Park	PRIPK	61
Public Park	PUBPK	61
Single Family	SF	65

Appendix B
Runoff Surfaces Summary

Runoff Surface ID	Description	Surface Type	Runoff Volume Type	Routing Model	Manning's N	Initial Loss Type	Initial Loss Value (ft)	Initial Abstraction Factor	Fixed Runoff Coefficient
1	Pavement	Impervious	Fixed	SWMM	0.011	Abs	0.0083	0.2	1
2	Open Space Fair	Pervious	CN	SWMM	0.030	SCS	0	0.2	n/a

Appendix C
Tables of Existing Network Elements

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
100	Manhole	531.60	525.05	Stored	2324964.7	6963789.1
101	Manhole	531.47	527.69	Sealed	2324965.9	6963832.5
101.2D	Manhole	531.47	530.28	2D	2324966.9	6963833.5
102	Manhole	531.78	527.55	Sealed	2324989.5	6963826.2
102.2D	Manhole	531.78	530.59	2D	2324990.5	6963827.2
103	Manhole	531.68	527.98	Sealed	2325012.6	6963793.9
103.2D	Manhole	531.68	530.49	2D	2325013.6	6963794.9
104	Manhole	531.66	527.84	Sealed	2325002.9	6963768.9
104.2D	Manhole	531.66	530.47	2D	2325003.9	6963769.9
105	Manhole	531.54	527.69	Sealed	2324960.6	6963743.9
105.2D	Manhole	531.54	530.35	2D	2324961.6	6963744.9
106	Manhole	531.11	526.21	Sealed	2324922.4	6963784.1
106.2D	Manhole	531.11	529.92	2D	2324923.4	6963785.1
110	Manhole	531.30	526.58	Stored	2324747.7	6963662.2
111	Manhole	531.46	527.41	Sealed	2324691.7	6963675.1
111.2D	Manhole	531.46	530.27	2D	2324692.7	6963676.1
112	Manhole	531.59	527.79	Sealed	2324729.5	6963695.9
112.2D	Manhole	531.59	530.40	2D	2324730.5	6963696.9
113	Manhole	531.51	528.01	Sealed	2324758.6	6963693.0
113.2D	Manhole	531.51	530.32	2D	2324759.6	6963694.0
114	Manhole	531.62	527.92	Sealed	2324778.2	6963659.0
114.2D	Manhole	531.62	530.43	2D	2324779.2	6963660.0
115	Manhole	531.43	528.08	Sealed	2324766.8	6963631.7
115.2D	Manhole	531.43	530.24	2D	2324767.8	6963632.7
120	Manhole	532.81	522.91	Sealed	2325577.4	6963380.8
121	Manhole	532.25	528.45	Sealed	2325556.8	6963410.6
121.2D	Manhole	532.25	531.06	2D	2325557.8	6963411.6
122	Manhole	534.15	530.55	Sealed	2325590.1	6963353.3
122.2D	Manhole	534.15	532.96	2D	2325591.1	6963354.3
123	Manhole	533.27	529.67	Sealed	2325523.8	6963307.7
123.2D	Manhole	533.27	532.08	2D	2325524.8	6963308.7
124	Manhole	533.00	529.30	Sealed	2325486.7	6963372.1
124.2D	Manhole	533.00	531.81	2D	2325487.7	6963373.1
130	Manhole	531.95	524.40	Stored	2325280.8	6963211.4
131	Manhole	531.63	528.03	Sealed	2325257.7	6963242.7
131.2D	Manhole	531.63	530.44	2D	2325258.7	6963243.7
1310	Manhole	530.98	524.16	Stored	2324474.6	6965802.7
1311	Manhole	531.26	527.22	Sealed	2324462.3	6965838.4
1311.2D	Manhole	531.26	530.07	2D	2324463.3	6965839.4
1312	Manhole	531.06	528.01	Sealed	2324432.1	6965756.7
1312.2D	Manhole	531.06	529.87	2D	2324433.1	6965757.7
1313	Manhole	531.14	528.29	Sealed	2324412.9	6965790.1
1313.2D	Manhole	531.14	529.95	2D	2324413.9	6965791.1
132	Manhole	532.12	528.22	Sealed	2325296.7	6963261.4
132.2D	Manhole	532.12	530.93	2D	2325297.7	6963262.4
1320	Manhole	530.00	517.94	Sealed	2325060.8	6965311.8
1321	Manhole	529.48	526.23	Sealed	2325065.7	6965243.4
1321.2D	Manhole	529.48	528.29	2D	2325066.7	6965244.4
1322	Manhole	529.48	526.23	Sealed	2325034.9	6965296.8
1322.2D	Manhole	529.48	528.29	2D	2325035.9	6965297.8
1323	Manhole	530.50	518.16	Sealed	2325165.4	6965124.6

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
1324.2D	Manhole	528.00	527.97	2D	2325235.6	6965131.6
1325	Manhole	530.00	528.00	Sealed	2325226.3	6965130.0
133	Manhole	532.25	528.01	Sealed	2325322.7	6963256.9
133.2D	Manhole	532.25	531.06	2D	2325323.7	6963257.9
1330	Manhole	530.33	526.08	Stored	2324780.1	6965206.5
1331	Manhole	529.21	526.21	Sealed	2324786.2	6965272.8
1331.2D	Manhole	529.21	528.02	2D	2324787.2	6965273.8
1332	Manhole	530.56	527.56	Sealed	2324876.5	6965115.3
1332.2D	Manhole	530.56	529.37	2D	2324877.5	6965116.3
1333	Manhole	530.55	527.25	Sealed	2324791.3	6965171.9
1333.2D	Manhole	530.55	529.36	2D	2324792.3	6965172.9
1334	Manhole	530.36	527.66	Sealed	2324766.4	6965177.9
1334.2D	Manhole	530.36	529.17	2D	2324767.4	6965178.9
1335	Manhole	530.21	526.16	Sealed	2324747.8	6965212.2
1335.2D	Manhole	530.21	529.02	2D	2324748.8	6965213.2
1336	Manhole	529.11	524.51	Sealed	2324629.5	6965451.1
1336.2D	Manhole	529.11	527.92	2D	2324630.5	6965452.1
1337	Manhole	529.05	523.75	Sealed	2324665.4	6965471.8
1337.2D	Manhole	529.05	527.86	2D	2324666.4	6965472.8
134	Manhole	532.03	528.73	Sealed	2325342.5	6963222.7
134.2D	Manhole	532.03	530.84	2D	2325343.5	6963223.7
135	Manhole	531.93	529.03	Sealed	2325333.6	6963198.1
135.2D	Manhole	531.93	530.74	2D	2325334.6	6963199.1
136	Manhole	531.93	529.28	Sealed	2325267.5	6963180.0
136.2D	Manhole	531.93	530.74	2D	2325268.5	6963181.0
137	Manhole	532.13	528.73	Sealed	2325247.5	6963213.5
137.2D	Manhole	532.13	530.94	2D	2325248.5	6963214.5
140	Manhole	531.66	521.46	Stored	2325770.4	6963495.7
1400	Outfall	522.50	522.50	Stored	2325057.6	6961344.5
1405	Manhole	532.57	522.84	Sealed	2325046.4	6961354.7
1405A	Manhole	532.57	522.84	Sealed	2325047.7	6961353.5
141	Manhole	531.46	528.06	Sealed	2325721.1	6963567.6
141.2D	Manhole	531.46	530.27	2D	2325722.1	6963568.6
1410	Manhole	551.86	523.23	Stored	2324895.8	6961501.2
1410A	Manhole	551.86	523.23	Stored	2324899.0	6961498.0
142	Manhole	531.52	527.12	Sealed	2325789.9	6963546.3
142.2D	Manhole	531.52	530.33	2D	2325790.9	6963547.3
1420	Manhole	536.00	524.28	Sealed	2324681.6	6961708.9
1420.2D	Manhole	536.00	534.80	2D	2324682.6	6961709.9
1421	Manhole	535.23	528.74	Sealed	2324608.3	6961783.9
1422.2D	Manhole	535.23	535.20	2D	2324603.1	6961790.4
1423	Manhole	533.30	525.90	Sealed	2324629.6	6961693.7
1423.2D	Manhole	533.30	532.10	2D	2324630.6	6961694.7
1425	Manhole	533.75	524.59	Stored	2324502.0	6961706.8
1426	Manhole	533.60	529.00	Sealed	2324491.7	6961752.3
1426.2D	Manhole	533.60	532.41	2D	2324492.7	6961753.3
1427	Manhole	534.04	529.34	Sealed	2324496.0	6961690.4
1427.2D	Manhole	534.04	532.85	2D	2324497.0	6961691.4
1428	Manhole	534.90	529.35	Sealed	2324538.5	6961512.7
1428.2D	Manhole	534.90	533.70	2D	2324539.5	6961513.7
1429	Manhole	534.10	527.70	Sealed	2324607.0	6961648.8

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
1429.2D	Manhole	534.10	532.90	2D	2324608.0	6961649.8
143	Manhole	531.46	526.56	Sealed	2325814.4	6963541.2
143.2D	Manhole	531.46	530.27	2D	2325815.4	6963542.2
1430	Manhole	533.81	525.13	Stored	2324188.9	6961703.2
1431	Manhole	533.82	529.15	Sealed	2324190.1	6961719.7
1431.2D	Manhole	533.82	532.63	2D	2324191.1	6961720.7
1432	Manhole	533.76	529.76	Sealed	2324196.8	6961669.2
1432.2D	Manhole	533.76	532.57	2D	2324197.8	6961670.2
1433	Manhole	533.84	529.54	Sealed	2324164.1	6961668.2
1433.2D	Manhole	533.84	532.65	2D	2324165.1	6961669.2
144	Manhole	531.43	527.00	Sealed	2325833.5	6963507.0
144.2D	Manhole	531.43	530.24	2D	2325834.5	6963508.0
1440	Manhole	535.00	525.50	Stored	2324055.1	6961698.6
145	Manhole	531.35	527.73	Sealed	2325826.2	6963483.2
145.2D	Manhole	531.35	530.16	2D	2325827.2	6963484.2
1450	Manhole	531.70	527.45	Sealed	2323783.5	6961693.8
1450.2D	Manhole	531.70	530.50	2D	2323784.5	6961694.8
146	Manhole	531.41	526.91	Sealed	2325784.5	6963458.5
146.2D	Manhole	531.41	530.22	2D	2325785.5	6963459.5
1460	Manhole	534.55	528.20	Sealed	2323523.1	6961822.9
1460.2D	Manhole	534.55	533.35	2D	2323524.1	6961823.9
147	Manhole	531.63	528.28	Sealed	2325732.5	6963448.6
147.2D	Manhole	531.63	530.44	2D	2325733.5	6963449.6
1470	Manhole	534.64	529.04	Sealed	2323390.3	6961664.9
1470.2D	Manhole	534.64	533.44	2D	2323391.3	6961665.9
1471	Manhole	535.44	531.49	Sealed	2323470.5	6961591.1
1471.2D	Manhole	535.44	534.24	2D	2323471.5	6961592.1
1472	Manhole	534.82	531.42	Sealed	2323414.5	6961542.5
1472.2D	Manhole	534.82	533.62	2D	2323415.5	6961543.5
1473	Manhole	534.31	529.54	Sealed	2323343.4	6961606.9
1473.2D	Manhole	534.31	533.11	2D	2323344.4	6961607.9
1474	Manhole	535.15	532.35	Sealed	2323200.6	6961741.6
1474.2D	Manhole	535.15	533.95	2D	2323201.6	6961742.6
1475	Manhole	534.93	531.28	Sealed	2323277.6	6961768.4
1475.2D	Manhole	534.93	533.73	2D	2323278.6	6961769.4
148	Manhole	531.11	526.81	Sealed	2325740.9	6963498.7
148.2D	Manhole	531.11	529.92	2D	2325741.9	6963499.7
150	Manhole	531.75	523.80	Stored	2326090.3	6962917.0
151	Manhole	531.42	526.42	Sealed	2326074.2	6962957.7
151.2D	Manhole	531.42	530.23	2D	2326075.2	6962958.7
152A	Manhole	531.70	527.30	Sealed	2326144.5	6962970.1
152A.2D	Manhole	531.70	530.51	2D	2326145.5	6962971.1
152B	Manhole	531.54	528.83	Sealed	2326163.2	6962936.1
152B.2D	Manhole	531.54	530.35	2D	2326164.2	6962937.1
153	Manhole	532.14	528.01	Sealed	2326078.7	6962886.3
153.2D	Manhole	532.14	530.95	2D	2326079.7	6962887.3
154	Manhole	531.96	527.46	Sealed	2326071.6	6962927.4
154.2D	Manhole	531.96	530.77	2D	2326072.6	6962928.4
155	Manhole	534.10	526.74	Sealed	2325869.4	6962789.4
156	Manhole	533.73	529.53	Sealed	2325814.5	6962779.5
156.2D	Manhole	533.73	532.54	2D	2325815.5	6962780.5

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
157	Manhole	534.26	530.16	Sealed	2325919.0	6962784.1
157.2D	Manhole	534.26	533.07	2D	2325920.0	6962785.1
158	Manhole	534.13	529.93	Sealed	2325850.7	6962743.7
158.2D	Manhole	534.13	532.94	2D	2325851.7	6962744.7
16	Outfall	499.10	499.10	Stored	2325124.9	6965875.3
160	Manhole	533.91	528.91	Stored	2325613.6	6962641.5
161	Manhole	533.84	529.54	Sealed	2325579.7	6962643.0
161.2D	Manhole	533.84	532.65	2D	2325580.7	6962644.0
162	Manhole	533.49	529.39	Sealed	2325650.2	6962683.8
162.2D	Manhole	533.49	532.30	2D	2325651.2	6962684.8
163	Manhole	533.72	529.52	Sealed	2325669.6	6962650.0
163.2D	Manhole	533.72	532.53	2D	2325670.6	6962651.0
164	Manhole	533.83	530.15	Sealed	2325616.8	6962594.8
164.2D	Manhole	533.83	532.64	2D	2325617.8	6962595.8
165	Manhole	533.93	530.25	Sealed	2325597.8	6962608.3
165.2D	Manhole	533.93	532.74	2D	2325598.8	6962609.3
16A	Manhole	521.00	515.01	Sealed	2325040.5	6965779.1
170	Manhole	529.00	520.77	Sealed	2324704.5	6965934.4
171	Manhole	528.72	524.02	Sealed	2324712.3	6965938.5
171.2D	Manhole	528.72	527.53	2D	2324713.3	6965939.5
172	Manhole	528.84	525.04	Sealed	2324649.2	6965926.7
172.2D	Manhole	528.84	527.65	2D	2324650.2	6965927.7
173	Manhole	528.91	523.06	Sealed	2324654.9	6965950.5
173.2D	Manhole	528.91	527.72	2D	2324655.9	6965951.5
1760	Manhole	538.00	529.54	Sealed	2323292.8	6960250.1
1761	Manhole	536.11	532.23	Sealed	2323318.4	6960297.2
1761.2D	Manhole	536.11	534.92	2D	2323319.4	6960298.2
1762	Manhole	536.48	532.36	Sealed	2323335.5	6960280.1
1762.2D	Manhole	536.48	535.29	2D	2323336.5	6960281.1
1763	Manhole	536.48	532.56	Sealed	2323275.4	6960247.4
1763.2D	Manhole	536.48	535.29	2D	2323276.4	6960248.4
1764	Manhole	536.31	532.21	Sealed	2323267.8	6960280.3
1764.2D	Manhole	536.31	535.12	2D	2323268.8	6960281.3
1765	Manhole	536.09	531.99	Sealed	2323285.3	6960297.8
1765.2D	Manhole	536.09	534.90	2D	2323286.3	6960298.8
1770	Manhole	538.00	530.10	Sealed	2323505.9	6960275.9
1771	Manhole	537.34	532.99	Sealed	2323510.7	6960315.2
1771.2D	Manhole	537.34	536.15	2D	2323511.7	6960316.2
1772	Manhole	537.32	532.72	Sealed	2323533.8	6960291.3
1772.2D	Manhole	537.32	536.13	2D	2323534.8	6960292.3
1790	Manhole	536.00	530.80	Sealed	2323568.5	6960610.9
1791	Manhole	536.21	532.33	Sealed	2323589.8	6960622.1
1791.2D	Manhole	536.21	535.02	2D	2323590.8	6960623.1
1792	Manhole	536.18	531.73	Sealed	2323556.7	6960624.8
1792.2D	Manhole	536.18	534.99	2D	2323557.7	6960625.8
17A	Manhole	524.15	515.01	Sealed	2325035.2	6965774.1
17B	Manhole	524.15	515.07	Sealed	2325035.7	6965773.5
17C	Manhole	524.15	515.18	Sealed	2325036.3	6965772.9
180	Manhole	533.50	523.45	Sealed	2324367.8	6966510.9
1800	Manhole	534.52	531.40	Sealed	2323858.2	6960623.3
1801	Manhole	535.46	532.42	Sealed	2323889.7	6960654.1

