CHAPTER 6

COLLECTION SYSTEM EVALUATION

INTRODUCTION

This chapter presents the results of the City of Woodland collection system evaluation. The evaluation includes a hydraulic/hydrologic analysis to evaluate the capacity of the collection systems under existing and future conditions. Existing and future population, land use, and wastewater flows presented in Chapters 3 and 5 of this Plan are utilized to develop data for use in the hydraulic model. Total land use area and wastewater flows are allocated to individual subareas, or basins, to identify current and future deficiencies in the collection system.

The components of the collection system are organized into three categories for the evaluation:

- Major Gravity Lines
- Force Mains
- Sewage Lift stations

The hydraulic modeling program, InfoSewer, developed by Innovyze, has been used to analyze the major gravity lines within the collection system for the system's capacity to accommodate current conditions (2013), and future conditions (2033). For the capacity analysis of the force mains and sewage lift stations, peak wet weather flows for 2033 conditions were estimated and compared to existing pump capacities.

HYDRAULIC MODEL

The output from the hydraulic model is used to evaluate the capacity of the existing collection system and to identify improvements that will be required to accommodate existing and future wastewater flows. The model can be updated and maintained for use as a tool to aid in future planning and design.

The hydraulic model was developed using InfoSewer (Version 7.6) software by Innovyze. The software program was designed for steady-state and dynamic analysis of gravity flow and pressure flow pipe networks. Version 7.6 is capable of modeling up to 6,000 nodes and is also capable for integration with GIS mapping. This version of InfoSewer has the capability of extended period simulation (EPS) modeling which was used for this analysis. Extended period simulation allows flow attenuation to occur as flow travels downstream whereas steady state models carry a plug of flow throughout the model to the most downstream point without attenuation.

MODEL LAYERS

The hydraulic model consists of numerous layers, each of which mimics a shapefile (or layer) utilized in GIS. Although the layers are not specific .shp files, they can be exported as a .shp file which can be utilized in a GIS system. The layers consist of manholes, outlets, wet wells, pipes, force mains, and pumps. In the model, each of the Lift Stations 1 through 14 are included as a fixed capacity that discharges to downstream manholes with the exception of Lift station 13 whose flows were added as a point flow into the gravity system within Basin W-10. Flows within each of the basins were calculated separately in an Excel spreadsheet (i.e., based on land use area, ERUs, and infiltration and inflow) and then input into the model at specific designated manholes.

Approximately 42 percent of the pipes within the combined collection system were modeled. The sections of the collection system that were modeled include all major sewer trunk lines and manholes that are expected to convey the majority of flows through the collection system. A schematic of the skeletonized system is shown in Figures 6-1 and 6-2, along with the basin overlay. Information required to construct the model was obtained from existing GIS data, linear interpolation between known inverts, survey, and assumed minimal slopes for the unknown areas. Use of each item is described below.

Surveyed Manholes

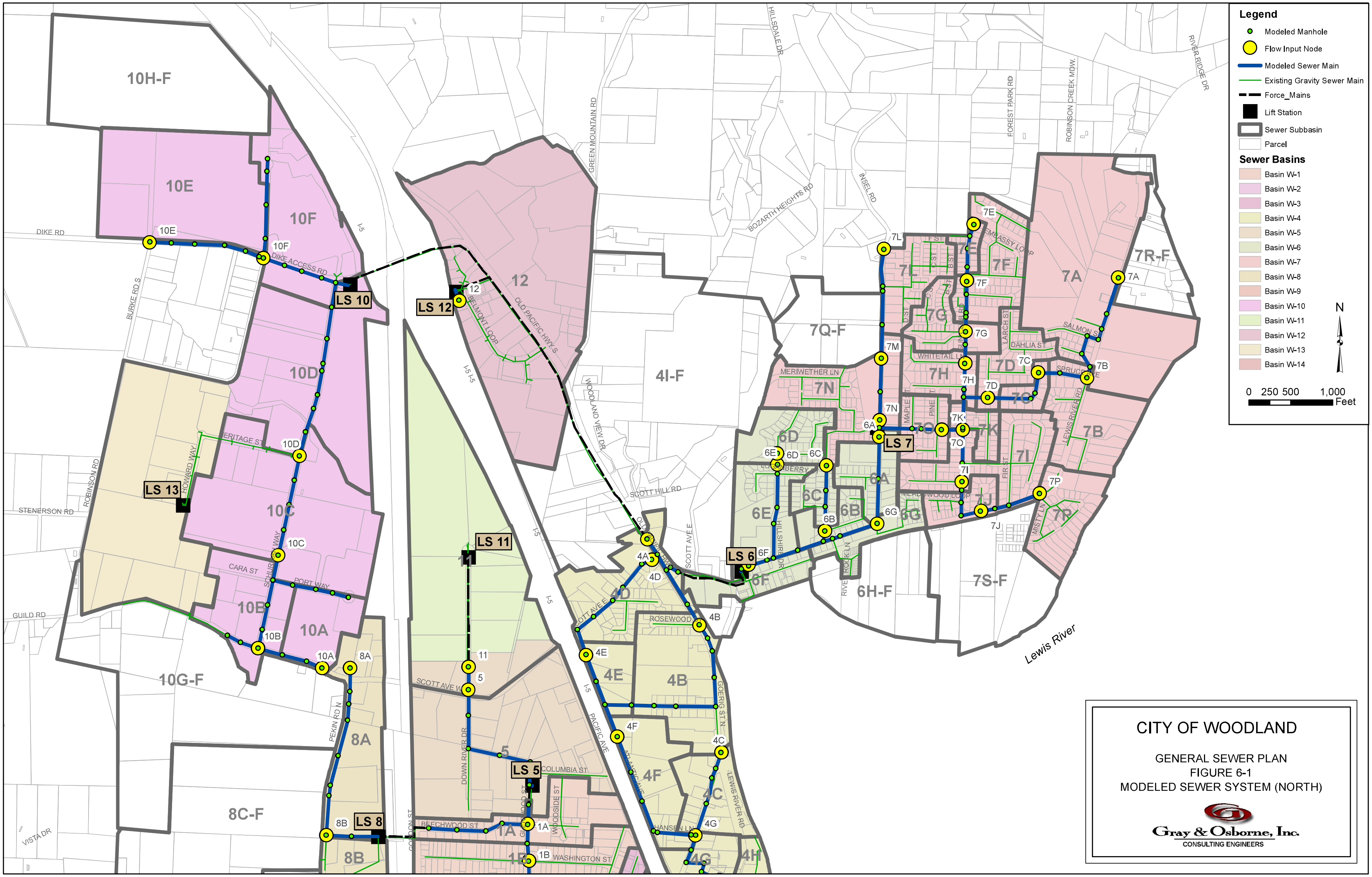
After collecting all the information available from GIS, there were gaps in the information necessary for a functional model. In July 2014, Gray & Osborne surveyors gathered a representative sample of manhole rim elevations and drop down measurements to inverts. Survey information was measured using the NAVD 88 datum.