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
1801.2D	Manhole	535.46	534.27	2D	2323890.7	6960655.1
1802	Manhole	535.43	532.03	Sealed	2323856.5	6960669.8
1802.2D	Manhole	535.43	534.24	2D	2323857.5	6960670.8
1805	Outfall	519.86	519.86	Stored	2323086.4	6959314.4
1805A	Manhole	536.50	522.99	Sealed	2322992.4	6959189.2
1806A	Manhole	536.46	522.99	Sealed	2322987.4	6959181.3
1806B	Manhole	536.46	522.99	Sealed	2322986.6	6959181.8
181	Manhole	533.82	529.72	Sealed	2324335.9	6966462.3
181.2D	Manhole	533.82	532.63	2D	2324336.9	6966463.3
1810	Manhole	551.88	526.55	Stored	2322884.2	6959044.1
1810A	Manhole	551.88	526.55	Stored	2322882.8	6959042.5
1812	Manhole	539.41	526.41	2D	2322754.9	6958927.9
1815	Manhole	539.32	525.76	2D	2322659.4	6959143.2
1819	Manhole	538.00	526.91	Sealed	2322657.9	6959649.9
182	Manhole	533.23	529.04	Sealed	2324313.5	6966499.0
182.2D	Manhole	533.23	532.04	2D	2324314.5	6966500.0
1820	Manhole	537.65	526.95	Stored	2322661.5	6959692.0
1821	Manhole	538.14	532.89	Sealed	2322675.3	6959681.0
1821.2D	Manhole	538.14	536.95	2D	2322676.3	6959682.0
1822	Manhole	537.31	533.47	Sealed	2322642.3	6959677.7
1822.2D	Manhole	537.31	536.12	2D	2322643.3	6959678.7
1823	Manhole	537.04	534.34	Sealed	2322807.9	6959728.7
1823.2D	Manhole	537.04	535.85	2D	2322808.9	6959729.7
1824	Manhole	536.91	532.99	Sealed	2322806.5	6959696.6
1824.2D	Manhole	536.91	535.72	2D	2322807.5	6959697.6
1825	Manhole	537.20	532.00	Stored	2322789.1	6959704.0
1830	Manhole	534.62	527.77	Stored	2322677.6	6960254.2
1831	Manhole	534.93	530.83	Sealed	2322678.6	6960294.0
1831.2D	Manhole	534.93	533.74	2D	2322679.6	6960295.0
1832	Manhole	535.09	530.69	Sealed	2322691.1	6960281.5
1832.2D	Manhole	535.09	533.90	2D	2322692.1	6960282.5
1833	Manhole	535.07	530.67	Sealed	2322691.4	6960248.9
1833.2D	Manhole	535.07	533.87	2D	2322692.4	6960249.9
1834	Manhole	535.02	530.84	Sealed	2322678.2	6960234.5
1834.2D	Manhole	535.02	533.83	2D	2322679.2	6960235.5
1835	Manhole	535.12	531.46	Sealed	2322645.2	6960235.1
1835.2D	Manhole	535.12	533.93	2D	2322646.2	6960236.1
1836	Manhole	535.05	531.57	Sealed	2322632.4	6960249.1
1836.2D	Manhole	535.05	533.86	2D	2322633.4	6960250.1
1837	Manhole	535.06	533.19	Sealed	2322632.8	6960282.1
1837.2D	Manhole	535.06	533.87	2D	2322633.8	6960283.1
1838	Manhole	534.94	531.74	Sealed	2322645.7	6960295.0
1838.2D	Manhole	534.94	533.75	2D	2322646.7	6960296.0
1840	Manhole	536.00	528.30	Sealed	2322969.9	6960250.5
1841	Manhole	536.28	532.33	Sealed	2322988.3	6960298.3
1841.2D	Manhole	536.28	535.09	2D	2322989.3	6960299.3
1842	Manhole	536.59	532.05	Sealed	2323005.4	6960281.3
1842.2D	Manhole	536.59	535.40	2D	2323006.4	6960282.3
1843	Manhole	536.65	532.38	Sealed	2323005.5	6960248.1
1843.2D	Manhole	536.65	535.46	2D	2323006.5	6960249.1
1844	Manhole	536.24	532.16	Sealed	2322988.0	6960230.6

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
1844.2D	Manhole	536.24	535.05	2D	2322989.0	6960231.6
1845	Manhole	536.35	532.35	Sealed	2322955.0	6960231.2
1845.2D	Manhole	536.35	535.16	2D	2322956.0	6960232.2
1846	Manhole	536.45	532.20	Sealed	2322938.1	6960248.4
1846.2D	Manhole	536.45	535.26	2D	2322939.1	6960249.4
1847	Manhole	536.48	531.58	Sealed	2322930.0	6960281.2
1847.2D	Manhole	536.48	535.29	2D	2322931.0	6960282.2
1848	Manhole	536.22	533.49	Sealed	2322949.3	6960300.4
1848.2D	Manhole	536.22	535.03	2D	2322950.3	6960301.4
1850	Manhole	536.00	529.74	Sealed	2322970.4	6960958.0
1851	Manhole	534.94	530.29	Sealed	2322975.1	6961048.2
1851.2D	Manhole	534.94	533.74	2D	2322976.1	6961049.2
1852	Manhole	534.90	530.80	Sealed	2323010.1	6960991.1
1852.2D	Manhole	534.90	533.71	2D	2323011.1	6960992.1
1853	Manhole	535.26	531.01	Sealed	2322991.7	6960970.8
1853.2D	Manhole	535.26	534.07	2D	2322992.7	6960971.8
1854	Manhole	535.06	530.76	Sealed	2322952.6	6960971.7
1854.2D	Manhole	535.06	533.87	2D	2322953.6	6960972.7
1855	Manhole	535.08	530.73	Sealed	2322928.1	6960990.8
1855.2D	Manhole	535.08	533.89	2D	2322929.1	6960991.8
1870	Manhole	540.00	530.10	Sealed	2322620.9	6959153.0
1880	Manhole	537.67	532.50	Sealed	2322400.7	6959155.4
1881	Manhole	537.90	533.76	Sealed	2322392.1	6959152.0
1881.2D	Manhole	537.90	536.71	2D	2322393.1	6959153.0
1882	Manhole	537.61	533.31	Sealed	2322371.2	6959132.2
1882.2D	Manhole	537.61	536.42	2D	2322372.2	6959133.2
1883	Manhole	537.57	533.42	Sealed	2322338.8	6959170.1
1883.2D	Manhole	537.57	536.38	2D	2322339.8	6959171.1
1884	Manhole	537.33	533.63	Sealed	2322370.4	6959205.8
1884.2D	Manhole	537.33	536.14	2D	2322371.4	6959206.8
1885	Manhole	537.75	533.33	Sealed	2322392.1	6959186.3
1885.2D	Manhole	537.75	536.56	2D	2322393.1	6959187.3
190	Manhole	531.50	524.13	Sealed	2324285.6	6966651.6
191	Manhole	530.31	527.71	Sealed	2324289.5	6966668.8
191.2D	Manhole	530.31	529.12	2D	2324290.5	6966669.8
192	Manhole	530.74	528.41	Sealed	2324251.2	6966647.0
192.2D	Manhole	530.74	529.55	2D	2324252.2	6966648.0
1925	Manhole	538.00	530.70	Sealed	2322621.5	6959693.6
1930	Manhole	536.97	531.80	Sealed	2322389.9	6959702.3
1930.2D	Manhole	536.97	535.77	2D	2322390.9	6959703.3
1932	Manhole	536.46	532.46	Sealed	2322375.4	6959685.9
1932.2D	Manhole	536.46	535.27	2D	2322376.4	6959686.9
1933	Manhole	538.08	535.78	Stored	2322323.1	6959695.6
1934	Manhole	536.19	532.79	Sealed	2322325.9	6959703.7
1934.2D	Manhole	536.19	535.00	2D	2322326.9	6959704.7
1935	Manhole	536.81	533.16	Sealed	2322342.8	6959779.5
1935.2D	Manhole	536.81	535.62	2D	2322343.8	6959780.5
1936	Manhole	536.70	533.19	Sealed	2322375.4	6959753.7
1936.2D	Manhole	536.70	535.51	2D	2322376.4	6959754.7
1937	Manhole	536.97	532.84	Sealed	2322393.3	6959735.7
1937.2D	Manhole	536.97	535.78	2D	2322394.3	6959736.7

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
20	Manhole	527.34	517.63	2D	2324884.3	6965627.8
200	Manhole	531.82	524.57	Sealed	2324223.6	6966757.7
20B	Manhole	530.26	517.52	Sealed	2324896.5	6965639.5
20C	Manhole	543.93	517.05	Sealed	2324949.5	6965690.8
20D	Manhole	543.93	516.63	Sealed	2324958.1	6965699.1
210	Manhole	532.68	526.28	Sealed	2324016.0	6966753.2
210.2D	Manhole	532.68	531.48	2D	2324017.0	6966754.2
220	Manhole	539.96	527.23	Sealed	2323931.7	6966763.9
220.2D	Manhole	539.96	538.76	2D	2323932.7	6966764.9
220AA	Manhole	537.79	527.51	Sealed	2323887.8	6966777.3
230	Manhole	535.71	528.76	Stored	2323800.6	6966962.1
231	Manhole	536.02	532.12	Sealed	2323800.8	6966981.5
231.2D	Manhole	536.02	534.83	2D	2323801.8	6966982.5
232	Manhole	536.07	530.42	Sealed	2323825.9	6966974.8
232.2D	Manhole	536.07	534.88	2D	2323826.9	6966975.8
233	Manhole	536.20	532.25	Sealed	2323843.4	6966939.1
233.2D	Manhole	536.20	535.01	2D	2323844.4	6966940.1
234	Manhole	535.99	531.54	Sealed	2323838.4	6966912.6
234.2D	Manhole	535.99	534.80	2D	2323839.4	6966913.6
235A	Manhole	535.92	532.32	Sealed	2323795.0	6966890.0
235A.2D	Manhole	535.92	534.73	2D	2323796.0	6966891.0
235B	Manhole	536.08	532.48	Sealed	2323766.1	6966896.5
235B.2D	Manhole	536.08	534.89	2D	2323767.1	6966897.5
236	Manhole	529.05	519.40	Sealed	2324621.8	6965495.9
237A	Manhole	536.03	532.48	Sealed	2323748.5	6966930.5
237A.2D	Manhole	536.03	534.84	2D	2323749.5	6966931.5
237B	Manhole	536.00	532.32	Sealed	2323757.6	6966961.0
237B.2D	Manhole	536.00	534.81	2D	2323758.6	6966962.0
238	Manhole	533.89	520.47	Sealed	2324392.3	6965457.8
239A	Manhole	532.53	528.03	Sealed	2324363.2	6965471.2
239A.2D	Manhole	532.53	531.34	2D	2324364.2	6965472.2
239B	Manhole	532.91	529.94	Sealed	2324260.7	6965490.3
239B.2D	Manhole	532.91	531.72	2D	2324261.7	6965491.3
240	Manhole	532.00	520.86	Sealed	2324304.4	6965405.5
250	Manhole	532.00	522.96	Sealed	2324256.1	6965006.9
251	Manhole	530.31	527.06	Sealed	2324295.9	6965039.0
251.2D	Manhole	530.31	529.12	2D	2324296.9	6965040.0
252	Manhole	530.37	526.75	Sealed	2324323.7	6964995.0
252.2D	Manhole	530.37	529.18	2D	2324324.7	6964996.0
253	Manhole	529.93	527.46	Sealed	2324219.8	6964988.5
253.2D	Manhole	529.93	528.74	2D	2324220.8	6964989.5
260	Manhole	530.00	522.15	2D	2324102.5	6965285.4
264	Manhole	532.00	522.80	Sealed	2324004.4	6965238.6
265	Storage	527.00	522.83	Stored	2323900.3	6965167.7
270	Manhole	531.37	523.61	Sealed	2324399.4	6964748.5
271	Manhole	530.52	526.37	Sealed	2324415.2	6964785.1
271.2D	Manhole	530.52	529.33	2D	2324416.2	6964786.1
272	Manhole	531.16	527.81	Sealed	2324489.3	6964656.0
272.2D	Manhole	531.16	529.97	2D	2324490.3	6964657.0
273	Manhole	530.64	528.74	Sealed	2324398.8	6964714.7
273.2D	Manhole	530.64	529.45	2D	2324399.8	6964715.7

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
274	Manhole	530.92	527.32	Sealed	2324377.8	6964719.7
274.2D	Manhole	530.92	529.73	2D	2324378.8	6964720.7
275	Manhole	530.78	526.43	Sealed	2324361.0	6964748.1
275.2D	Manhole	530.78	529.59	2D	2324362.0	6964749.1
280	Manhole	530.64	527.24	Stored	2324175.9	6964622.5
281	Manhole	531.09	527.86	Sealed	2324197.2	6964653.5
281.2D	Manhole	531.09	529.90	2D	2324198.2	6964654.5
282	Manhole	530.81	527.56	Sealed	2324206.7	6964599.1
282.2D	Manhole	530.81	529.62	2D	2324207.7	6964600.1
283	Manhole	530.25	527.45	Sealed	2324170.1	6964579.1
283.2D	Manhole	530.25	529.06	2D	2324171.1	6964580.1
290	Manhole	542.96	531.56	Stored	2323713.1	6967631.8
291A	Manhole	544.88	540.25	Sealed	2323663.0	6967663.3
291A.2D	Manhole	544.88	543.69	2D	2323664.0	6967664.3
291B	Manhole	544.13	540.38	Sealed	2323707.7	6967703.1
291B.2D	Manhole	544.13	542.94	2D	2323708.7	6967704.1
292A	Manhole	543.25	538.25	Sealed	2323684.2	6967580.1
292A.2D	Manhole	543.25	542.06	2D	2323685.2	6967581.1
292B	Manhole	544.12	539.72	Sealed	2323653.5	6967634.5
292B.2D	Manhole	544.12	542.93	2D	2323654.5	6967635.5
293	Manhole	548.84	543.34	Stored	2323484.6	6967499.6
294A	Manhole	548.87	545.62	Sealed	2323449.1	6967443.6
294A.2D	Manhole	548.87	547.68	2D	2323450.1	6967444.6
294B	Manhole	550.11	546.41	Sealed	2323417.7	6967498.0
294B.2D	Manhole	550.11	548.92	2D	2323418.7	6967499.0
295	Manhole	539.40	533.00	Stored	2323890.9	6967738.2
296A	Manhole	539.93	534.43	Sealed	2323850.0	6967748.7
296A.2D	Manhole	539.93	538.74	2D	2323851.0	6967749.7
296B	Manhole	538.90	534.40	Sealed	2323885.5	6967768.9
296B.2D	Manhole	538.90	537.71	2D	2323886.5	6967769.9
297A	Manhole	540.86	536.46	Sealed	2323931.0	6967821.9
297A.2D	Manhole	540.86	539.67	2D	2323932.0	6967822.9
297B	Manhole	538.46	533.36	Sealed	2323915.6	6967713.9
297B.2D	Manhole	538.46	537.27	2D	2323916.6	6967714.9
30	Manhole	529.20	518.55	Stored	2325358.2	6964779.6
300	Manhole	538.36	526.34	2D	2323846.1	6965490.7
305	Manhole	536.80	529.50	Sealed	2323660.8	6965548.1
306	Manhole	534.98	530.70	Sealed	2323671.4	6965556.0
306.2D	Manhole	534.98	533.79	2D	2323672.4	6965557.0
307	Manhole	535.19	530.79	Sealed	2323635.0	6965602.5
307.2D	Manhole	535.19	533.99	2D	2323636.0	6965603.5
31	Manhole	529.58	525.88	Sealed	2325358.3	6964825.2
31.2D	Manhole	529.58	528.39	2D	2325359.3	6964826.2
310	Manhole	536.72	533.17	Sealed	2323338.7	6965631.2
310.2D	Manhole	536.72	535.52	2D	2323339.7	6965632.2
312	Manhole	536.68	534.78	Sealed	2323306.0	6965634.9
312.2D	Manhole	536.68	535.49	2D	2323307.0	6965635.9
315	Manhole	537.38	528.08	Stored	2323815.8	6966252.8
316	Manhole	536.02	532.24	Sealed	2323852.4	6966352.0
316.2D	Manhole	536.02	534.83	2D	2323853.4	6966353.0
317	Manhole	537.05	535.10	Sealed	2323805.7	6966220.5

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
317.2D	Manhole	537.05	535.86	2D	2323806.7	6966221.5
318A	Manhole	536.83	533.68	Sealed	2323732.0	6966258.4
318A.2D	Manhole	536.83	535.64	2D	2323733.0	6966259.4
318B	Manhole	536.93	533.23	Sealed	2323767.8	6966286.9
318B.2D	Manhole	536.93	535.74	2D	2323768.8	6966287.9
318C	Manhole	536.03	530.88	Sealed	2323783.4	6966311.9
318C.2D	Manhole	536.03	534.84	2D	2323784.4	6966312.9
32	Manhole	529.38	525.08	Sealed	2325397.1	6964758.6
32.2D	Manhole	529.38	528.19	2D	2325398.1	6964759.6
320	Manhole	537.84	529.44	Stored	2323571.7	6966340.8
33	Manhole	529.31	523.71	Sealed	2325360.5	6964736.4
33.2D	Manhole	529.31	528.12	2D	2325361.5	6964737.4
330	Manhole	541.32	535.49	Stored	2323181.0	6966295.6
331	Manhole	541.14	538.02	Sealed	2323153.0	6966353.5
331.2D	Manhole	541.14	539.95	2D	2323154.0	6966354.5
332	Manhole	538.98	536.06	Sealed	2323273.8	6966303.7
332.2D	Manhole	538.98	537.79	2D	2323274.8	6966304.7
333	Manhole	542.14	539.38	Sealed	2323125.6	6966280.3
333.2D	Manhole	542.14	540.95	2D	2323126.6	6966281.3
334	Manhole	541.41	539.04	Sealed	2323129.1	6966319.4
334.2D	Manhole	541.41	540.22	2D	2323130.1	6966320.4
34	Manhole	529.52	525.55	Sealed	2325336.4	6964743.1
34.2D	Manhole	529.52	528.33	2D	2325337.4	6964744.1
345	Manhole	551.20	544.95	Sealed	2322890.0	6966014.6
346	Manhole	551.42	548.01	Sealed	2322894.2	6966070.2
346.2D	Manhole	551.42	550.23	2D	2322895.2	6966071.2
347	Manhole	551.82	548.37	Sealed	2322898.6	6966003.2
347.2D	Manhole	551.82	550.63	2D	2322899.6	6966004.2
348A	Manhole	552.78	550.23	Sealed	2322849.6	6966015.0
348A.2D	Manhole	552.78	551.59	2D	2322850.6	6966016.0
348B	Manhole	552.35	548.83	Sealed	2322859.6	6966044.6
348B.2D	Manhole	552.35	551.16	2D	2322860.6	6966045.6
35	Manhole	530.04	525.82	Sealed	2325315.2	6964780.1
35.2D	Manhole	530.04	528.85	2D	2325316.2	6964781.1
355	Manhole	566.94	555.90	Sealed	2322562.2	6965855.7
356	Manhole	565.42	561.95	Sealed	2322550.2	6965887.5
356.2D	Manhole	565.42	564.23	2D	2322551.2	6965888.5
357	Manhole	564.82	561.89	Sealed	2322557.6	6965833.3
357.2D	Manhole	564.82	563.63	2D	2322558.6	6965834.3
358	Manhole	565.52	562.62	Sealed	2322488.3	6965912.7
358.2D	Manhole	565.52	564.33	2D	2322489.3	6965913.7
36	Manhole	529.48	526.23	Sealed	2325321.1	6964804.2
36.2D	Manhole	529.48	528.29	2D	2325322.1	6964805.2
360	Manhole	567.59	556.60	Sealed	2322440.6	6965779.2
361	Manhole	566.18	563.81	Sealed	2322411.2	6965848.2
361.2D	Manhole	566.18	564.99	2D	2322412.2	6965849.2
362	Manhole	567.02	563.65	Sealed	2322407.9	6965802.3
362.2D	Manhole	567.02	565.83	2D	2322408.9	6965803.3
370	Manhole	566.83	558.23	Stored	2322139.6	6965535.2
371	Manhole	565.28	562.94	Sealed	2322078.9	6965665.1
371.2D	Manhole	565.28	564.09	2D	2322079.9	6965666.1

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
372	Manhole	567.08	558.13	Stored	2322150.7	6965531.6
373	Manhole	569.40	566.10	Sealed	2322260.2	6965497.3
373.2D	Manhole	569.40	568.21	2D	2322261.2	6965498.3
374	Manhole	565.23	561.01	Sealed	2322057.3	6965638.4
374.2D	Manhole	565.23	564.04	2D	2322058.3	6965639.4
375	Manhole	565.50	559.12	Sealed	2322064.2	6965642.2
380	Manhole	565.84	559.48	Stored	2321856.0	6965309.7
381	Manhole	565.16	563.06	Sealed	2321878.0	6965329.0
381.2D	Manhole	565.16	563.97	2D	2321879.0	6965330.0
382	Manhole	566.10	563.10	Sealed	2321885.1	6965320.6
382.2D	Manhole	566.10	564.91	2D	2321886.1	6965321.6
383	Manhole	566.66	562.44	Sealed	2321846.8	6965293.1
383.2D	Manhole	566.66	565.47	2D	2321847.8	6965294.1
390	Manhole	568.30	562.27	Stored	2321495.1	6965147.6
391	Manhole	568.35	562.27	Sealed	2321506.7	6965158.9
391.2D	Manhole	568.35	567.15	2D	2321507.7	6965159.9
392	Manhole	568.46	564.37	Sealed	2321481.2	6965138.4
392.2D	Manhole	568.46	567.27	2D	2321482.2	6965139.4
40	Manhole	530.50	519.55	Sealed	2325687.4	6964220.0
400	Manhole	538.28	532.60	Sealed	2323351.9	6966695.9
401	Manhole	537.69	535.21	Sealed	2323351.0	6966749.9
401.2D	Manhole	537.69	536.50	2D	2323352.0	6966750.9
402	Manhole	537.65	533.48	Sealed	2323393.3	6966680.2
402.2D	Manhole	537.65	536.46	2D	2323394.3	6966681.2
403	Manhole	537.73	533.93	Sealed	2323369.3	6966651.9
403.2D	Manhole	537.73	536.54	2D	2323370.3	6966652.9
404	Manhole	537.72	534.72	Sealed	2323325.5	6966646.5
404.2D	Manhole	537.72	536.53	2D	2323326.5	6966647.5
405	Manhole	538.42	533.43	Sealed	2323321.5	6966692.6
405.2D	Manhole	538.42	537.23	2D	2323322.5	6966693.6
406	Manhole	538.74	534.82	Sealed	2323322.1	6966743.1
406.2D	Manhole	538.74	537.55	2D	2323323.1	6966744.1
41	Manhole	530.30	526.60	Sealed	2325689.7	6964252.5
41.2D	Manhole	530.30	529.11	2D	2325690.7	6964253.5
410	Manhole	552.01	543.60	Stored	2322993.9	6967110.8
411	Manhole	552.36	547.54	Sealed	2322950.9	6967189.9
411.2D	Manhole	552.36	551.17	2D	2322951.9	6967190.9
412	Manhole	552.85	547.15	Sealed	2322962.2	6967089.4
412.2D	Manhole	552.85	551.65	2D	2322963.2	6967090.4
413	Manhole	552.69	548.42	Sealed	2322926.1	6967168.4
413.2D	Manhole	552.69	551.50	2D	2322927.1	6967169.4
42	Manhole	530.49	525.84	Sealed	2325713.1	6964245.8
42.2D	Manhole	530.49	529.30	2D	2325714.1	6964246.8
420	Manhole	550.57	544.80	Sealed	2323177.7	6967272.3
421	Manhole	550.05	546.19	Sealed	2323171.4	6967368.1
421.2D	Manhole	550.05	548.86	2D	2323172.4	6967369.1
422	Manhole	549.09	545.89	Sealed	2323190.8	6967277.4
422.2D	Manhole	549.09	547.90	2D	2323191.8	6967278.4
43	Manhole	530.46	525.81	Sealed	2325732.8	6964212.4
43.2D	Manhole	530.46	529.27	2D	2325733.8	6964213.4
44	Manhole	530.52	526.72	Sealed	2325665.6	6964173.6

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
44.2D	Manhole	530.52	529.33	2D	2325666.6	6964174.6
440	Manhole	555.25	549.56	Sealed	2322658.1	6966871.7
441	Manhole	555.08	550.90	Sealed	2322657.4	6966947.2
441.2D	Manhole	555.08	553.89	2D	2322658.4	6966948.2
442	Manhole	555.48	552.06	Sealed	2322665.1	6966842.1
442.2D	Manhole	555.48	554.29	2D	2322666.1	6966843.1
443	Manhole	555.38	551.21	Sealed	2322629.2	6966894.1
443.2D	Manhole	555.38	554.19	2D	2322630.2	6966895.1
444	Manhole	554.98	549.98	Sealed	2322632.0	6966924.5
444.2D	Manhole	554.98	553.79	2D	2322633.0	6966925.5
45	Manhole	530.44	525.99	Sealed	2325646.2	6964207.0
45.2D	Manhole	530.44	529.25	2D	2325647.2	6964208.0
450	Manhole	567.22	561.87	Stored	2321715.5	6966067.7
451	Manhole	567.28	563.14	Sealed	2321715.7	6966137.1
451.2D	Manhole	567.28	566.09	2D	2321716.7	6966138.1
452	Manhole	567.25	563.66	Sealed	2321755.4	6966088.1
452.2D	Manhole	567.25	566.06	2D	2321756.4	6966089.1
453	Manhole	567.52	563.65	Sealed	2321695.3	6966038.6
453.2D	Manhole	567.52	566.33	2D	2321696.3	6966039.6
454	Manhole	567.59	563.73	Sealed	2321653.0	6966085.3
454.2D	Manhole	567.59	566.40	2D	2321654.0	6966086.3
455	Manhole	567.70	563.70	Sealed	2321659.3	6966118.8
455.2D	Manhole	567.70	566.51	2D	2321660.3	6966119.8
456	Manhole	567.14	563.65	Sealed	2321684.6	6966139.9
456.2D	Manhole	567.14	565.95	2D	2321685.6	6966140.9
46	Manhole	530.20	525.70	Sealed	2325652.5	6964231.0
46.2D	Manhole	530.20	529.01	2D	2325653.5	6964232.0
460	Manhole	568.74	563.90	Sealed	2321440.4	6965841.2
461	Manhole	569.53	565.34	Sealed	2321364.9	6965875.8
461.2D	Manhole	569.53	568.34	2D	2321365.9	6965876.8
462	Manhole	568.90	565.10	Sealed	2321402.3	6965795.5
462.2D	Manhole	568.90	567.71	2D	2321403.3	6965796.5
463	Manhole	569.39	565.10	Sealed	2321360.8	6965843.1
463.2D	Manhole	569.39	568.20	2D	2321361.8	6965844.1
47	Manhole	530.42	520.50	Sealed	2325875.2	6964318.0
470	Manhole	573.61	567.00	Sealed	2321153.8	6965606.5
471	Manhole	571.92	568.84	Sealed	2321071.8	6965631.0
471.2D	Manhole	571.92	570.73	2D	2321072.8	6965632.0
472	Manhole	571.59	567.38	Sealed	2321109.1	6965552.3
472.2D	Manhole	571.59	570.40	2D	2321110.1	6965553.3
473	Manhole	572.37	567.75	Sealed	2321068.5	6965600.3
473.2D	Manhole	572.37	571.18	2D	2321069.5	6965601.3
48A	Manhole	529.02	527.62	Stored	2325904.5	6964360.7
48B	Manhole	530.25	526.50	Sealed	2325908.2	6964357.9
48B.2D	Manhole	530.25	529.06	2D	2325909.2	6964358.9
49A	Manhole	530.41	526.66	Sealed	2325958.6	6964343.6
49A.2D	Manhole	530.41	529.22	2D	2325959.6	6964344.6
49B	Manhole	530.73	526.78	Sealed	2325897.8	6964306.2
49B.2D	Manhole	530.73	529.54	2D	2325898.8	6964307.2
50	Manhole	532.07	520.37	Sealed	2326000.4	6963623.6
51	Manhole	530.68	525.48	Sealed	2325967.9	6963629.5

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
51.2D	Manhole	530.68	529.49	2D	2325968.9	6963630.5
52	Manhole	530.87	525.07	Sealed	2325991.6	6963598.4
52.2D	Manhole	530.87	529.68	2D	2325992.6	6963599.4
60	Manhole	530.94	520.49	Stored	2325103.6	6964638.6
61	Manhole	532.38	528.43	Sealed	2325126.4	6964691.7
61.2D	Manhole	532.38	531.19	2D	2325127.4	6964692.7
62	Manhole	530.81	527.26	Sealed	2325165.7	6964623.9
62.2D	Manhole	530.81	529.62	2D	2325166.7	6964624.9
63A	Manhole	531.16	527.08	Sealed	2325123.3	6964599.0
63A.2D	Manhole	531.16	529.97	2D	2325124.3	6964600.0
63B	Manhole	531.19	528.14	Sealed	2325099.0	6964605.6
63B.2D	Manhole	531.19	530.00	2D	2325100.0	6964606.6
64A	Manhole	531.26	527.31	Sealed	2325077.5	6964643.0
64A.2D	Manhole	531.26	530.07	2D	2325078.5	6964644.0
64B	Manhole	531.13	527.18	Sealed	2325083.5	6964666.7
64B.2D	Manhole	531.13	529.94	2D	2325084.5	6964667.7
65	Manhole	531.80	522.60	Sealed	2324879.5	6964503.9
66	Manhole	532.38	528.43	Sealed	2324893.2	6964556.5
66.2D	Manhole	532.38	531.19	2D	2324894.2	6964557.5
67	Manhole	532.45	528.40	Sealed	2324930.5	6964491.7
67.2D	Manhole	532.45	531.26	2D	2324931.5	6964492.7
68	Manhole	532.30	528.50	Sealed	2324860.9	6964454.0
68.2D	Manhole	532.30	531.11	2D	2324861.9	6964455.0
69	Manhole	532.35	528.55	Sealed	2324827.9	6964509.7
69.2D	Manhole	532.35	531.16	2D	2324828.9	6964510.7
70	Manhole	531.70	524.35	Stored	2324615.8	6964354.7
71	Manhole	531.96	528.12	Sealed	2324661.7	6964399.5
71.2D	Manhole	531.96	530.77	2D	2324662.7	6964400.5
72	Manhole	531.85	528.45	Sealed	2324680.3	6964365.6
72.2D	Manhole	531.85	530.66	2D	2324681.3	6964366.6
73	Manhole	531.50	527.50	Sealed	2324672.3	6964340.7
73.2D	Manhole	531.50	530.31	2D	2324673.3	6964341.7
74	Manhole	531.72	527.32	Sealed	2324629.2	6964316.0
74.2D	Manhole	531.72	530.53	2D	2324630.2	6964317.0
75	Manhole	531.96	527.81	Sealed	2324603.3	6964320.6
75.2D	Manhole	531.96	530.77	2D	2324604.3	6964321.6
76	Manhole	531.74	528.04	Sealed	2324586.3	6964356.3
76.2D	Manhole	531.74	530.55	2D	2324587.3	6964357.3
80	Manhole	531.13	526.18	Stored	2324422.5	6964241.7
81	Manhole	531.96	527.81	Sealed	2324425.3	6964263.0
81.2D	Manhole	531.96	530.77	2D	2324426.3	6964264.0
82	Manhole	531.42	528.52	Sealed	2324444.7	6964229.1
82.2D	Manhole	531.42	530.23	2D	2324445.7	6964230.1
83	Manhole	531.30	527.05	Sealed	2324398.5	6964182.6
83.2D	Manhole	531.30	530.11	2D	2324399.5	6964183.6
90	Manhole	531.30	523.02	Sealed	2325453.0	6964070.7
91	Manhole	531.47	527.47	Sealed	2325435.8	6964157.5
91.2D	Manhole	531.47	530.28	2D	2325436.8	6964158.5
92A	Manhole	531.46	527.91	Sealed	2325496.0	6964054.6
92A.2D	Manhole	531.46	530.27	2D	2325497.0	6964055.6
92B	Manhole	531.41	527.11	Sealed	2325453.1	6964029.6