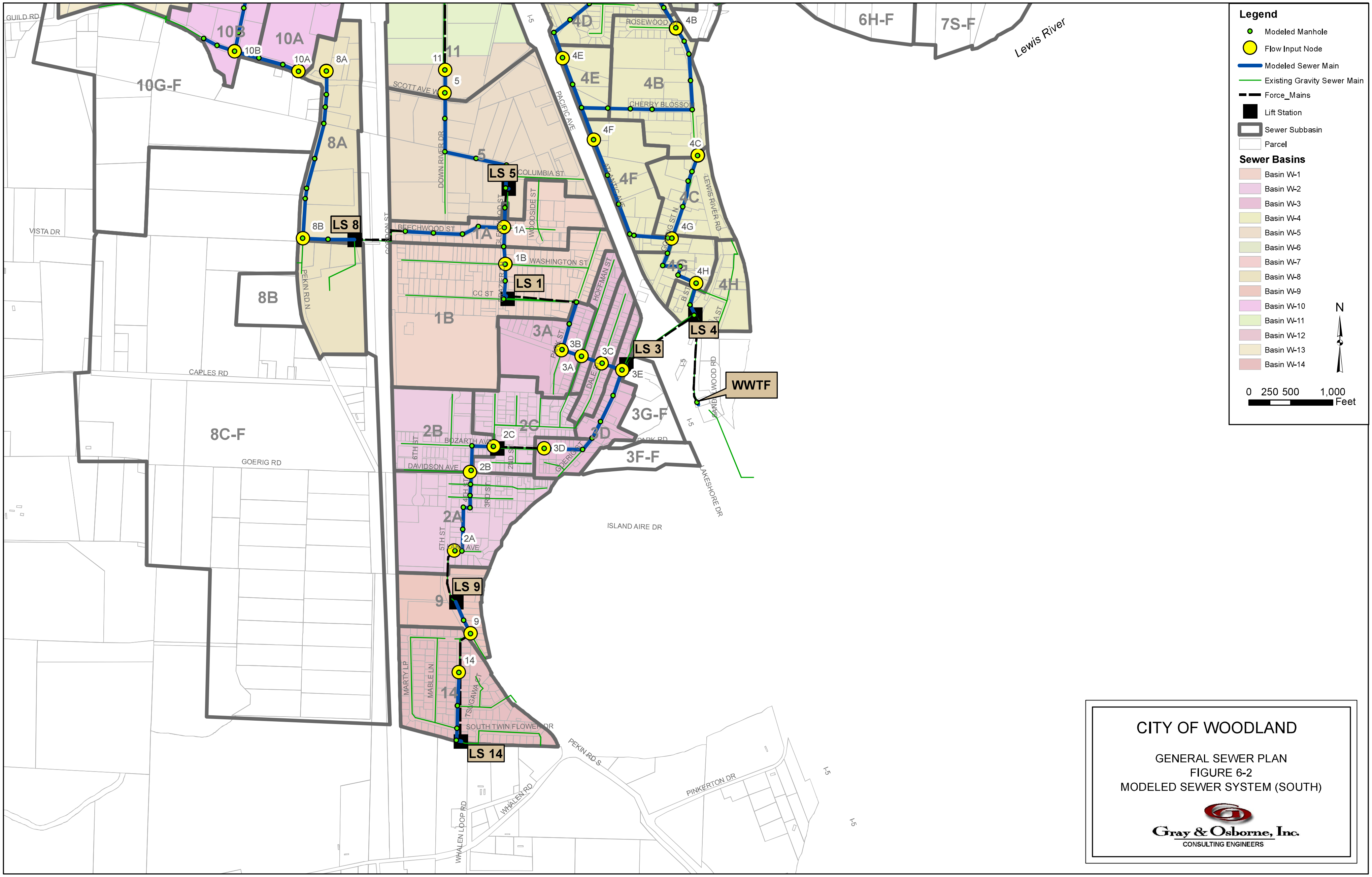
Interpolated Manholes

After collecting all the information available from GIS and survey, there were still significant gaps in the information necessary for a functional model. In the case where manhole information was missing along a straight run, the inverts at this manhole were interpolated and/or an assumed minimal slope was inserted. The minimal slopes assumed were 0.004 and 0.0022 for 8-inch and 12-inch pipes, respectively.

Lift Stations

For simplicity, the lift stations are modeled as constant discharge pumps that pump at the lift station capacity, so that the lift stations produce a constant discharge regardless of head conditions. A future refinement of the model may include the pump curves for all of the lift stations and/or the results from drawdown tests for each lift station.


Legend
Modeled Manhole
Flow Input Node
Modeled Sewer Main
Existing Gravity Sewer Main
Force_Mains
Lift Station
Sewer Subbasin
Parcel
Sewer Basins
Basin W-1
Basin W-2
Basin W-3
Basin W-4
Basin W-5
Basin W-6
Basin W-7
Basin W-8
Basin W-9
Basin W-10
Basin W-11
Basin W-12
Basin W-13
Basin W-14
N
0 250 500 1,000
Feet
CITY OF WOODLAND
GENERAL SEWER PLAN
FIGURE 6-1
MODELED SEWER SYSTEM (NORTH)
Gray & Osborne, Inc.
CONSULTING ENGINEERS
LS 5
LS 6
LS 7
LS 8
LS 10
LS 11
LS 12
LS 13
10H-F
10E
10F
10D
10C
10B
10A
10G-F
8A
8B
8C-F
12
7Q-F
4I-F
7N
6D
6E
6C
6B
6A
6G
6F
6H-F
7S-F
7R-F
7A
7B
7C
7D
7E
7F
7G
7H
7I
7J
7K
7L
7M
7O
7P
4A
4B
4C
4D
4E
4F
4G
4H
1A
1B
5
11
Lewis River
DIKE RD
DIKE ACCESS RD
BURKE RD S
ROBINSON RD
STENERSON RD
GUILD RD
VISTA DR
PEKIN RD N
HOWARD WAY
CARA ST
PORT WAY
OLD PACIFIC HWY S
BELMONT LOOP
GREEN MOUNTAIN RD
BOZARTH HEIGHTS RD
INSEL RD
HILLSDALE DR
FOREST PARK RD
ROBINSON CREEK MDW.
RIVER RIDGE DR
WOODLAND VIEW DR
SCOTT HILL RD
SCOTT AVE E
SCOTT AVE W
DOWN RIVER DR
COLUMBIA ST
WOODSIDE ST
BEECHWOOD ST
WASHINGTON ST
PACIFIC AVE
ATLANTIC AVE
HANSEN LN
LEWIS RIVER RD
GOERIG ST N
ROSEWOOD
MERIWETHER LN
WHITETAIL LN
MAPLE ST
PINE ST
FIR ST
DAHLIA ST
LARCH ST
SALMON ST
SPRUCE
EMBASSY LOOP
MISTY LN
HILLSHIRE DR
I-5


CITY OF WOODLAND
GENERAL SEWER PLAN
FIGURE 6-2
MODELED SEWER SYSTEM (SOUTH)
Gray & Osborne, Inc.
CONSULTING ENGINEERS
Legend
Modeled Manhole
Flow Input Node
Modeled Sewer Main
Existing Gravity Sewer Main
Force_Mains
Lift Station
Sewer Subbasin
Parcel
Sewer Basins
Basin W-1
Basin W-2
Basin W-3
Basin W-4
Basin W-5
Basin W-6
Basin W-7
Basin W-8
Basin W-9
Basin W-10
Basin W-11
Basin W-12
Basin W-13
Basin W-14
N
0 250 500 1,000 Feet
WWTF
LS 1
LS 3
LS 4
LS 5
LS 8
LS 9
LS 14
Lewis River

BASINS

The collection system is organized around fourteen main sewer basins. These basins are described in Chapter 4 and are shown in Figure 4-3.