Summary of Existing Nodes

Node ID	Node Type	Ground Level (ft AD)	Chamber Floor Level (ft AD)	Flood Type	X	Y
92B.2D	Manhole	531.41	530.22	2D	2325454.1	6964030.6
93A	Manhole	531.23	527.23	Sealed	2325429.2	6964035.8
93A.2D	Manhole	531.23	530.04	2D	2325430.2	6964036.8
93B	Manhole	531.45	527.25	Sealed	2325410.6	6964069.6
93B.2D	Manhole	531.45	530.26	2D	2325411.6	6964070.6
94	Manhole	531.38	527.53	Sealed	2325415.9	6964093.8
94.2D	Manhole	531.38	530.19	2D	2325416.9	6964094.8
95	Manhole	533.70	524.08	Sealed	2325209.0	6963930.3
96	Manhole	533.15	531.50	Sealed	2325157.5	6963941.2
96.2D	Manhole	533.15	531.96	2D	2325158.5	6963942.2
97	Manhole	533.21	528.34	Sealed	2325227.5	6963979.9
97.2D	Manhole	533.21	532.02	2D	2325228.5	6963980.9
98	Manhole	533.21	529.11	Sealed	2325260.9	6963921.7
98.2D	Manhole	533.21	532.02	2D	2325261.9	6963922.7
99	Manhole	533.20	529.20	Sealed	2325189.5	6963884.4
99.2D	Manhole	533.20	532.01	2D	2325190.5	6963885.4
Bazaar-Flap	Manhole	532.00	523.62	Sealed	2323472.5	6963061.8
Bazaar-Flap!	Manhole	532.00	523.56	Sealed	2323473.2	6963061.2
Bazaar-Gate	Manhole	557.00	523.00	Sealed	2323455.7	6963044.0
Bazaar-Headwa	Manhole	526.34	523.02	2D	2323387.5	6962877.3
Bazaar-OUT	Outfall	523.59	523.56	2D	2323474.0	6963063.2
Bazaar42-US	Manhole	531.40	530.20	2D	2323225.2	6962948.0