The model inputs for InfoSewer originated from tables set up in an Excel spreadsheet (see Appendix G). The flows applied to the model are an average sanitary flow, peak sanitary flow and I/I flow. Known flows were converted to ERUs and applied directly to nodes for four industries: Columbia River Carbonates, Northwest Pet Products, Pacific Seafood, and Hamilton Materials.

HYDRAULIC MODELING ANALYSIS

Once basin data was collected, hydraulic models were developed for both the 2013 and 2033 conditions utilizing the major trunk lines of the existing sewer collection system. This approach was used to identify pipeline deficiencies including surcharged pipes or pipes with low velocities.

Basin data for 2013 and 2033 are presented in Appendix G. Pipe deficiencies resulting from the model are included in Appendix H for 2013 and 2033. For the initial model setup (2013), there are a total of 221 nodes, or manholes, in the InfoSewer model. Approximately 63,195 lineal feet of pipe is included for the hydraulic model, which represents approximately 42 percent of the total collection system.

To support the development of the hydraulic model, an overall map was prepared to show the pipe and manhole identification numbers of the modeled system. This map is included in Appendix J.

YEAR 2013 HYDRAULIC MODELING ANALYSIS

Land use data and the collection area basins from Figure 4-3 were used to distribute the wastewater flows from Table 5-12 into the hydraulic model (see Appendix G for the results of the distribution). Individual subbasins were delineated amongst each of the basins to help distribute flow where necessary as shown in Figures 6-1 and 6-2. For 2013, County GIS land use parcel data was used to determine the land use within these subbasins. The land use area was then associated with an ERU category (single-family residential, multifamily residential, commercial, industrial, etc.). Table 6-1 shows the zoning and ERU distribution for Woodland.

TABLE 6-1

Woodland 2013 ERU Distribution

Basin	Residential	Commercial	Vacant
W-1	56%	38%	6%
W-2	39%	45%	16%
W-3	56%	33%	11%
W-4	29%	44%	27%
W-5	1%	82%	17%
W-6	68%	15%	17%
W-7	60%	4%	37%
W-8	4%	87%	9%
W-9	49%	26%	25%
W-10	8%	40%	52%
W-11	0%	35%	65%
W-12	2%	13%	85%
W-14	97%	0%	3%

ERUs were distributed within each basin in relation to the amount of land use within the basin. The ERUs were multiplied by the average annual flows based on the value of 135 gpd/ERU (per Table 5-6). In addition to the domestic flows, I/I was added as well. I/I is assumed to be constant throughout the sewer service area and all sewered acreage was multiplied by the I/I value of 222 gpad (per Table 5-8).

Peak hour flows are used for design purposes in the hydraulic model. To obtain the peak hour flows the peak day value of 0.69 mgd for 2013 was disbursed throughout the subbasins and then peaked within the model with diurnal curves relating to the typical basin land use (i.e., 20 percent commercial/80 percent residential, 40 percent commercial/60 percent residential, or 100 percent commercial). The diurnal curves peak the flow approximately two times greater than the peak day flow to represent the peak hour flow. Appendix I displays the diurnal curves whereas detailed spreadsheets of the flow calculations may be found in Appendix G.

SITE SPECIFIC FLOW INPUTS

Industrial flows for Columbia River Carbonates, Northwest Pet Products, Pacific Seafood, Walt's Meats and Hamilton Materials were converted to ERUs and added at specific nodes in the model. Table 6-2 displays the specific sanitary sewer loads inserted into the model for these industries.

TABLE 6-2

Industrial Flow Allocations

Industry	Flow Allocated (gpd)
Columbia River Carbonates	2,240
Northwest Pet Products	9,171
Pacific Seafood	12,741
Walt's Meats[(1)]	42,191/90,000
Hamilton Materials	10,467

(1) Includes 2013 flow and future 2033 flow based upon NPDES Permit Limit.

YEAR 2033 HYDRAULIC MODELING ANALYSIS

Once the data was developed to represent 2013 conditions, it was revised to represent 2033 projections. The overall flow projections from Table 5-12 and County future land use GIS data were the basis for these future estimates. From Table 5-12, it is anticipated that an additional 0.50 mgd of peak hour flow will occur in 2033. This additional flow was disbursed to areas of new or redeveloped growth based on the future land use shown in Figure 3-7.

For the hydraulic model, the infiltration/inflow flow rate (222 gpad) is assumed to remain constant at the levels seen in 2013.

Appendix G summarizes the data assumed for each subarea under 2033 conditions.

MODELING RESULTS WITHOUT IMPROVEMENTS

Deficiencies in the collection system are defined as follows:

- Manholes are shown as deficient when InfoSewer reports that the manhole is full and surcharged to the manhole rim during peak hour flow conditions. In this case, the manhole itself is not the actual deficiency but it alludes to a problem downstream due to either a pipe or a certain hydraulic restriction.

- Pipe segments are considered deficient with respect to velocity when the flow is less than 2 feet per second during peak hour flow conditions. Inadequate velocities may lead to lack of scouring and solids settlement in the pipe.

- Pipe segments are considered deficient with respect to capacity when InfoSewer reports that the depth at the peak hour flow through the pipe is equal to or exceeds the maximum depth of pipe (i.e., the diameter). Essentially, this means that the pipe is running full at the modeled flows and that flow is surcharging within the manholes. This may be due to a lack of capacity in the pipe itself or a downstream hydraulic condition.

Appendix H and Figures 6-3 through 6-6 present the initial modeling output results for the 2013 peak hour flow conditions. The report identifies each pipeline segment and manhole. The model output shows that about 74 percent of the modeled pipeline segments are characterized by low velocity (less than 2.0 feet per second). It is likely that additional pipe segments have low velocity during low flows. A total of 32 segments are shown to have insufficient pipeline capacity. Within the model, six manholes are also shown to be surcharged to the rim.

Appendix H presents the initial modeling output results for 2033. For 2033, no additional pipe segments had insufficient capacity however two manholes/pipelines were shown to be surcharged due to the addition of the maximum allowable flow from Walt's Meats (Pipes 9.2 and 9.3 within Basin W-9). There are no additional pipes that are shown to have low velocity.

The 2033 peak hour influent flows at the WWTF predicted by InfoSewer is 1,125 gpm, or 1.62 mgd. Per Table 5-12, the design peak hour flow for the WWTP is 1.72 mgd, comparable to the rate shown by the modeled peak hour flow for 2033.

The 2033 hydraulic modeling analysis identified a total of 34 pipeline capacity deficiencies and six surcharged manholes. Table 6-3 lists the deficiencies per basin. These deficiencies are also shown graphically in Figures 6-3 through 6-6. Many other pipelines have velocities less than two feet per second (a deficiency criteria) but are capable of handling the existing and projected flows, and therefore are not recommended for improvements. It should be noted that most of these pipelines were modeled at assumed minimal slopes and in reality, may be providing faster velocities than shown in the model output. However, the pipelines should be monitored by the City as part of its ongoing operations and maintenance to identify potential solids deposition in the pipelines.