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
100	1	95	282.2	CIRC	36	36	525.05	524.08	0.015
101	1	100	43.5	CIRC	15	15	527.69	525.05	0.015
102	1	100	44.6	CIRC	18	18	527.55	525.05	0.015
103	1	100	48.1	CIRC	18	18	527.98	525.05	0.015
104	1	100	43.2	CIRC	18	18	527.84	525.05	0.015
105	1	100	45.4	CIRC	18	18	527.69	525.05	0.015
106	1	100	42.5	CIRC	18	18	526.21	525.05	0.015
110	1	100	251.4	CIRC	30	30	526.58	525.55	0.015
111	1	110	57.4	CIRC	27	27	527.41	526.58	0.015
112	1	110	38.3	CIRC	18	18	527.79	527.25	0.015
113	1	110	32.8	CIRC	18	18	528.01	526.58	0.015
114	1	110	30.7	CIRC	18	18	527.92	526.58	0.015
115	1	110	36.0	CIRC	21	21	528.08	526.58	0.015
120	1	140	224.6	CIRC	36	36	522.91	521.46	0.015
121	1	120	36.2	CIRC	18	18	528.45	527.21	0.015
122	1	120	30.3	CIRC	18	18	530.55	522.91	0.015
123	1	120	90.7	CIRC	18	18	529.67	522.91	0.015
124	1	120	91.2	CIRC	18	18	529.30	522.91	0.015
130	1	120	341.6	CIRC	30	30	524.40	522.91	0.015
131	1	130	38.8	CIRC	18	18	528.03	527.05	0.015
1310	1	170	264.9	CIRC	24	24	524.16	522.84	0.015
1311	1	1310	37.8	CIRC	18	18	527.22	526.50	0.015
1312	1	1310	62.7	CIRC	15	15	528.01	526.10	0.015
1313	1	1310	63.0	CIRC	18	18	528.29	525.80	0.015
132	1	130	52.5	CIRC	15	15	528.22	524.40	0.015
1320	1	20	362.0	ARCH	96	54	518.17	517.63	0.015
1321	1	1320	68.6	CIRC	18	18	526.23	518.17	0.015
1322	1	1320	29.9	CIRC	18	18	526.23	518.17	0.015
1323	1	1320	214.4	ARCH	96	54	518.16	517.94	0.015
1325	1	1323	61.1	CIRC	24	24	528.00	526.88	0.015
133	1	130	61.9	CIRC	18	18	528.01	524.40	0.015
1330	1	236	329.9	CIRC	24	24	526.08	522.00	0.015
1331	1	1330	66.5	CIRC	18	18	526.21	526.08	0.015
1332	1	1330	132.7	CIRC	12	12	527.56	526.08	0.015
1333	1	1330	36.4	CIRC	15	15	527.25	526.08	0.015
1334	1	1330	31.7	CIRC	15	15	527.66	526.08	0.015
1335	1	1330	32.8	CIRC	18	18	526.16	526.08	0.015
1336	1	236	45.5	CIRC	18	18	524.51	524.28	0.015
1337	1	236	49.8	CIRC	18	18	523.75	523.50	0.015
134	1	130	62.7	CIRC	15	15	528.73	524.85	0.015
135	1	130	54.5	CIRC	15	15	529.03	524.85	0.015
136	1	130	34.1	CIRC	18	18	529.28	526.70	0.015
137	1	130	33.4	CIRC	18	18	528.73	526.70	0.015
140	1	50	263.2	ARCH	60	45	521.46	521.12	0.015
1405A	1	1400	13.4	CIRC	42	42	522.87	522.50	0.015
141	1	140	87.2	CIRC	18	18	528.06	521.46	0.015
1410A	1	1405	205.6	CIRC	42	42	523.25	522.87	0.015
142	1	140	54.2	CIRC	24	24	527.12	521.46	0.015
1420	1	1410	309.8	CIRC	42	42	524.28	523.26	0.015
1421	1	1420	104.9	CIRC	27	27	528.74	526.79	0.015
1423	1	1420	54.2	CIRC	24	24	525.90	524.63	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
1425	1	1420	179.6	CIRC	42	42	524.59	524.28	0.015
1426	1	1425	46.7	CIRC	21	21	529.00	526.00	0.015
1427	1	1425	17.5	CIRC	18	18	529.34	526.00	0.015
1428	1	1429	152.4	CIRC	21	21	529.35	528.35	0.015
1429	1	1423	50.3	CIRC	24	24	527.70	525.90	0.015
143	1	140	63.3	CIRC	24	24	526.56	521.46	0.015
1430	1	1425	313.1	CIRC	42	42	525.13	524.59	0.015
1431	1	1430	16.8	CIRC	21	21	529.15	528.93	0.015
1432	1	1430	34.4	CIRC	21	21	529.76	525.13	0.015
1433	1	1430	43.5	CIRC	18	18	529.54	525.13	0.015
144	1	140	64.0	CIRC	24	24	527.00	521.46	0.015
1440	1	1430	128.5	CIRC	42	42	525.50	525.13	0.015
145	1	140	57.1	CIRC	15	15	527.73	521.46	0.015
1450	1	1440	279.0	CIRC	36	36	527.45	526.77	0.015
146	1	140	39.7	CIRC	24	24	526.91	521.46	0.015
1460	1	1450	290.9	CIRC	36	36	528.20	527.50	0.015
147	1	140	60.5	CIRC	18	18	528.28	521.46	0.015
1470	1	1460	220.1	CIRC	36	36	529.04	528.20	0.015
1471	1	1470	109.0	CIRC	18	18	531.49	530.34	0.015
1472	1	1473	95.9	CIRC	18	18	531.42	529.54	0.015
1473	1	1470	74.7	CIRC	30	30	530.24	529.04	0.015
1474	1	1473	196.3	CIRC	18	18	532.35	529.54	0.015
1475	1	1470	153.1	CIRC	24	24	531.28	530.34	0.015
148	1	140	29.7	CIRC	18	18	526.81	521.46	0.015
150	1	140	661.2	CIRC	36	36	523.80	521.46	0.015
151	1	150	43.8	CIRC	21	21	526.42	523.80	0.015
152A	1	150	75.9	CIRC	24	24	527.30	523.80	0.015
152B	1	150	75.3	CIRC	21	21	528.83	523.80	0.015
153	1	150	32.8	CIRC	24	24	528.01	523.82	0.015
154	1	150	21.4	CIRC	21	21	527.46	523.82	0.015
155	1	150	255.2	CIRC	24	24	526.74	523.82	0.015
156	1	155	55.7	CIRC	24	24	529.53	526.74	0.015
157	1	155	49.9	CIRC	24	24	530.16	526.74	0.015
158	1	155	49.3	CIRC	24	24	529.93	526.74	0.015
160	1	155	295.5	CIRC	24	24	528.94	526.74	0.015
161	1	160	33.9	CIRC	18	18	529.54	530.58	0.015
162	1	160	56.0	CIRC	18	18	529.39	528.91	0.015
163	1	160	56.6	CIRC	18	18	529.52	528.91	0.015
164	1	160	46.8	CIRC	18	18	530.15	528.91	0.015
165	1	160	36.8	CIRC	18	18	530.25	528.94	0.015
16A	1	16	128.0	OT2:1	156	102	515.04	499.10	0.015
170	1	20	355.4	CIRC	42	42	520.77	518.53	0.015
171	1	170	8.9	CIRC	15	15	524.02	520.77	0.015
172	1	170	55.9	CIRC	18	18	525.04	520.77	0.015
173	1	170	52.2	CIRC	15	15	523.06	520.77	0.015
1760	1	1840	322.9	CIRC	36	36	529.54	528.90	0.015
1761	1	1760	39.3	CIRC	18	18	532.23	529.54	0.015
1762	1	1760	41.4	CIRC	18	18	532.36	529.54	0.015
1763	1	1760	27.5	CIRC	18	18	532.56	529.54	0.015
1764	1	1760	33.8	CIRC	18	18	532.21	529.54	0.015
1765	1	1760	35.9	CIRC	18	18	531.99	529.54	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
1770	1	1760	217.9	CIRC	36	36	530.10	529.54	0.015
1771	1	1770	25.4	CIRC	18	18	532.99	530.10	0.015
1772	1	1770	23.3	CIRC	18	18	532.72	530.10	0.015
1790	1	1770	353.5	CIRC	30	30	530.80	530.10	0.015
1791	1	1790	16.8	CIRC	18	18	532.33	530.80	0.015
1792	1	1790	16.5	CIRC	21	21	531.73	530.80	0.015
180	1	170	667.7	CIRC	42	42	523.45	520.77	0.015
1800	1	1790	300.1	CIRC	30	30	531.40	530.80	0.015
1801	1	1800	31.8	CIRC	15	15	532.42	531.40	0.015
1802	1	1800	33.1	CIRC	24	24	532.03	531.40	0.015
1805A	1	1805	156.6	OT2:1	120	72	523.02	519.86	0.015
181	1	180	58.1	CIRC	18	18	529.72	523.45	0.015
1810	1	1806A	289.4	RECT	38.4	105.6	526.58	523.02	0.015
1810	2	1806B	171.6	RECT	38.4	105.6	526.58	523.02	0.015
1812	1	1810A	174.1	RECT	68.4	105.6	526.41	526.58	0.015
1815	1	1812	278.0	ARCH	60	54	525.76	526.41	0.015
1819	1	1815	109.6	ARCH	60	54	526.91	525.76	0.015
182	1	180	55.5	CIRC	18	18	529.04	523.45	0.015
1820	1	1819	42.3	ARCH	60	54	527.05	526.97	0.015
1821	1	1819	21.4	CIRC	18	18	532.89	526.97	0.015
1822	1	1819	24.6	CIRC	21	21	533.47	526.97	0.015
1823	1	1825	31.0	CIRC	18	18	534.34	532.20	0.015
1824	1	1825	18.9	CIRC	18	18	532.99	532.50	0.015
1825	1	1820	128.2	CIRC	24	24	532.00	530.00	0.015
1830	1	1820	558.1	ARCH	60	45	528.04	526.95	0.015
1831	1	1830	34.2	CIRC	18	18	530.83	527.77	0.015
1832	1	1830	33.9	CIRC	18	18	530.69	527.77	0.015
1833	1	1830	33.0	CIRC	18	18	530.67	527.77	0.015
1834	1	1830	33.7	CIRC	18	18	530.84	527.77	0.015
1835	1	1830	33.5	CIRC	18	18	531.46	527.77	0.015
1836	1	1830	33.2	CIRC	18	18	531.57	527.77	0.015
1837	1	1830	34.4	CIRC	18	18	533.19	527.77	0.015
1838	1	1830	35.0	CIRC	18	18	531.74	527.77	0.015
1840	1	1830	312.5	ARCH	48	43	528.30	527.77	0.015
1841	1	1840	36.5	CIRC	18	18	532.33	528.30	0.015
1842	1	1840	35.2	CIRC	21	21	532.05	528.30	0.015
1843	1	1840	35.0	CIRC	21	21	532.38	528.30	0.015
1844	1	1840	36.4	CIRC	18	18	532.16	528.30	0.015
1845	1	1840	38.6	CIRC	18	18	532.35	528.30	0.015
1846	1	1840	39.8	CIRC	18	18	532.20	528.30	0.015
1847	1	1840	47.6	CIRC	18	18	531.58	528.30	0.015
1848	1	1840	43.9	CIRC	18	18	533.49	528.30	0.015
1850	1	1840	707.5	ARCH	36	24	529.74	529.00	0.015
1851	1	1850	76.2	CIRC	25.2	25.2	530.29	529.74	0.015
1852	1	1850	40.0	CIRC	18	18	530.80	529.74	0.015
1853	1	1850	16.7	CIRC	18	18	531.01	529.74	0.015
1854	1	1850	22.5	CIRC	18	18	530.76	529.74	0.015
1855	1	1850	50.5	CIRC	12	12	530.73	529.74	0.015
1870	1	1815	40.3	CIRC	24	24	530.10	527.16	0.015
1880	1	1870	220.2	CIRC	24	24	532.50	530.10	0.015
1881	1	1880	21.8	CIRC	18	18	533.76	533.30	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
1882	1	1880	37.6	CIRC	15	15	533.31	533.30	0.015
1883	1	1880	66.6	CIRC	18	18	533.42	533.30	0.015
1884	1	1885	29.2	CIRC	15	15	533.63	533.33	0.015
1885	1	1880	21.5	CIRC	15	15	533.33	533.00	0.015
190	1	180	162.9	CIRC	42	42	524.13	523.45	0.015
191	1	190	17.6	CIRC	12	12	527.71	524.13	0.015
192	1	190	34.7	CIRC	24	24	528.41	524.13	0.015
1925	1	1820	40.0	CIRC	24	24	530.70	527.18	0.015
1930	1	1925	231.8	CIRC	24	24	531.80	530.70	0.015
1932	1	1930	36.0	CIRC	18	18	532.46	532.97	0.015
1933	1	1934	8.6	CIRC	8	8	535.78	533.32	0.015
1934	1	1930	69.8	CIRC	18	18	532.79	532.44	0.015
1935	1	1930	81.7	CIRC	15	15	533.16	532.75	0.015
1936	1	1937	25.4	CIRC	18	18	533.19	532.84	0.015
1937	1	1930	19.5	CIRC	15	15	532.92	532.44	0.015
20	1	20B	16.8	ARCH	144	86	517.63	517.52	0.015
200	1	190	122.9	CIRC	42	42	524.57	524.13	0.015
20B	1	20C	73.8	20B.1	144	87	517.52	517.09	0.015
20D	1	17A	108.5	RECT	60	60	516.63	515.04	0.015
20D	2	17B	107.5	RECT	60	60	516.63	515.10	0.015
20D	3	17C	109.2	RECT	60	60	516.63	515.21	0.015
210	1	200	207.7	CIRC	36	36	526.28	524.57	0.015
220	1	210	85.0	CIRC	36	36	527.23	526.28	0.015
220AA	1	220	45.9	CIRC	36	36	527.51	527.23	0.015
230	1	220AA	204.3	CIRC	36	36	528.76	527.51	0.015
231	1	230	19.4	CIRC	18	18	532.12	528.76	0.015
232	1	230	28.2	CIRC	21	21	530.42	528.76	0.015
233	1	230	48.6	CIRC	21	21	532.25	528.76	0.015
234	1	230	62.3	CIRC	18	18	531.54	528.76	0.015
235A	1	230	72.4	CIRC	18	18	532.32	528.76	0.015
235B	1	230	74.1	CIRC	18	18	532.48	528.76	0.015
236	1	20	300.2	ARCH	78	62	519.40	518.13	0.015
237A	1	230	61.0	CIRC	21	21	532.48	528.76	0.015
237B	1	230	43.0	CIRC	21	21	532.32	528.76	0.015
238	2	236	232.6	ARCH	78	61	520.47	519.40	0.015
239A	1	238	51.0	CIRC	18	18	528.03	523.42	0.015
239B	1	238	154.8	CIRC	18	18	529.94	523.42	0.015
240	1	238	102.3	ARCH	84	109	520.86	520.47	0.015
250	1	260	318.1	ARCH	36	24	522.96	522.15	0.015
251	1	250	112.9	CIRC	21	21	527.06	522.96	0.015
252	1	250	162.1	CIRC	18	18	526.75	522.96	0.015
253	1	250	116.2	CIRC	12	12	527.46	522.96	0.015
260	1	240	234.9	ARCH	78	54	522.15	521.43	0.015
264	1	260	108.7	ARCH	78	54	522.83	522.15	0.015
270	1	250	295.5	ARCH	36	24	523.61	522.96	0.015
271	1	270	39.8	CIRC	18	18	526.37	523.61	0.015
272	1	270	129.0	CIRC	18	18	527.81	523.61	0.015
273	1	270	33.8	CIRC	18	18	528.74	523.61	0.015
274	1	270	36.0	CIRC	18	18	527.32	523.61	0.015
275	1	270	38.4	CIRC	18	18	526.43	523.61	0.015
280	1	270	256.6	CIRC	24	24	527.24	523.61	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
281	1	280	37.6	CIRC	18	18	527.86	527.24	0.015
282	1	280	38.7	CIRC	18	18	527.56	527.24	0.015
283	1	280	43.8	CIRC	18	18	527.45	527.24	0.015
290	1	220AA	938.7	CIRC	36	36	531.56	528.19	0.015
291A	1	290	59.1	CIRC	18	18	540.25	531.56	0.015
291B	1	290	71.5	CIRC	18	18	540.38	531.56	0.015
292A	1	290	59.2	CIRC	18	18	538.25	531.56	0.015
292B	1	290	59.6	CIRC	18	18	539.72	531.56	0.015
293	1	290	264.0	CIRC	18	18	543.34	531.56	0.015
294A	1	293	66.3	CIRC	18	18	545.62	545.39	0.015
294B	1	293	66.9	CIRC	18	18	546.41	545.44	0.015
295	1	290	207.2	CIRC	24	24	533.00	531.56	0.015
296A	1	296B	42.2	CIRC	18	18	534.43	534.40	0.015
296B	1	295	31.2	CIRC	18	18	534.40	533.00	0.015
297A	1	295	92.8	CIRC	18	18	536.46	533.00	0.015
297B	1	295	34.7	CIRC	18	18	533.36	533.00	0.015
30	1	1323	395.2	ARCH	96	54	518.55	518.16	0.015
305	1	300	193.9	CIRC	24	24	529.50	526.34	0.015
306	1	305	13.3	CIRC	18	18	530.70	529.50	0.015
307	1	305	60.2	CIRC	24	24	530.79	529.50	0.015
31	1	30	45.6	CIRC	18	18	525.88	518.55	0.015
310	1	307	346.8	CIRC	24	24	533.17	530.84	0.015
312	1	310	32.9	CIRC	18	18	534.78	533.67	0.015
315	1	300	792.0	ARCH	60	54	528.08	526.34	0.015
316	1	315	105.7	CIRC	18	18	532.24	528.08	0.015
317	1	315	33.8	CIRC	15	15	535.10	528.08	0.015
318A	1	315	84.0	CIRC	15	15	533.68	528.08	0.015
318B	1	315	58.9	CIRC	24	24	533.23	528.08	0.015
318C	1	315	67.4	CIRC	24	24	530.88	528.08	0.015
32	1	30	44.1	CIRC	24	24	525.08	518.55	0.015
320	1	315	259.5	ARCH	60	54	529.44	528.08	0.015
33	1	30	43.2	CIRC	18	18	523.71	518.55	0.015
330	1	320	398.5	ARCH	48	43	535.49	529.44	0.015
331	1	330	64.4	CIRC	18	18	538.02	535.49	0.015
332	1	330	93.1	CIRC	15	15	536.06	535.49	0.015
333	1	330	57.5	CIRC	15	15	539.38	535.49	0.015
334	1	330	57.1	CIRC	15	15	539.04	535.49	0.015
34	1	30	42.5	CIRC	24	24	525.55	518.55	0.015
345	1	330	404.6	ARCH	48	43	544.95	535.49	0.015
346	1	345	55.8	CIRC	15	15	548.01	544.95	0.015
347	1	345	14.3	CIRC	15	15	548.37	544.95	0.015
348A	1	345	40.4	CIRC	15	15	550.23	544.95	0.015
348B	1	345	42.7	CIRC	21	21	548.83	544.95	0.015
35	1	30	43.0	CIRC	24	24	525.82	518.55	0.015
355	1	345	365.4	ARCH	48	43	555.90	544.95	0.015
356	1	355	34.0	CIRC	15	15	561.95	555.90	0.015
357	1	355	22.9	CIRC	15	15	561.89	555.90	0.015
358	1	355	93.3	CIRC	15	15	562.62	555.90	0.015
36	1	30	44.5	CIRC	18	18	526.23	518.55	0.015
360	1	355	144.4	ARCH	60	45	556.60	555.90	0.015
361	1	360	75.0	CIRC	15	15	563.81	556.60	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
362	1	360	40.0	CIRC	15	15	563.65	556.60	0.015
370	1	372	11.7	CIRC	42	42	558.23	558.22	0.015
371	1	375	27.2	CIRC	15	15	562.94	559.12	0.015
372	1	360	413.5	ARCH	60	45	558.13	556.60	0.015
373	1	372	114.8	CIRC	18	18	566.10	558.13	0.015
374	1	375	7.9	CIRC	18	18	561.01	559.12	0.015
375	1	370	130.9	CIRC	36	36	559.12	558.23	0.015
380	1	372	369.5	ARCH	48	43	559.90	558.13	0.015
381	1	380	29.3	CIRC	12	12	563.06	559.48	0.015
382	1	380	31.1	CIRC	12	12	563.10	559.48	0.015
383	1	380	18.9	CIRC	18	18	562.44	559.48	0.015
390	1	391	16.2	CIRC	36	36	562.27	562.31	0.015
391	1	380	391.0	ARCH	48	35	562.27	559.78	0.015
392	1	390	16.6	CIRC	24	24	564.37	562.40	0.015
40	1	30	649.2	ARCH	78	54	519.55	518.55	0.015
400	1	320	418.6	CIRC	24	24	532.60	529.44	0.015
401	1	400	54.0	CIRC	15	15	535.21	532.60	0.015
402	1	400	44.2	CIRC	15	15	533.48	532.60	0.015
403	1	400	47.3	CIRC	18	18	533.93	532.60	0.015
404	1	400	56.1	CIRC	15	15	534.72	532.60	0.015
405	1	400	30.7	CIRC	18	18	533.43	532.60	0.015
406	1	400	55.8	CIRC	15	15	534.82	532.60	0.015
41	1	40	32.6	CIRC	24	24	526.60	519.55	0.015
410	1	400	548.0	CIRC	24	24	543.60	532.60	0.015
411	1	410	90.0	CIRC	21	21	547.54	543.60	0.015
412	1	410	38.2	CIRC	24	24	547.15	544.23	0.015
413	1	410	88.9	CIRC	21	21	548.42	543.60	0.015
42	1	40	36.4	CIRC	24	24	525.84	519.55	0.015
420	1	410	244.7	CIRC	24	24	544.80	543.60	0.015
421	1	420	96.0	CIRC	15	15	546.19	544.80	0.015
422	1	420	14.1	CIRC	15	15	545.89	544.80	0.015
43	1	40	46.0	CIRC	24	24	525.81	519.55	0.015
44	1	40	51.4	CIRC	24	24	526.72	519.55	0.015
440	1	412	412.2	CIRC	24	24	549.56	547.15	0.015
441	1	440	75.6	CIRC	24	24	550.90	549.56	0.015
442	1	440	30.4	CIRC	18	18	552.06	549.56	0.015
443	1	440	36.5	CIRC	24	24	551.21	549.56	0.015
444	1	440	59.0	CIRC	18	18	549.98	549.56	0.015
45	1	40	43.2	CIRC	24	24	525.99	519.55	0.015
450	1	375	550.3	CIRC	24	24	561.87	559.12	0.015
451	1	450	69.4	CIRC	18	18	563.14	561.87	0.015
452	1	450	44.8	CIRC	18	18	563.66	561.87	0.015
453	1	450	35.5	CIRC	18	18	563.65	561.87	0.015
454	1	450	65.0	CIRC	18	18	563.73	561.87	0.015
455	1	450	75.9	CIRC	18	18	563.70	561.87	0.015
456	1	450	78.5	CIRC	24	24	563.65	561.97	0.015
46	1	40	36.7	CIRC	21	21	525.70	519.55	0.015
460	1	450	356.4	CIRC	24	24	563.90	561.87	0.015
461	1	460	83.0	CIRC	18	18	565.34	563.90	0.015
462	1	460	59.5	CIRC	18	18	565.10	563.90	0.015
463	1	460	79.6	CIRC	18	18	565.10	563.90	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
47	1	40	211.8	CIRC	24	24	520.50	519.55	0.015
470	1	460	370.4	CIRC	24	24	567.00	564.40	0.015
471	1	470	85.6	CIRC	18	18	568.84	567.00	0.015
472	1	470	70.3	CIRC	15	15	567.38	567.00	0.015
473	1	470	85.5	CIRC	18	18	567.75	567.00	0.015
48A	1	48B	4.6	CIRC	8	8	527.62	527.08	0.015
48B	1	47	51.8	CIRC	18	18	526.50	525.00	0.015
49A	1	47	87.3	CIRC	18	18	526.66	525.00	0.015
49B	1	47	25.5	CIRC	18	18	526.78	525.00	0.015
50	1	40	699.9	ARCH	78	54	520.37	519.55	0.015
51	1	50	33.0	CIRC	24	24	525.48	520.37	0.015
52	1	50	26.7	CIRC	24	24	525.07	520.37	0.015
60	1	30	291.0	CIRC	30	30	520.49	519.83	0.015
61	1	60	57.8	CIRC	12	12	528.43	528.00	0.015
62	1	60	63.8	CIRC	18	18	527.26	527.00	0.015
63A	1	60	44.2	CIRC	18	18	527.08	520.49	0.015
63B	1	60	33.4	CIRC	15	15	528.14	520.49	0.015
64A	1	60	26.5	CIRC	15	15	527.31	526.59	0.015
64B	1	60	34.5	CIRC	18	18	527.18	526.59	0.015
65	1	60	261.5	CIRC	30	30	522.60	520.49	0.015
66	1	65	54.4	CIRC	12	12	528.43	522.60	0.015
67	1	65	52.5	CIRC	12	12	528.40	522.60	0.015
68	1	65	53.2	CIRC	18	18	528.50	522.60	0.015
69	1	65	51.9	CIRC	18	18	528.55	522.60	0.015
70	1	65	303.0	CIRC	24	24	524.35	522.60	0.015
71	1	70	64.2	CIRC	18	18	528.12	524.35	0.015
72	1	70	65.5	CIRC	18	18	528.45	524.35	0.015
73	1	70	58.3	CIRC	18	18	527.50	524.35	0.015
74	1	70	41.0	CIRC	18	18	527.32	525.47	0.015
75	1	70	36.3	CIRC	18	18	527.81	525.47	0.015
76	1	70	29.5	CIRC	18	18	528.04	524.35	0.015
80	1	70	223.8	CIRC	24	24	526.18	524.35	0.015
81	1	80	21.4	CIRC	18	18	527.81	526.18	0.015
82	1	80	25.6	CIRC	18	18	528.52	526.18	0.015
83	1	80	63.8	CIRC	24	24	527.05	526.18	0.015
90	1	40	277.9	CIRC	36	36	523.02	522.13	0.015
91	1	90	88.5	CIRC	18	18	527.47	523.02	0.015
92A	1	90	45.9	CIRC	18	18	527.91	523.02	0.015
92B	1	90	41.1	CIRC	18	18	527.11	523.02	0.015
93A	1	90	42.3	CIRC	18	18	527.23	523.02	0.015
93B	1	90	42.5	CIRC	15	15	527.25	523.02	0.015
94	1	90	43.7	CIRC	18	18	527.53	523.02	0.015
95	1	90	281.5	CIRC	36	36	524.08	523.02	0.015
96	1	95	52.6	CIRC	6	6	531.50	524.08	0.015
97	1	95	52.9	CIRC	18	18	528.34	524.08	0.015
98	1	95	52.6	CIRC	18	18	529.11	524.08	0.015
99	1	95	49.9	CIRC	18	18	529.20	524.08	0.015
Bazaar-Gate	1	Bazaar-Flap	24.8	RECT	48	48	523.00	523.65	0.015
Bazaar-Gate	2	Bazaar-Flap!	24.8	RECT	48	48	523.00	523.59	0.015

Summary of Existing Links

US Node ID	Link Suffix	DS Node ID	Length (ft)	Shape ID	Width (in)	Height (in)	US Invert Level (ft AD)	DS Invert Level (ft AD)	Manning's N
Bazaar-Headwall	1	Bazaar-Gate	141.8	RECT	48	48	523.02	523.00	0.015
Bazaar42-US	1	Bazaar-Headwall	108.0	CIRC	42	42	530.20	529.50	0.015