TABLE 6-3

2013 and 2033 Gravity Main Pipe Deficiencies

Basin	Location	Modeling Location	Capacity Issue Identified in Hydraulic Model(1)
1	Glenwood Street	MH 1-5 to LS 1	Surcharges; Undersized 8-inch pipe
3	Goerig Street	MH 3-7 to LS 3; MH 3-29 to LS 3	LS 3 at capacity so all pipes and five manholes within Basin 3 were fully surcharged
	Bozarth Avenue	MH 3-29 to 3-30	Undersized 8-inch pipe
4	B Street	MH 4-6 to LS 4	Slightly surcharges by 0.13' (12-inch pipe)
	Goerig Street	MH 4-27 to MH 4-26	Slightly surcharges by 0.18' (8-inch pipe)
	Cherry Blossom Lane	MH-17 to MH-15	Slightly surcharges by 0.09' (12-inch pipe)
6	Springwood Drive to Lewis River Road	MH 6-33 to MH 6-26	Invert at Lewis River Road is higher than invert coming from Springwood Drive
9	Pekin Road South	MH 9-2 to MH 9-3	LS 9 undersized if maximum allowable discharge from Walt's Meats occurs
10	Dike Access Road	MH 10-39 to MH 10-38	Adverse (negative) slope

(1) Surcharges noted under the 2033 flow scenario.

YEAR 2013 AND 2033 MODELING RESULTS WITH IMPROVEMENTS

Although there were numerous deficiencies shown in the 2013 and 2033 models, only a few recommended improvements are necessary (see Table 6-4). Figures 6-3 through 6-6 show the recommended improvements to correct these deficiencies. With the recommended improvements listed below, a revised model showed no deficiencies for the areas listed other than the minimal accepted surcharging described in Table 6-4. It should be emphasized that the model was based on the limited available survey information and information from other sources; thus it is recommended that implementation of all projects related to this capacity assessment in Woodland be further evaluated prior to design and construction.

TABLE 6-4

Recommended Gravity Main Improvements

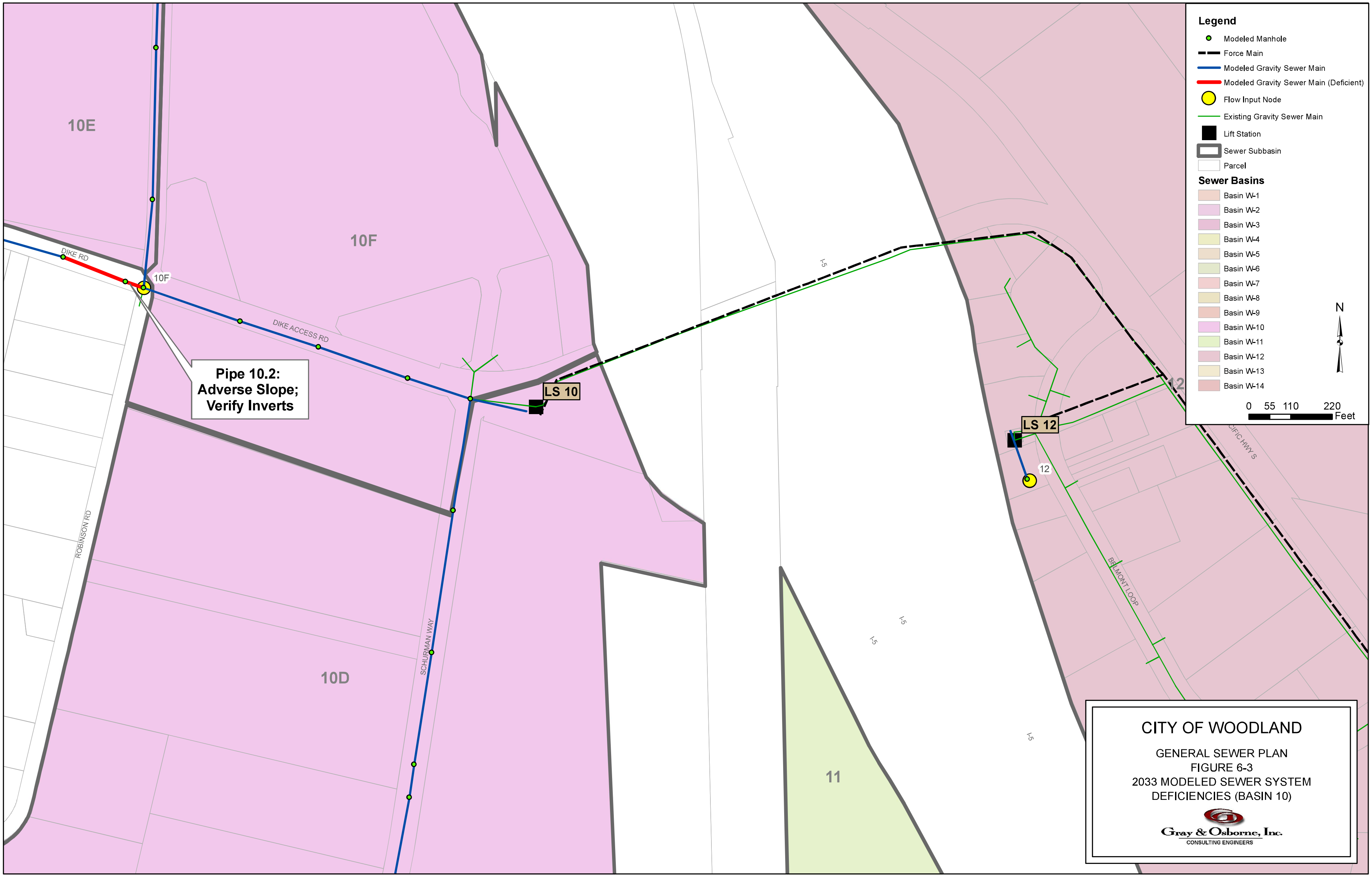
Basin	Location	Modeling Location	Capacity Issue	Recommendation(1)
1	Glenwood Street	MH 1-5 to LS 1	Surcharges; Undersized 8-inch pipe	Replace 900 LF of 8-inch pipe w/10-inch pipe from MH 1-5 to LS 1
3	Goerig Street	MH 3-7 to LS 3; MH 3-29 to LS 3	LS 3 at capacity so all pipes and 6 manholes within Basin 3 were fully surcharged	Upgrade LS 3 capacity from 330 gpm to 585 gpm
	Bozarth Avenue	MH 3-29 to 3-30	Undersized 8-inch pipe	Replace 217 LF 8-inch pipe with 12-inch pipe (after verifying downstream pipe is 12 inches)
4	B Street	MH 4-6 to LS 4	Slightly surcharges by 0.13' (12-inch pipe)	Remain as is due to minimal surcharge
	Goerig Street	MH 4-27 to MH 4-26	Slightly surcharges by 0.18' (8-inch pipe)	Remain as is due to minimal surcharge
	Cherry Blossom Lane	MH-17 to MH-15	Slightly surcharges by 0.09' (12-inch pipe)	Remain as is due to minimal surcharge
6	Springwood Drive to Lewis River Road	MH 6-33 to MH 6-26	Invert at Lewis River Road is higher than invert coming from Springwood Drive	Survey MH 6-26 at Lewis River Road to verify offset inverts
9	Pekin Road South	MH 9-2 to MH 9-3	LS 9 undersized if maximum allowable discharge from Walt's Meats occurs	Monitor capacity issue in the future relative to the discharge occurring from Walt's Meats
10	Dike Access Road	MH 10-39 to MH 10-38	Adverse (negative) slope	Survey MH 10-39 and MH 10-38

(1) Verification of inverts for these areas should be done prior to design or construction to confirm capacity issues.

LIFT STATION CAPACITY ANALYSIS

The City of Woodland operates and maintains fourteen lift stations. Table 6-5 shows the capacity analysis for each of the lift stations.

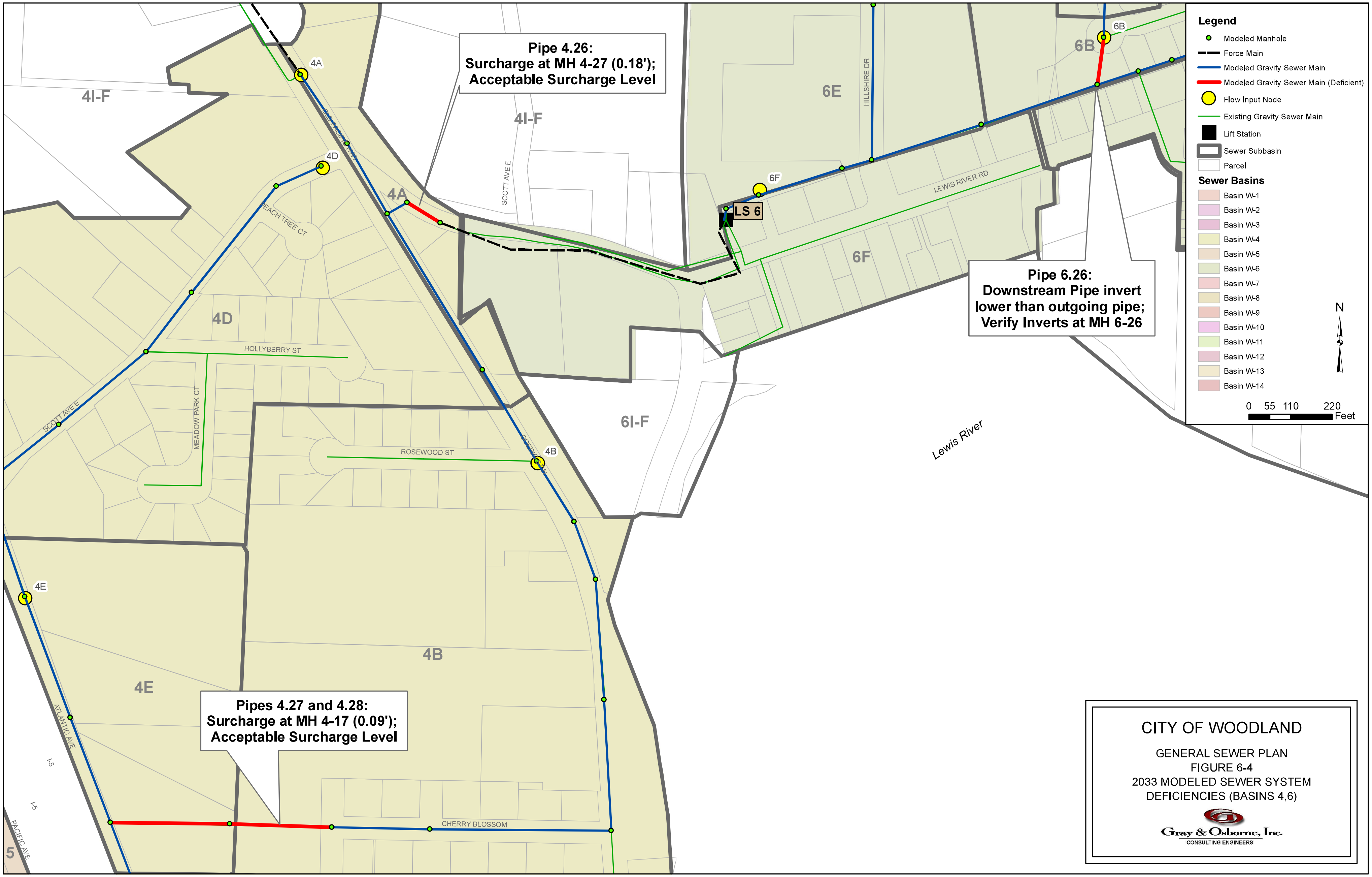
For Woodland's lift stations, the peak flows previously developed for the 2013 and 2033 scenarios are compared to each of the lift station's existing capacity in Table 6-5. For the 2033 scenario, capacity surplus or deficiency is determined.



CITY OF WOODLAND

GENERAL SEWER PLAN
FIGURE 6-3
2033 MODELED SEWER SYSTEM
DEFICIENCIES (BASIN 10)

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CITY OF WOODLAND

GENERAL SEWER PLAN
FIGURE 6-4
2033 MODELED SEWER SYSTEM
DEFICIENCIES (BASINS 4,6)

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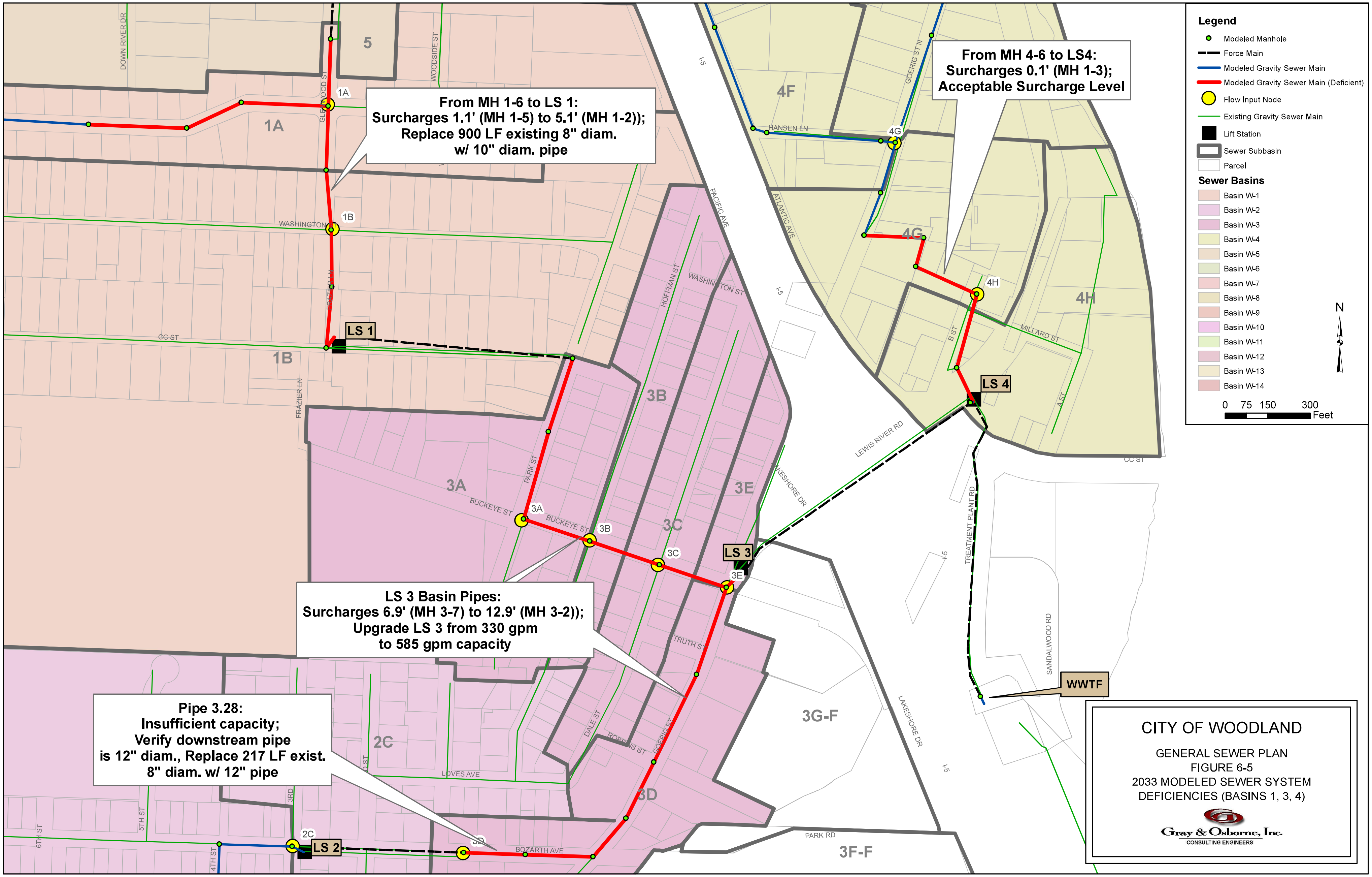
CONSULTING ENGINEERS