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
101.2D	2	101	Weir	530.31	5	0.67
102.2D	2	102	Weir	530.62	5	0.67
103.2D	2	103	Weir	530.52	5	0.67
104.2D	2	104	Weir	530.50	5	0.67
105.2D	2	105	Weir	530.38	5	0.67
106.2D	2	106	Weir	529.95	10	0.67
111.2D	2	111	Weir	530.30	10	0.67
112.2D	2	112	Weir	530.43	5	0.67
113.2D	2	113	Weir	530.35	5	0.67
114.2D	2	114	Weir	530.46	5	0.67
115.2D	2	115	Weir	530.27	5	0.67
121.2D	2	121	Weir	531.09	5	0.67
122.2D	2	122	Weir	532.99	5	0.67
123.2D	2	123	Weir	532.11	5	0.67
124.2D	2	124	Weir	531.84	8	0.67
131.2D	2	131	Weir	530.47	10	0.67
1311.2D	2	1311	Weir	530.10	5	0.67
1312.2D	2	1312	Weir	529.90	5	0.67
1313.2D	2	1313	Weir	529.98	5	0.67
132.2D	2	132	Weir	530.96	5	0.67
1321.2D	2	1321	Weir	528.32	5	0.67
1322.2D	2	1322	Weir	528.32	10	0.67
133.2D	2	133	Weir	531.09	5	0.67
1331.2D	2	1331	Weir	528.05	3	0.67
1332.2D	2	1332	Weir	529.40	3	0.67
1333.2D	2	1333	Weir	529.39	5	0.67
1334.2D	2	1334	Weir	529.20	5	0.67
1335.2D	2	1335	Weir	529.05	5	0.67
1336.2D	2	1336	Weir	527.95	10	0.67
1337.2D	2	1337	Weir	527.89	10	0.67
134.2D	2	134	Weir	530.87	5	0.67
135.2D	2	135	Weir	530.77	5	0.67
136.2D	2	136	Weir	530.77	5	0.67
137.2D	2	137	Weir	530.97	5	0.67
141.2D	2	141	Weir	530.30	10	0.67
142.2D	2	142	Weir	530.36	10	0.67
1420.2D	1	1420	Weir	534.83	20	0.67
1423.2D	1	1423	Weir	532.13	5	0.67
1426.2D	2	1426	Weir	532.44	10	0.67
1427.2D	2	1427	Weir	532.88	10	0.67
1428.2D	1	1428	Weir	533.73	10	0.67
1429.2D	1	1429	Weir	532.93	20	0.67
143.2D	2	143	Weir	530.30	10	0.67
1431.2D	2	1431	Weir	532.66	20	0.67
1432.2D	2	1432	Weir	532.60	10	0.67
1433.2D	2	1433	Weir	532.68	10	0.67
144.2D	2	144	Weir	530.27	10	0.67
145.2D	2	145	Weir	530.19	10	0.67
1450.2D	1	1450	Weir	530.53	20	0.67
146.2D	2	146	Weir	530.25	10	0.67
1460.2D	1	1460	Weir	533.38	20	0.67

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
147.2D	2	147	Weir	530.47	10	0.67
1470.2D	1	1470	Weir	533.47	10	0.67
1471.2D	1	1471	Weir	534.27	5	0.67
1472.2D	1	1472	Weir	533.65	10	0.67
1473.2D	1	1473	Weir	533.14	10	0.67
1474.2D	1	1474	Weir	533.98	5	0.67
1475.2D	1	1475	Weir	533.76	5	0.67
148.2D	2	148	Weir	529.95	10	0.67
151.2D	2	151	Weir	530.26	10	0.67
152A.2D	2	152A	Weir	530.54	10	0.67
152B.2D	2	152B	Weir	530.38	10	0.67
153.2D	2	153	Weir	530.98	10	0.67
154.2D	2	154	Weir	530.80	10	0.67
156.2D	2	156	Weir	532.57	10	0.67
157.2D	2	157	Weir	533.10	10	0.67
158.2D	2	158	Weir	532.97	10	0.67
161.2D	2	161	Weir	532.68	10	0.67
162.2D	2	162	Weir	532.33	10	0.67
163.2D	2	163	Weir	532.56	10	0.67
164.2D	2	164	Weir	532.67	10	0.67
165.2D	2	165	Weir	532.77	10	0.67
171.2D	2	171	Weir	527.56	5	0.67
172.2D	2	172	Weir	527.68	5	0.67
173.2D	2	173	Weir	527.75	5	0.67
1761.2D	2	1761	Weir	534.95	5	0.67
1762.2D	2	1762	Weir	535.32	5	0.67
1763.2D	2	1763	Weir	535.32	5	0.67
1764.2D	2	1764	Weir	535.15	5	0.67
1765.2D	2	1765	Weir	534.93	5	0.67
1771.2D	2	1771	Weir	536.18	5	0.67
1772.2D	2	1772	Weir	536.16	5	0.67
1791.2D	2	1791	Weir	535.05	10	0.67
1792.2D	2	1792	Weir	535.02	10	0.67
1801.2D	2	1801	Weir	534.30	10	0.67
1802.2D	2	1802	Weir	534.27	10	0.67
181.2D	2	181	Weir	532.66	5	0.67
182.2D	2	182	Weir	532.07	5	0.67
1821.2D	2	1821	Weir	536.98	5	0.67
1822.2D	2	1822	Weir	536.15	10	0.67
1823.2D	2	1823	Weir	535.88	5	0.67
1824.2D	2	1824	Weir	535.75	5	0.67
1831.2D	2	1831	Weir	533.77	5	0.67
1832.2D	2	1832	Weir	533.93	10	0.67
1833.2D	2	1833	Weir	533.90	5	0.67
1834.2D	2	1834	Weir	533.86	5	0.67
1835.2D	2	1835	Weir	533.96	5	0.67
1836.2D	2	1836	Weir	533.89	5	0.67
1837.2D	2	1837	Weir	533.90	5	0.67
1838.2D	2	1838	Weir	533.78	5	0.67
1841.2D	2	1841	Weir	535.12	5	0.67
1842.2D	2	1842	Weir	535.43	5	0.67

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
1843.2D	2	1843	Weir	535.49	5	0.67
1844.2D	2	1844	Weir	535.08	5	0.67
1845.2D	2	1845	Weir	535.19	5	0.67
1846.2D	2	1846	Weir	535.29	5	0.67
1847.2D	2	1847	Weir	535.32	5	0.67
1848.2D	2	1848	Weir	535.06	5	0.67
1851.2D	2	1851	Weir	533.77	10	0.67
1852.2D	2	1852	Weir	533.74	5	0.67
1853.2D	2	1853	Weir	534.10	5	0.67
1854.2D	2	1854	Weir	533.90	10	0.67
1855.2D	2	1855	Weir	533.92	5	0.67
1881.2D	2	1881	Weir	536.74	5	0.67
1882.2D	2	1882	Weir	536.45	10	0.67
1883.2D	2	1883	Weir	536.41	10	0.67
1884.2D	2	1884	Weir	536.17	5	0.67
1885.2D	2	1885	Weir	536.59	5	0.67
191.2D	2	191	Weir	529.15	10	0.67
192.2D	2	192	Weir	529.58	10	0.67
1930.2D	1	1930	Weir	535.80	10	0.5
1932.2D	2	1932	Weir	535.30	10	0.67
1934.2D	2	1934	Weir	535.03	5	0.67
1935.2D	2	1935	Weir	535.65	5	0.67
1936.2D	2	1936	Weir	535.54	5	0.67
1937.2D	2	1937	Weir	535.81	5	0.67
210.2D	1	210	Weir	531.51	20	0.67
220.2D	1	220	Weir	538.79	20	0.67
231.2D	2	231	Weir	534.86	5	0.67
232.2D	2	232	Weir	534.91	5	0.67
233.2D	2	233	Weir	535.04	5	0.67
234.2D	2	234	Weir	534.83	5	0.67
235A.2D	2	235A	Weir	534.76	5	0.67
235B.2D	2	235B	Weir	534.92	5	0.67
237A.2D	2	237A	Weir	534.87	5	0.67
237B.2D	2	237B	Weir	534.84	5	0.67
239A.2D	2	239A	Weir	531.37	5	0.67
239B.2D	2	239B	Weir	531.75	5	0.67
251.2D	2	251	Weir	529.15	5	0.67
252.2D	2	252	Weir	529.21	5	0.67
253.2D	2	253	Weir	528.77	5	0.67
271.2D	2	271	Weir	529.36	5	0.67
272.2D	2	272	Weir	530.00	5	0.67
273.2D	2	273	Weir	529.48	5	0.67
274.2D	2	274	Weir	529.76	5	0.67
275.2D	2	275	Weir	529.62	5	0.67
281.2D	2	281	Weir	529.93	5	0.67
282.2D	2	282	Weir	529.65	5	0.67
283.2D	2	283	Weir	529.09	3	0.67
291A.2D	2	291A	Weir	543.72	10	0.67
291B.2D	2	291B	Weir	542.97	10	0.67
292A.2D	2	292A	Weir	542.09	5	0.67
292B.2D	2	292B	Weir	542.96	10	0.67

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
294A.2D	2	294A	Weir	547.71	5	0.67
294B.2D	2	294B	Weir	548.95	10	0.67
296A.2D	2	296A	Weir	538.77	5	0.67
296B.2D	2	296B	Weir	537.74	10	0.67
297A.2D	2	297A	Weir	539.70	10	0.67
297B.2D	2	297B	Weir	537.30	5	0.67
306.2D	2	306	Weir	533.82	5	0.67
307.2D	1	307	Weir	534.02	5	0.67
31.2D	2	31	Weir	528.42	10	0.67
310.2D	1	310	Weir	535.55	5	0.67
312.2D	2	312	Weir	535.52	5	0.67
316.2D	2	316	Weir	534.86	5	0.67
317.2D	2	317	Weir	535.89	5	0.67
318A.2D	2	318A	Weir	535.67	5	0.67
318B.2D	2	318B	Weir	535.77	10	0.67
318C.2D	2	318C	Weir	534.87	10	0.67
32.2D	2	32	Weir	528.22	10	0.67
33.2D	2	33	Weir	528.15	10	0.67
331.2D	2	331	Weir	539.98	5	0.67
332.2D	2	332	Weir	537.82	5	0.67
333.2D	2	333	Weir	540.98	5	0.67
334.2D	2	334	Weir	540.25	5	0.67
34.2D	2	34	Weir	528.36	10	0.67
346.2D	2	346	Weir	550.26	10	0.67
347.2D	2	347	Weir	550.66	5	0.67
348A.2D	2	348A	Weir	551.62	5	0.67
348B.2D	2	348B	Weir	551.19	10	0.67
35.2D	2	35	Weir	528.88	10	0.67
356.2D	2	356	Weir	564.26	5	0.67
357.2D	2	357	Weir	563.66	5	0.67
358.2D	2	358	Weir	564.36	5	0.67
36.2D	2	36	Weir	528.32	10	0.67
361.2D	2	361	Weir	565.02	5	0.67
362.2D	2	362	Weir	565.86	5	0.67
371.2D	2	371	Weir	564.12	5	0.67
373.2D	2	373	Weir	568.24	5	0.67
374.2D	2	374	Weir	564.07	5	0.67
381.2D	2	381	Weir	564.00	5	0.67
382.2D	2	382	Weir	564.94	5	0.67
383.2D	2	383	Weir	565.50	5	0.67
391.2D	1	391	Weir	567.18	5	0.67
392.2D	2	392	Weir	567.30	10	0.67
401.2D	2	401	Weir	536.53	5	0.67
402.2D	2	402	Weir	536.49	5	0.67
403.2D	2	403	Weir	536.57	5	0.67
404.2D	2	404	Weir	536.56	5	0.67
405.2D	2	405	Weir	537.26	5	0.67
406.2D	2	406	Weir	537.58	5	0.67
41.2D	2	41	Weir	529.14	10	0.67
411.2D	2	411	Weir	551.20	5	0.67
412.2D	1	412	Weir	551.68	5	0.67

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
413.2D	2	413	Weir	551.53	5	0.67
42.2D	2	42	Weir	529.33	10	0.67
421.2D	2	421	Weir	548.89	10	0.67
422.2D	2	422	Weir	547.93	5	0.67
43.2D	2	43	Weir	529.30	10	0.67
44.2D	2	44	Weir	529.36	10	0.67
441.2D	2	441	Weir	553.92	5	0.67
442.2D	2	442	Weir	554.32	5	0.67
443.2D	2	443	Weir	554.22	10	0.67
444.2D	2	444	Weir	553.82	5	0.67
45.2D	2	45	Weir	529.28	10	0.67
451.2D	2	451	Weir	566.12	5	0.67
452.2D	2	452	Weir	566.09	5	0.67
453.2D	2	453	Weir	566.36	5	0.67
454.2D	2	454	Weir	566.43	5	0.67
455.2D	2	455	Weir	566.54	5	0.67
456.2D	2	456	Weir	565.98	5	0.67
46.2D	2	46	Weir	529.04	10	0.67
461.2D	2	461	Weir	568.37	5	0.67
462.2D	2	462	Weir	567.74	5	0.67
463.2D	2	463	Weir	568.23	5	0.67
471.2D	2	471	Weir	570.76	10	0.67
472.2D	2	472	Weir	570.43	5	0.67
473.2D	2	473	Weir	571.21	10	0.67
48B.2D	2	48B	Weir	529.09	5	0.67
49A.2D	2	49A	Weir	529.25	5	0.67
49B.2D	2	49B	Weir	529.57	5	0.67
51.2D	2	51	Weir	529.52	10	0.67
52.2D	2	52	Weir	529.71	10	0.67
61.2D	2	61	Weir	531.22	5	0.67
62.2D	2	62	Weir	529.65	5	0.67
63A.2D	2	63A	Weir	530.00	5	0.67
63B.2D	2	63B	Weir	530.03	5	0.67
64A.2D	2	64A	Weir	530.10	5	0.67
64B.2D	2	64B	Weir	529.97	5	0.67
66.2D	2	66	Weir	531.22	5	0.67
67.2D	2	67	Weir	531.29	5	0.67
68.2D	2	68	Weir	531.14	5	0.67
69.2D	2	69	Weir	531.19	5	0.67
71.2D	2	71	Weir	530.80	5	0.67
72.2D	2	72	Weir	530.69	5	0.67
73.2D	2	73	Weir	530.34	5	0.67
74.2D	2	74	Weir	530.56	5	0.67
75.2D	2	75	Weir	530.80	5	0.67
76.2D	2	76	Weir	530.58	5	0.67
81.2D	2	81	Weir	530.80	5	0.67
82.2D	2	82	Weir	530.26	5	0.67
83.2D	2	83	Weir	530.14	8	0.67
91.2D	2	91	Weir	530.31	5	0.67
92A.2D	2	92A	Weir	530.30	5	0.67
92B.2D	2	92B	Weir	530.25	5	0.67

Summary of Existing Weirs

US Node ID	Link Suffix	DS Node ID	Link Type	Crest (ft AD)	Width (ft)	Height (ft)
93A.2D	2	93A	Weir	530.07	5	0.67
93B.2D	2	93B	Weir	530.29	5	0.67
94.2D	2	94	Weir	530.22	5	0.67
96.2D	2	96	Weir	531.99	5	0.67
97.2D	2	97	Weir	532.05	5	0.67
98.2D	2	98	Weir	532.05	5	0.67
99.2D	2	99	Weir	532.04	5	0.67

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
101	101.2D	0.772	69	1.1	118.3	96.0	4.0
102	102.2D	0.336	69	1.4	68.4	96.0	4.0
103	103.2D	0.348	69	0.5	77.6	96.0	4.0
104	104.2D	0.804	69	1.0	116.2	96.0	4.0
105	105.2D	0.963	69	0.3	135.7	96.0	4.0
106	106.2D	0.923	69	0.3	121.0	96.0	4.0
111	111.2D	17.132	69	0.4	528.9	96.0	4.0
112	112.2D	0.248	69	0.3	36.5	96.0	4.0
113	113.2D	0.923	69	0.3	135.7	96.0	4.0
114	114.2D	0.840	69	0.3	99.4	96.0	4.0
115	115.2D	0.517	69	0.3	39.2	96.0	4.0
121	121.2D	1.030	69	0.1	137.1	96.0	4.0
122	122.2D	2.021	69	0.3	145.1	96.0	4.0
123	123.2D	2.029	69	0.4	174.2	96.0	4.0
124	124.2D	1.041	69	0.4	156.7	96.0	4.0
131	131.2D	0.908	69	0.5	131.4	96.0	4.0
1311	1311.2D	1.830	69	0.9	139.8	96.0	4.0
1312	1312.2D	0.187	69	1.1	44.5	96.0	4.0
1313	1313.2D	3.053	69	1.0	214.5	96.0	4.0
132	132.2D	0.799	69	1.0	110.6	96.0	4.0
1321	1321.2D	0.867	69	0.8	145.0	96.0	4.0
1322	1322.2D	0.285	69	0.8	49.0	96.0	4.0
1325	1324.2D	12.737	69	0.9	396.8	96.0	4.0
133	133.2D	0.324	69	1.0	73.3	96.0	4.0
1331	1331.2D	0.067	69	1.8	51.0	96.0	4.0
1332	1332.2D	0.990	69	0.4	181.4	96.0	4.0
1333	1333.2D	0.779	69	0.7	111.9	96.0	4.0
1334	1334.2D	2.367	69	0.7	140.2	96.0	4.0
1335	1335.2D	0.238	69	0.6	57.2	96.0	4.0
1336	1336.2D	3.210	69	0.8	363.9	96.0	4.0
1337	1337.2D	2.256	69	0.7	292.7	96.0	4.0
134	134.2D	0.229	69	0.2	93.2	96.0	4.0
135	135.2D	1.925	69	0.3	134.4	96.0	4.0
136	136.2D	11.174	69	2.0	504.9	96.0	4.0
137	137.2D	0.858	69	0.4	80.8	96.0	4.0
141	141.2D	0.803	69	0.9	149.9	96.0	4.0
142	142.2D	1.011	69	0.8	151.3	96.0	4.0
1420	1420.2D	0.513	69	16.2	157.6	96.0	4.0
1421	1422.2D	3.352	73.5	4.2	225.7	96.0	4.0
1423	1423.2D	0.187	69	1.3	104.7	96.0	4.0
1426	1426.2D	1.266	77.97	0.8	226.3	96.0	4.0
1427	1427.2D	0.999	77.86	0.0	117.7	96.0	4.0
1428	1428.2D	2.341	72.66	4.0	225.6	96.0	4.0
1429	1429.2D	1.129	69	6.6	140.2	96.0	4.0
143	143.2D	0.131	69	0.3	39.0	96.0	4.0
1431	1431.2D	0.716	84	0.5	167.1	96.0	4.0
1432	1432.2D	3.020	81.77	2.3	169.3	96.0	4.0
1433	1433.2D	4.966	83.81	2.3	277.7	96.0	4.0
144	144.2D	0.227	69	1.8	88.2	96.0	4.0
145	145.2D	0.986	69	0.8	120.7	96.0	4.0
1450	1450.2D	5.592	84	0.6	384.8	96.0	4.0

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
146	146.2D	1.023	69	1.0	109.7	96.0	4.0
1460	1460.2D	3.351	84	0.2	324.0	96.0	4.0
147	147.2D	0.319	69	1.1	78.5	96.0	4.0
1470	1470.2D	0.472	84	0.2	70.0	96.0	4.0
1471	1471.2D	3.314	84	1.6	142.0	96.0	4.0
1472	1472.2D	4.089	83.86	1.5	169.9	96.0	4.0
1473	1473.2D	1.695	84	1.5	270.4	96.0	4.0
1474	1474.2D	4.189	84	1.1	330.3	96.0	4.0
1475	1475.2D	0.639	84	0.2	70.0	96.0	4.0
148	148.2D	0.411	69	1.0	92.0	96.0	4.0
151	151.2D	0.739	69	1.3	105.9	96.0	4.0
152A	152A.2D	1.564	69	0.5	173.8	96.0	4.0
152B	152B.2D	0.813	69	1.1	132.8	96.0	4.0
153	153.2D	16.004	69	1.2	448.2	96.0	4.0
154	154.2D	0.259	69	1.0	53.7	96.0	4.0
156	156.2D	0.095	69	0.2	47.0	96.0	4.0
157	157.2D	1.665	69	0.4	46.4	96.0	4.0
158	158.2D	12.592	69	0.3	307.9	96.0	4.0
161	161.2D	0.105	69	1.3	34.4	96.0	4.0
162	162.2D	0.097	69	0.2	44.4	96.0	4.0
163	163.2D	1.403	69	0.4	87.1	96.0	4.0
164	164.2D	8.151	69	1.6	353.3	96.0	4.0
165	165.2D	0.140	69	1.0	39.2	96.0	4.0
171	171.2D	0.215	69	16.2	101.5	96.0	4.0
172	172.2D	0.527	69	2.2	100.9	96.0	4.0
173	173.2D	2.837	69	1.8	225.1	96.0	4.0
1761	1761.2D	0.813	83.69	0.5	78.5	96.0	4.0
1762	1762.2D	0.194	75.7	1.7	57.6	96.0	4.0
1763	1763.2D	0.704	69	6.0	114.9	96.0	4.0
1764	1764.2D	0.127	76.59	2.0	45.3	96.0	4.0
1765	1765.2D	1.065	83.76	0.5	100.6	96.0	4.0
1771	1771.2D	0.319	81.8	0.9	85.1	96.0	4.0
1772	1772.2D	0.237	69.41	13.0	89.8	96.0	4.0
1791	1791.2D	2.124	70.58	0.9	249.6	96.0	4.0
1792	1792.2D	1.853	83.17	1.1	299.6	96.0	4.0
1801	1801.2D	1.812	70.25	4.3	199.6	96.0	4.0
1802	1802.2D	1.063	75.29	1.7	152.7	96.0	4.0
181	181.2D	0.637	69	0.8	52.9	96.0	4.0
1812	1812	1.540	69	0.6	276.1	96.0	4.0
182	182.2D	0.732	69	1.1	58.2	96.0	4.0
1821	1821.2D	0.965	69	0.4	75.8	96.0	4.0
1822	1822.2D	0.910	69	0.5	103.0	96.0	4.0
1823	1823.2D	0.397	69	0.6	106.7	96.0	4.0
1824	1824.2D	2.525	69	2.8	194.9	96.0	4.0
1831	1831.2D	2.617	69.19	0.4	167.5	96.0	4.0
1832	1832.2D	0.249	69	1.0	55.6	96.0	4.0
1833	1833.2D	0.263	69	2.1	75.4	96.0	4.0
1834	1834.2D	1.708	69	0.5	128.0	96.0	4.0
1835	1835.2D	1.787	69	0.6	110.6	96.0	4.0
1836	1836.2D	2.347	72.81	1.1	163.4	96.0	4.0
1837	1837.2D	1.665	69	1.0	121.6	96.0	4.0

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
1838	1838.2D	4.155	69.25	0.8	233.4	96.0	4.0
1841	1841.2D	0.809	82.37	0.6	112.5	96.0	4.0
1842	1842.2D	0.367	76.29	0.9	71.5	96.0	4.0
1843	1843.2D	1.382	69	3.8	142.9	96.0	4.0
1844	1844.2D	1.472	69	3.1	124.7	96.0	4.0
1845	1845.2D	1.284	69	0.6	111.7	96.0	4.0
1846	1846.2D	0.146	69	2.3	59.1	96.0	4.0
1847	1847.2D	0.114	69	2.0	49.2	96.0	4.0
1848	1848.2D	0.616	69	0.4	119.0	96.0	4.0
1851	1851.2D	9.055	84	1.1	390.1	96.0	4.0
1852	1852.2D	4.435	83.84	1.4	158.4	96.0	4.0
1853	1853.2D	1.799	83.88	0.6	135.0	96.0	4.0
1854	1854.2D	1.390	69.59	0.5	124.2	96.0	4.0
1855	1855.2D	0.404	80.55	1.6	39.8	96.0	4.0
1881	1881.2D	0.793	69	0.3	104.1	96.0	4.0
1882	1882.2D	0.504	69	1.5	94.7	96.0	4.0
1883	1883.2D	6.400	82.25	0.8	379.6	96.0	4.0
1884	1884.2D	0.211	69	2.3	70.4	96.0	4.0
1885	1885.2D	0.863	69	0.5	137.3	96.0	4.0
191	191.2D	8.646	69	0.8	319.9	96.0	4.0
192	192.2D	1.915	69	1.3	264.8	96.0	4.0
1930	1930.2D	0.318	69	2.2	75.7	96.0	4.0
1932	1932.2D	1.510	69	1.0	164.1	96.0	4.0
1933	1934.2D	3.519	81.22	1.1	247.7	96.0	4.0
1935	1935.2D	2.455	79.63	1.4	243.1	96.0	4.0
1936	1936.2D	0.598	69	1.1	78.4	96.0	4.0
1937	1937.2D	0.354	69	0.9	74.9	96.0	4.0
20	20	4.579	69	3.5	368.5	96.0	4.0
210	210.2D	8.029	69	0.5	217.8	96.0	4.0
220	220.2D	2.654	69	0.2	118.7	96.0	4.0
231	231.2D	1.259	69	1.8	97.8	96.0	4.0
232	232.2D	2.371	69	1.0	133.8	96.0	4.0
233	233.2D	0.166	69	2.4	59.1	96.0	4.0
234	234.2D	0.253	69	2.2	81.2	96.0	4.0
235A	235A.2D	0.791	69	0.1	100.2	96.0	4.0
235B	235B.2D	0.176	69	0.2	74.2	96.0	4.0
237A	237A.2D	0.106	69	0.3	61.2	96.0	4.0
237B	237B.2D	1.494	69	2.4	111.2	96.0	4.0
239A	239A.2D	0.950	69	0.8	51.6	96.0	4.0
239B	239B.2D	1.269	69	1.0	78.6	96.0	4.0
251	251.2D	4.030	69	0.0	236.4	96.0	4.0
252	252.2D	2.049	69	0.4	118.6	96.0	4.0
253	253.2D	2.949	69	0.3	332.0	96.0	4.0
264	265	48.152	69	2.0	968.1	87.2	12.8
271	271.2D	0.890	69	0.0	151.2	96.0	4.0
272	272.2D	0.829	69	0.8	138.9	96.0	4.0
273	273.2D	0.966	69	0.8	113.9	96.0	4.0
274	274.2D	1.144	69	0.8	126.5	96.0	4.0
275	275.2D	0.401	69	2.8	121.9	96.0	4.0
281	281.2D	0.353	69	0.9	133.6	96.0	4.0
282	282.2D	0.262	69	0.5	32.2	96.0	4.0

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
283	283.2D	4.488	69	0.9	440.8	96.0	4.0
291A	291A.2D	0.818	69	4.4	112.7	65.1	34.9
291B	291B.2D	0.539	69	4.5	88.9	65.8	34.2
292A	292A.2D	0.246	69	2.0	47.0	93.7	6.3
292B	292B.2D	1.161	69	2.8	102.3	65.2	34.8
294A	294A.2D	0.126	69	1.9	71.4	84.9	15.1
294B	294B.2D	1.143	69	2.0	125.5	66.4	33.6
296A	296A.2D	0.488	69	5.2	69.0	71.4	28.6
296B	296B.2D	0.653	69	5.4	98.7	96.0	4.0
297A	297A.2D	0.702	69	5.6	242.6	96.0	4.0
297B	297B.2D	0.386	69	1.3	70.7	96.0	4.0
306	306.2D	1.751	69	0.8	116.7	96.0	4.0
307	307.2D	4.207	69	0.5	218.9	96.0	4.0
31	31.2D	0.574	69	1.9	67.0	96.0	4.0
310	310.2D	0.805	69	0.3	51.9	90.3	9.7
312	312.2D	16.865	69	2.8	563.8	61.6	38.4
316	316.2D	7.309	69.01	1.0	169.7	94.9	5.1
317	317.2D	0.165	69	0.5	114.4	96.0	4.0
318A	318A.2D	0.375	69	0.7	36.1	92.4	7.6
318B	318B.2D	3.030	69	0.4	196.7	95.3	4.7
318C	318C.2D	2.509	69	1.1	94.5	96.0	4.0
32	32.2D	1.389	69	1.7	167.1	96.0	4.0
33	33.2D	1.032	69	2.1	159.4	96.0	4.0
331	331.2D	1.657	69	2.1	99.4	72.3	27.7
332	332.2D	0.350	69	3.2	32.4	61.0	39.0
333	333.2D	2.411	69	1.8	127.5	76.5	23.5
334	334.2D	2.556	69	2.1	157.3	69.8	30.2
34	34.2D	0.197	69	1.0	42.8	96.0	4.0
346	346.2D	1.664	69	1.0	99.7	70.7	29.3
347	347.2D	0.309	69	4.5	37.5	61.7	38.3
348A	348A.2D	2.314	69	1.5	117.0	70.3	29.7
348B	348B.2D	2.760	69	1.7	158.9	65.0	35.0
35	35.2D	0.865	69	0.7	125.3	96.0	4.0
356	356.2D	1.257	69	0.3	87.1	73.5	26.5
357	357.2D	4.231	69	0.4	192.8	64.2	35.8
358	358.2D	1.070	69	0.5	74.5	61.0	39.0
36	36.2D	0.748	69	0.7	116.5	96.0	4.0
361	361.2D	0.876	69	0.3	64.2	63.7	36.3
362	362.2D	2.441	69	0.3	157.1	70.9	29.1
371	371.2D	1.564	69	0.6	133.3	66.9	33.1
373	373.2D	0.663	69	1.1	108.4	61.3	38.7
374	374.2D	3.192	69	0.7	254.9	67.1	32.9
381	381.2D	3.099	69	0.4	193.4	67.5	32.5
382	382.2D	5.428	69	0.9	289.3	61.8	38.2
383	383.2D	8.686	69	0.8	506.4	63.4	36.6
391	391.2D	3.218	69	0.2	261.9	68.9	31.1
392	392.2D	10.928	69	0.6	297.9	67.3	32.7
401	401.2D	0.605	69	1.2	78.5	96.0	4.0
402	402.2D	0.222	69	0.9	44.9	96.0	4.0
403	403.2D	0.239	69	0.6	28.8	95.4	4.6
404	404.2D	1.465	69	2.8	162.9	90.3	9.7