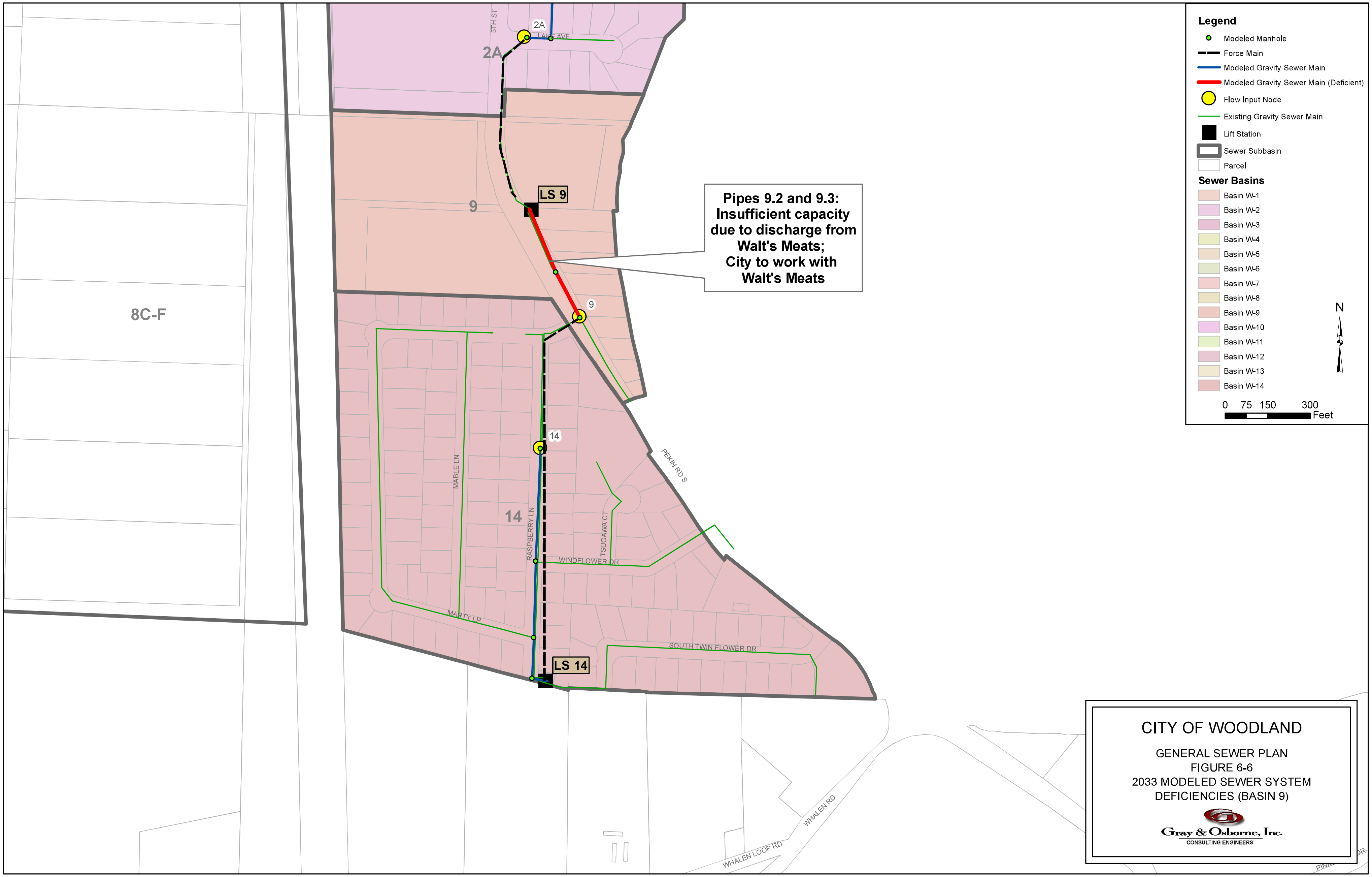
CITY OF WOODLAND

GENERAL SEWER PLAN

FIGURE 6-5

2033 MODELED SEWER SYSTEM DEFICIENCIES (BASINS 1, 3, 4)

Gray & Osborne, Inc.
CONSULTING ENGINEERS



CITY OF WOODLAND

GENERAL SEWER PLAN
FIGURE 6-6
2033 MODELED SEWER SYSTEM
DEFICIENCIES (BASIN 9)

Gray & Osborne, Inc.
CONSULTING ENGINEERS

The lift station analysis presented in Table 6-5 shows that five of Woodland's lift stations have inadequate capacity for flows projected through 2033. The deficit for Lift Station 2 is minimal, and thus this lift station should be monitored for capacity issues as flows increase. Likewise, Lift Station 9 deficiencies occur if Walt's Meats discharges at its maximum allowable discharge limits. Therefore, it is recommended that this station be monitored for future capacity issues as the flow from Walt's Meats increases. It should also be noted that City staff has noticed that Lift Station No. 11 can get overwhelmed by instantaneous flows from Pacific Seafoods; however, the City will work with them to remedy this in the future. In review of historical run time data for the lift stations, it appears that Lift Station 1 may not be at capacity as suggested in Table 6-5. It is recommended that the City monitor this station for future capacity constraints. In addition, from the run times available, it appears that Lift Station 6 is close to capacity at the present time. An analysis titled "Pump Station 6 – Capacity Analysis and Upsizing Calculations" prepared by Olsen Engineering in January 2014 confirms this. Per the analysis, it was recommended that Lift Station 6 be upgraded to a 550 gpm station to accommodate future growth. From both the model and run time data, Lift Stations 3, 4 and 6 appear to be undersized. Therefore, it is recommended that the capacity be increased at these stations to accommodate future flows.