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
405	405.2D	2.807	69	3.7	249.7	90.8	9.2
406	406.2D	1.025	69	2.8	97.4	96.0	4.0
41	41.2D	1.049	69	0.5	121.0	96.0	4.0
411	411.2D	1.110	71.05	0.5	83.5	96.0	4.0
412	412.2D	0.248	69	0.9	31.2	88.4	11.6
413	413.2D	2.993	69	0.8	223.0	83.0	17.0
42	42.2D	1.333	69	1.0	117.9	96.0	4.0
421	421.2D	4.382	71.54	0.8	310.3	96.0	4.0
422	422.2D	0.265	69	1.3	41.8	96.0	4.0
43	43.2D	2.061	69	0.5	187.8	96.0	4.0
44	44.2D	0.380	69	0.5	81.0	96.0	4.0
441	441.2D	2.369	69	0.9	185.5	77.6	22.4
442	442.2D	0.668	69	1.8	42.7	66.5	33.5
443	443.2D	10.822	70.25	1.2	381.9	77.1	22.9
444	444.2D	2.131	69	1.8	152.5	76.9	23.1
45	45.2D	0.285	69	0.5	60.1	96.0	4.0
451	451.2D	2.914	71.46	0.4	199.7	72.5	27.5
452	452.2D	0.306	69	0.3	40.7	96.0	4.0
453	453.2D	0.328	69	0.3	42.7	96.0	4.0
454	454.2D	3.270	72.46	0.7	171.2	72.4	27.6
455	455.2D	2.468	72.81	0.6	158.5	71.1	28.9
456	456.2D	2.311	72.52	0.7	267.9	71.8	28.2
46	46.2D	1.087	69	1.0	153.9	96.0	4.0
461	461.2D	2.392	74.6	1.1	165.6	67.7	32.3
462	462.2D	0.245	69	0.9	31.1	96.0	4.0
463	463.2D	3.404	74.35	14.3	192.3	73.3	26.7
471	471.2D	2.514	77.52	1.5	181.3	66.5	33.5
472	472.2D	0.705	69	1.4	31.2	78.1	21.9
473	473.2D	14.369	77.78	2.8	435.5	66.7	33.3
48B	48B.2D	2.442	69	2.4	194.1	96.0	4.0
49A	49A.2D	0.068	69	3.9	104.0	96.0	4.0
49B	49B.2D	2.316	69	0.5	224.7	96.0	4.0
51	51.2D	1.097	69	1.0	162.1	96.0	4.0
52	52.2D	1.162	69	1.0	125.2	96.0	4.0
61	61.2D	0.298	69	0.6	55.0	96.0	4.0
62	62.2D	0.838	69	0.3	126.3	96.0	4.0
63A	63A.2D	0.888	69	0.6	117.9	96.0	4.0
63B	63B.2D	0.628	69	1.0	115.4	96.0	4.0
64A	64A.2D	0.467	69	1.2	115.2	96.0	4.0
64B	64B.2D	0.596	69	0.5	88.3	96.0	4.0
66	66.2D	0.460	69	0.6	84.4	96.0	4.0
67	67.2D	0.795	69	0.4	99.9	96.0	4.0
68	68.2D	2.022	69	0.4	164.4	96.0	4.0
69	69.2D	0.268	69	0.9	80.4	96.0	4.0
71	71.2D	0.228	69	2.0	87.6	96.0	4.0
72	72.2D	0.236	69	2.5	85.5	96.0	4.0
73	73.2D	0.809	69	0.6	107.3	96.0	4.0
74	74.2D	0.475	69	0.7	74.2	96.0	4.0
75	75.2D	0.504	69	0.3	64.1	96.0	4.0
76	76.2D	0.181	69	2.2	87.8	96.0	4.0
81	81.2D	0.164	69	2.0	60.8	96.0	4.0

Summary of Existing Subcatchments

Subcatchment ID	Node ID	Total Area (acre)	Curve Number	Slope (%)	Dimension (ft)	Runoff Area 1 (%)	Runoff Area 2 (%)
82	82.2D	0.822	69	0.3	99.1	96.0	4.0
83	83.2D	4.699	69	0.6	424.8	96.0	4.0
91	91.2D	0.714	69	0.5	144.0	96.0	4.0
92A	92A.2D	1.039	69	0.6	141.8	96.0	4.0
92B	92B.2D	0.803	69	0.9	157.7	96.0	4.0
93A	93A.2D	0.344	69	1.0	76.4	96.0	4.0
93B	93B.2D	0.374	69	1.2	89.8	96.0	4.0
94	94.2D	1.289	69	0.7	200.7	96.0	4.0
96	96.2D	0.159	69	0.8	57.6	96.0	4.0
97	97.2D	0.357	69	0.1	58.6	96.0	4.0
98	98.2D	0.993	69	0.1	118.9	96.0	4.0
99	99.2D	0.963	69	0.4	135.4	96.0	4.0
Bazaar	Bazaar42-U	18.446	78	0.7	508.2	96.0	4.0
Bazaar-Headwall	Bazaar-Headw	16.870	78.79	1.0	563.9	96.0	4.0

Appendix D
TRVA Storm Drain Tailwater Design Assumptions

CENTRAL CITY PROJECT
CITY STORM DRAIN FACILITIES
TECHNICAL DESIGN MEMORANDUM
STORM DRAIN CONCEPTUAL ALIGNMENTS, OUTFALL LOCATIONS, AND DESIGN ASSUMPTIONS

Issue: Conceptual Alignments for municipal storm drain relocations including discharges into the Bypass Channel and corresponding tailwater assumptions

Background:

- Under contract with the City of Fort Worth, Freese and Nichols, Inc. (FNI) and Transystems Corporation (TSC) have performed storm drain master planning for the relocation of municipal storm drain systems impacted by the Central City project components.

- The storm drain masterplan includes storm drain systems impacted by the bypass channel, the Henderson, North Main, and White Settlement bridges, and the interior lake and associated gate structures.

- Detailed modeling of the existing and proposed storm drain facilities was developed using Infoworks SD for the masterplan.

- Representatives from the City of Fort Worth, TRVA, FNI, Transystems, TRWD, and the USACE have met on multiple occasions to discuss the storm drain relocations and conceptual alignments. These meetings have occurred on or around the following dates (most recent listed first): July 2012, May 2012, August 2011, January 2011, September 2010, July 2009, and November 2008.

- The proposed storm drain alignments have been presented in writing to the project partners most recently through the preparation of the Work Breakdown Structure (WBS) exhibits. The WBS exhibits are attached for reference.

- The Cemetery drainage area is proposed to outfall in the bypass channel along the natural flowpath for the contributing drainage area. The impact of this outfall location is additional dewatering considerations during construction for the channel contractor. FNI performed calculations to estimate the potential cost impacts of dewatering the channel compared to constructing a gravity line paralleling the bypass channel to outfall further downstream of the project limits. The results of the analysis indicated that it was much more cost effective to bear the temporary pumping costs than encumber the larger capital costs for the longer drainage alignment.

- The Grand Avenue drainage area is proposed to be served by a storm drain trunk line that runs along 10th Street and under the existing levee then outfalls into the floodway at a location near the TRWD maintenance facility. In November 2010, FNI sent a letter to the USACE asking for approval of this concept alignment in writing. No written response was ever received according to our files, but we have understood based on discussion with the TRVA that this line was approved in concept pending the details of the outfall and levee crossing details to be provided further in design. A separate technical design memorandum deals explicitly with the design assumptions associated with Grand Avenue.

- FNI has requested guidance from the USACE and TRWD concerning the future operation of the Central City system with respect to tailwater conditions for the storm drain systems but never received conclusive guidance. In order to move the project forward, FNI documented the design assumptions in a tailwater design memorandum dated February 21, 2012 and circulated to the project partners for review. This memo was discussed during a meeting with the USACE on May 15, 2012. This information has been provided and discussed in the above identified meetings. This document is to provide guidance in writing that the assumptions were agreed upon among all participants (TRVA, TRWD, CFW, TSC, FNI, CDM and USACE) during the meeting held on May 15, 2012.

Conceptual Alignments and Design Assumptions

- The Conceptual Alignments including discharge locations shown in the WBS exhibits have been approved in concept pending further details of the actual outfall structures.

- The assumptions documented in the tailwater memorandum have been approved.

Attachments:

- WBS Exhibits
- Tailwater Memorandum

Project Delivery Team Meeting

Representatives from the City of Fort Worth, TRVA, FNI, Transystems, TRWD, and the USACE have met on multiple occasions to discuss the storm drain relocations and conceptual alignments. These meetings have occurred on or around the following dates (most recent listed first): July 2012, May 2012, August 2011, January 2011, September 2010, July 2009, and November 2008.

Conclusion/Recommendation

USACE as the contracting agency and TRWD as the local sponsor approve the conceptual alignments and design assumptions as noted above.

Date: 8/21/12

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END OF TECHNICAL DESIGN DOCUMENT

MEMORANDUM

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SUBJECT: TRVA Storm Drain Tailwater Design Assumptions

DATE: February 21, 2012

This memorandum documents the design assumptions related to the downstream starting conditions (i.e. tailwaters) utilized during the TRVA storm drain master planning efforts. The content of this memo will be included in the final storm drain report, so full project background information is not presented here.

The tailwater conditions were analyzed under existing and proposed conditions. Existing conditions refers to the current condition of the Trinity River, before any TRVA project components are implemented. Proposed conditions refer to post project conditions following the completion of the TRVA project including the bypass channel, interior gates, and Samuels Avenue Dam.

FNI considered several different tailwater scenarios for the sizing of the storm drain. In general, two types of scenarios were considered: unsteady (time varying) and steady (non-time varying). Ultimately, it was decided that steady tailwaters were the most appropriate design assumption for this application. Each of these scenarios is discussed in detail below.

Unsteady Tailwater

The time varying tailwaters focused on synthetic stage hydrographs approximated from paired hydrologic (HEC-1) and hydraulic (HEC-RAS) models of the Trinity River provided by the USACE. Ideally, a synthetic stage hydrograph would be developed from an unsteady hydraulic model but such a model was not available as it is still under development by the USACE. These tailwaters provided a good approximation of potential downstream starting conditions during a synthetic design storm.

However, after consultation with the City and USACE, unsteady tailwaters were determined to be too uncertain given the possible combinations of timing that could impact the river stage, especially in an operated system such as the Fort Worth Floodway. Several unknowns contributed to the decision that unsteady tailwaters were not an appropriate design assumption including:

- the operation of upstream reservoirs in the TRWD system
- uncertain initial conditions (starting lake levels)
- unknown operation of the Samuels Avenue Dam and other TRVA gates
- orientation and direction of storm movement
- spatial distribution of rainfall

Rather than make assumptions for each of these unknowns, it was decided that a steady tailwater provided a simpler and more conservative design assumption.

Steady Tailwater – Existing Conditions

The existing conditions tailwater for the 100-year storm of interior drainage events was based on a prevailing river discharge defined as 15,000 and 13,500 cubic feet per second (cfs) on the West Fork Trinity River reaches downstream and upstream from the Clear Fork confluence, respectively. The prevailing river discharge on the Clear Fork was 6,000 cfs based on the regulated release from Benbrook Dam. These values were provided by the USACE via email from Craig Loftin on November 8, 2010. For information purposes, Table 1 summarizes the relationship between the prevailing discharge and the frequency events.

Table 1. Trinity River Summary of Flows (cfs)

	2-yr	5-yr	10-yr	100-yr	USACE
West Fork Above Confluence	7800	13500	14500	35400	13500
Clear Fork Above Confluence	9400	14300	19800	39800	6000
West Fork Below Confluence	12100	18800	26100	58200	15000

At each outfall location, the prevailing river discharge was input to the existing conditions HEC-RAS model to develop a starting water surface condition. Review of the standard coincidental occurrence ratios suggests that the study drainage areas are in the ratio category of 1,000:1. This ratio would suggest for a 100-yr storm on the local drainage area, that a 10-yr tailwater would be appropriate. In light of the relative magnitude of the prevailing discharge to the frequency events, it was decided to use the prevailing discharge river tailwater elevations for all storm events. Table 2 (attached) summarizes the tailwaters used for the existing conditions analysis at each outfall location for each storm event.

Steady Tailwater – Proposed Conditions

The proposed conditions tailwater requires consideration of proposed TRVA project components. This task is complicated by the fact that the gate operations of the Samuels Avenue Dam have not been finalized. Multiple river discharge rate and dam gate elevation combinations were analyzed to develop proposed conditions tailwaters. The proposed tailwaters for each outfall location are discussed in detail below.

Grand Avenue Outfall

The proposed tailwater at the Grand Avenue outfall location was assumed as 525 ft-msl. Several different scenarios were evaluated before determining the 525 elevation. These included peak on peak (i.e. 100-year river elevation), coincident analysis, and a range of "target" WSELs at the outfall location. A sensitivity analysis was performed whereby proposed storm drain sizes were developed for each scenario to determine the most appropriate starting condition. The minimum size of the proposed storm drain at the Grand Avenue outfall was determined by analyzing the system at free outfall conditions. This produced a size of 10x6. The highest tailwater that still produced the 10x6 outlet size was a tailwater elevation of 519. The maximum possible tailwater analyzed was the 100-year (peak on peak), which resulted in a 19x6 box with a tailwater elevation of 530. Therefore, the sensitivity analysis considered tailwater elevations 519 through 530 in one foot increments which produced box sizes between 10x6 and 19x6.. Table 3 summarizes the results of the sensitivity analysis. Based on the

sensitivity analysis and other factors, the 525 elevation was determined to be the most appropriate starting condition. Other factors that contributed to this decision include:

- 525 is the target normal water surface elevation in the bypass channel and the outfall will experience this elevation during the majority of the rainfall events
- The Samuels Avenue Dam has sufficient capacity to pass the prevailing river discharge of 15,000 cfs while maintaining the 525 elevation.

Table 3. Grand Ave Sensitivity Analysis

Tailwater	Pipe Size
Free Discharge up to 519	10x6
525	12x6
526	13x6
527	13x6
528	14x6
529	17x6
530	19x6

The 100-year storm event was the baseline condition for determining proposed pipe sizes. Proposed pipes in lower return events were modeled with the same assumptions as the 100-year storm. The water surface at the dam was assumed to be at elevation 525 as this is considered to be the lowest potential tailwater elevation in the bypass channel.

Cemetery and Bazaar Outfalls

To be consistent with the Grand Avenue design assumption, the proposed tailwater for the Cemetery Outfall was assumed to be 525.16, which is the normal water surface in the Bypass Channel at this location under prevailing discharge. Likewise, the proposed tailwater for the Bazaar Outfall was assumed to be 525.88 and the proposed tailwater for the Greenleaf Outfall was assumed to be 526.54.

Interior Outfalls

The proposed tailwaters for the storm drain systems that outfall into the interior lake were assumed to be 526 ft-msl for the 100-year design storm. This was based on the normal water surface of 525 ft-msl plus one (1) foot of additional freeboard to account for fluctuations in the water surface due to interior drainage events. These outfalls include the Viola Outfall, the New Main Outfall, the Henderson Outfall, all Canals and future local drainage lines. Based on the project EIS, the interior lake is planned to be isolated from the river and bypass channel during flood events by operating the Clear Fork Gate, the Trinity Point Gate, and the TRWD gate. Under these scenarios, only local drainage will contribute to the interior area which will be removed by operation of a stormwater pump station. According to the EIS, if all of the pumps fail, water in the interior could reach the 529.69 level. However, it should be noted that the pump stations are only needed when the river level is high and the interior cannot drain by gravity. The river level would only be high in a significant storm event for the entire Trinity Basin. The joint probability of a significant storm event on the entire Trinity Basin as well as the local interior drainage area exceeds a 100-year design storm. Therefore, in an attempt to be consistent with the other outfall design assumptions, the river was assumed to be at prevailing discharge which would allow the interior to either drain by gravity or through the operation of one or more pumps from the pump stations which led to the 526 ft-msl design assumption.

Coincident Tailwaters

In addition to the design tailwaters discussed above, tailwater elevations were developed for the opposite coincident pair of the 100-year storm. Based on the ratio of drainage areas, the opposite pair of a 10-year storm should be evaluated on a 100-year tailwater elevation. These elevations were obtained from the same hydraulic models mentioned above. We anticipate that for a 100-year event on the Trinity, the dam would be operated to provide maximum conveyance. Therefore for the proposed models, the dam gates were assumed to be open to their lowest elevation. This set of tailwaters was only developed for the 100-year check storm. Post-project tailwater elevations for all events are summarized in the attached Table 2.

Table 2. Tailwater Summary

		Existing		Proposed	
Outfall Name	**Sump ID**	**Prevailing**	**100-Year**	**Prevailing**	**100-Year**
Grand Avenue	-	-	-	525.07	530.09
Cemetery	-	-	-	525.16	531.05
Bazaar	16W	527.77	539.45	525.88	535.14
Greenleaf Street	-	527.70	541.23	526.54	540.77
Main Street	26W	511.72	529.47	-	-
New Main Street	26W	-	-	526.00	526.00
Calvert Street	25C	527.18	538.79	526.00	526.00
Viola Street	-	-	-	526.00	526.00

Notes:

Existing tailwaters from HEC-RAS Trinity River CDC model developed by USACE for Central City dated February 2008

Proposed tailwaters from HEC-RAS Trinity River Model developed by CDM dated June 2009

Prevailing flow tailwaters are paired with all local frequency storms for capacity checks. 100-year tailwater used for 10-year coincidence check only.

Sump methodology analyzed for 100-year return interval. Sump elevation selected as worst case combination of 10-yr local storm with 100-yr external tailwater or 100-yr local storm with prevailing tailwater.

Appendix E
Digital Models