TABLE 6-5

2033 Lift Station Capacity Analysis

Lift Station	Total 2013 Peak Flow (gpm)	Total 2033 Peak Flow(1) (gpm)	Lift Station Capacity (gpm)	2033 Surplus (+)/ Deficit (-) (gpm)(3)
1	**415(2)**	**350(2)**	**275**	**(-) 75**
2	**279(2)**	**268(2)**	**250**	**(-) 18**
3	**540**	**585**	**330**	**(-) 255**
4	**858**	**1,145**	**850**	**(-) 295**
5	59	59	220	(+) 161
6	**330**	**335**	**345**	**(+) 10**
7	201	219	300	(+) 81
8	28	108	200	(+) 92
9	**159**	**332**	**300**	**(-) 32**
10	71	100	170	(+) 70
11	23	23	250	(+) 227
12	7	20	290	(+) 270
13	16	16	250	(+) 234
14	41	41	135	(+) 94

(1) Assumes upstream lift station capacities increased for Lift Station 1 (to 350 gpm), Lift Station 3 (to 585 gpm), Lift Station 4 (1,145 gpm), and Lift Station 6 (550 gpm) and were conveyed downstream.

(2) Greater flow attenuation occurred within the model with the 2033 scenario which had improved lift station capacity downstream, hence the smaller flow shown in 2033 versus 2013.

(3) Bold font represents lift stations shown to be undersized within the model and should be monitored for capacity issues in the future. Dark shading indicates a recommended capacity upgrade.

FORCE MAIN CAPACITY EVALUATION

The capacity evaluation for the force mains is tied directly to the lift station capacity evaluation. The capacity of each force main is based on a maximum design velocity of 8 feet per second (fps). This capacity is compared to the existing lift station capacity and the predicted peak flow for 2033 conditions. The results of this evaluation are shown in Table 6-6.

TABLE 6-6

Force Main Capacity Analysis

Lift Station	Existing Lift Station Capacity (gpm)	Force Main Diameter (in)	Existing Force Main Capacity (gpm)	2033 Peak Flow Requirement (gpm)	2033 Surplus (+)/ Deficiency (-) (gpm)
LS 1	275	6	705	350	(+) 355
LS 2	250	6	705	268	(+) 437
LS 3	330	8	1,253	585	(+) 668
LS 4	850	8	1,253	1,145	(+) 108
LS 5	220	6	705	59	(+) 646
LS 6	345	6	705	335	(+) 370
LS 7	300	6	705	219	(+) 486
LS 8	200	4	313	108	(+) 205
LS 9	300	6	705	332	(+) 373
LS 10	170	6	705	100	(+) 605
LS 11	250	4	313	23	(+) 290
LS 12	290	6	705	20	(+) 685
LS 13	250	4	313	16	(+) 297
LS 14	135	4	313	41	(+) 272

As shown in Table 6-6, all force main capacities are assumed to be adequate as they exceed both the current lift station capacity and 2033 planning period capacity for all lift stations.

COLLECTION SYSTEM IMPROVEMENT SUMMARY

A summary of the recommended improvements to the collection system based on the model results are described in Table 6-4 and shown in Figures 6-3 through 6-6. A detailed cost analysis is provided at the end of this Chapter and a timeline for improvements is presented in the Capital Improvement Plan Chapter of this Plan.

FIELD OBSERVATIONS

LIFT STATIONS

As shown in Table 6-5, it is recommended that the capacity of Lift Stations 3 and 4 be increased in order to accommodate 2033 flows. From a field perspective, a survey of the City's lift stations by Gray & Osborne and City staff on April 22 and 23, 2014 revealed the following conditions and operational issues:

Lift Station 1 – 554 CC Street in Residential Area

Lift station in street; 6-foot-diameter concrete wet well; stainless steel rails; 4' x 3' hatch.

- Hatch cracked/welded near hinges.
- Operating range in wet well is too small for inflow per operator.

Discharge valve vault has 3-inch drain to wet well; 4' x 2'-6" hatch.

- Hatch has corroded hinges on one side and will not open.

Lift Station 2 – 386 Bozarth Avenue in Commercial Area

Wet well 6-foot diameter concrete; 3' x 5' hatch.

- Pump hatch cracked and does not appear to be traffic rated.
- Chipped concrete at top of wet well cracked.
- Pump rails galvanized and corroding.
- Steel grate cut edge inside wet well.

Discharge valve vault 3' x 4'-6" hatch.

- Valve vault hatch does not open.

Lift Station 3 – 906 Goerig Street in Residential Area

Wet well 6-foot diameter concrete; 3' x 4' hatch; steel platform (50%).

- Ladder and platform heavily corroded.

Discharge valve vault 4-inch steel piping with welded transition to 8-inch steel force main; 32-inch square hatch; no drain.

- No isolation valve on bypass pump connection; welded insert approximately 3-inch diameter with threaded cap.
- 4-inch welded steel discharge piping; fair condition.
- Evidence of routine pipe submersion.

Lift Station 4 – 1013 Lewis River Road near Gas Station/Convenience Store

Wet well 10-foot-diameter concrete; 3'-6"x7'-6" 3 door hatch.

- No service disconnect.
- No vent.

Discharge valve vault 8-inch DI piping through vault; discharge manifold buried outside vault; 3'-6" x 7' valve hatch; drain to wet well with c.v. in vault; power fed to wet well via four each alum explosion-proof j-boxes in vault.

- No bypass pump connection.

Lift Station 5 – 1390 Glenwood in Port of Woodland

Wet well 6-foot-diameter concrete; diamond plate lid/hatch 3' x 4'.

- Control panel smaller than typical; some control equipment mounted in telemetry panel.
- Top of pump rails 4 feet below hatch; concrete ledger is available for a platform, but no platform installed.
- Steel pump discharge pipe heavily corroded at upper 90.

Discharge valve vault concrete with steel lid; hatch 2'-6" x 2'.

- Welded steel piping with check valves; not isolation valve.
- Open bottom and side penetrations; evidence of submersion.
- No isolation valve on bypass pump connection; welded insert approximately 2-inch diameter with threaded cap.

Lift Station 6 – 1709 Lewis River Road next to Fire Station in Residential Area

Wet well 6-foot-diameter concrete; 32" x 48" hatch.

- 1996 flood was 1.5 feet over rim elevation; hatch not sealed.
- No wet well vent.
- Upper elbow on ductile iron discharge pipe badly corroded.

Discharge valve vault 4-inch DI discharge piping combines to 6-inch DI force main; 4-inch bypass connection with g.v and c.v.; 32-inch square hatch.

- Valve vault has no drain; evidence of submersion.

Lift Station 7 – 300 Insel Road in Meriwether Development

Wet well 6-foot-diameter concrete; 32" x 48" hatch.

- No local safety disconnect. Pump control panel is 200 feet approx. from wet well and behind wall.
- No wet well vent.
- Large quantity of floatables in the wet well.

Discharge valve vault 4-inch DI discharge piping combines to 6-inch DI force main; 4-inch bypass connection with g.v and c.v.; 32-inch square hatch.

- No issues noted.

Lift Station 8 – 348 North Pekin Road in Industrial Park

Wet well 6-foot-diameter concrete; half plate platform that covers discharge piping (exits to east); 42"x48" hatch.

- North pump discharge leaks heavily at the bottom flange on the upper elbow.
- Platform is corroded and has been trimmed; structural condition unknown; obscures discharge piping.
- No vent.

Discharge valve vault concrete; 32-inch square hatch.

- Vault is too small to work on pipes and has been broken out; fittings are tight against the side walls of the vault.
- Drain does not appear to connect to wet well. Plugged with evidence of submersion.
- No grout on penetrations.
- No bypass pump connection.
- White silt noted in 12-inch inlet stream (west) to wet well.

Lift Station 9 – 108 South Pekin in a Residential Area

Wet well 5-foot-diameter concrete; 32" x 42" hatch.

- Moderate corrosion on wet well discharge piping. Material unknown; appears to be welded steel or cast iron drain pipe.

Discharge valve vault concrete; 3' x 6' 2-door hatch; 4-inch piping and valves to 4-inch force main; pressure gauges; 4-inch pig/bypass port; drains to wet well with flap valve.

- No issues noted.

Lift Station 10 – 1481 Dike Access Road in Commercial Area

Wet well 6-foot-diameter concrete; 32" x 48" hatch.

- Pump power enters wet well via explosion-proof aluminum j-box inside wet well with steel bolts heavily corroded and will be difficult to service.
- No vent.
- Control wiring enters through a non-explosion proof j-box in the wet well.

32-inch square hatch; 4-inch DI piping passes through vault (no manifold visible).

- No drain (vault found flooded; check valves not accessible).

Lift Station 11 – 1755 Down River Drive in Industrial Park

Wet well 5-foot-diameter concrete; wet well hatch 4' x 2'-6"; stainless steel rails.

- No vent.
- Operator notes that seafood plant discharge overwhelms the station regularly causing alarms.

Discharge valve vault manifold outside vault; valve vault hatch 33-inch square; 4-inch plug valve; 4-inch swing check.

- No drain/flooded.

Lift Station 12 – 1931 Belmont Loop in Commercial Area

Wet well 6-foot-diameter concrete; 3' x 4' hatch.

- Wet well vents through 4-inch opening in concrete lid; not gooseneck.

Discharge valve vault.

- Unable to open hatch.

Lift Station 13 – 1775 Howard Way in Industrial Park

Wet well 5-foot-diameter concrete; 6-foot-diameter offset lid; 32" x 48" hatch.

- Moderate corrosion on pump rail upper bracket and bolts.

Discharge valve vault 32" x 68" hatch; 4-inch piping; 4-inch bypass with g.v.; pressure gauge on common discharge; has a drain.

- No issues noted.

Lift Station 14 – 250 Raspberry Lane in Residential Area

Wet well 6-foot-diameter concrete.

- Upper discharge elbows (DI) heavily corroded.

Although all lift stations are operable, some have non-functional hatches and deteriorated platforms, electrical components and piping that are in need of reconstruction and/or replacement. In some cases the valve vaults are not equipped with drains and this causes flooding, which can reduce the life of the valves, fitting and piping. Not all lift station wet wells are vented.

Lift station 11 pumps may need to be upsized unless discharges from Pacific Seafood can be altered to avoid exceeding this lift station's capacity. It is recommended the City communicate with Pacific Seafood to determine whether operational changes can resolve this issue without physical modifications to the lift station.

An evaluation of costs and potential modifications and repairs for the City's lift stations is provided at the end of this Chapter.

COLLECTION SYSTEM

Discussions with City maintenance staff indicate that most routine problems in the collection system result from grease, rags and disposable wipes that require the City to perform regular flushing to prevent accumulation of these materials.

City maintenance staff has identified two primary areas where sewer backups occur:

- Upstream of Lift Station 6 due to rags and grease accumulation.
- Between Lake Avenue and 4th Street possibly due to a "belly" in the line downstream of Lift Station 9.

Education of sewer users about the risks of clogging sewers due to the discharge of grease and rags/disposable wipes into the sewer is recommended to address this problem. To determine the cause of problems between Lake Avenue and 4th Street it is recommended that the City perform a televised inspection of this section of the collection system to determine its condition and verify if the configuration of the line is contributing to accumulation of debris.

In 2013 the City relined 17,480 lineal feet of sewer line in the older part of the City, primarily in Basins 1A, 1B, 2B, 2C, 3A, 3B, 3C, 3D and 3E. The City intends to continue with this work to line all remaining concrete and transite sewer pipe. There is an estimated 21,900 lineal feet of concrete and transite sewer lines in the City's collection system and an estimated 4,420 lineal feet of pipe remains to be slip-lined, including sections in the vicinity of the SR 503/Scott Avenue intersection project that the City will be constructing next year.

The City performed televised inspection of the sewer piping that was slip-lined to verify the work was completed satisfactorily, however, the City should consider smoke testing the rehabilitated sections of the sewer system once the slip-lining work is completed as a means of verifying these older rehabilitated lines are no longer at risk of high infiltration.

Maintenance staff is also concerned about the condition of older laterals in the sewer system, especially in the area where older sewer lines were recently rehabilitated by slip-lining the pipes. It is City policy to require sewer users to maintain laterals. Smoke testing in the areas where sewer mains have been rehabilitated could also be used to identify sewer laterals in need of repair and notify property owners accordingly.

LIFT STATION REPLACEMENT COSTS

Based on the lift station evaluation, five of the City's fourteen lift stations are identified as likely to require significant upgrade or replacement within the upcoming 20-year CIP period. These five stations are generally older and showing signs of wear. The five stations are listed in Table 6-7, together with estimated replacement dates in 5-year increments, as well as general station characteristics. The replacement dates shown are relative and subject to adjustment, based on ongoing condition of the facility. A set of typical characteristics is also identified for use in estimating a typical replacement cost. The remaining nine stations are expected to last through the 20-year planning period with minor repairs and upgrades as needed.

TABLE 6-7

Lift Stations with Estimated Remaining Useful Life of Less Than 20 Years

Lift Station	Estimated Replacement Year	Existing Pump Motor Size	Existing Wet Well Diameter (in)	Existing Wet Well Depth (ft)
Lift Station 1	2025	7.5 hp	72	16
Lift Station 2	2025	5 hp	72	19
Lift Station 3	2030	7.5 hp	72	21
Lift Station 5	2020	3 hp	72	19
Lift Station 8	2030	5 hp	72	20
Typical Assumed Replacement	—	Up to 10 hp	72	20

Table 6-8 provides a cost estimate for the typical duplex submersible replacement lift station as identified in Table 6-7. As noted in Table 6-8, the typical replacement cost assumes a pump motor size of up to 10 horsepower, a 6-foot wet well diameter, and a wet well depth of up to 20 feet. Due to the age and site constraints typical at the five stations identified in Table 6-7, the typical replacement cost includes an allowance for the following:

- Slide rail shoring and dewatering.
- Up to 70 square yards of pavement replacement.

- Up to 2 cubic yards of sidewalk and gutter replacement.
- Up to 100 feet of chain link fencing.
- New electrical rack with updated utility service and miscellaneous electrical components.
- New force main piping.

The typical replacement cost for a single lift station shown in Table 6-8 specifically excludes the cost for a replacement control panel and telemetry.

The cost for replacement of control panels and update of the SCADA system is discussed in the SCADA evaluation at the end of this chapter.

TABLE 6-8

Single Lift Station Replacement Cost (1)

No.	Item	Quantity	Unit Price	Amount
1	Mobilization and Demobilization	1 LS	$20,000	$20,000
2	Site Work, including Dewatering, TESC, Shoring, Grading, and Excavation	1 LS	$35,000	$35,000
3	72-inch Diameter Wet Well up to 20 feet Deep w/o Coating, includes Installation	1 LS	$32,000	$32,000
4	Submersible Pumps, Base Elbow, and Rails up to 10 hp including Installation	1 LS	$42,000	$42,000
5	Discharge Valve Vault	1 LS	$14,000	$14,000
6	Piping including Wet Well, Valve Vault, Gravity, and Force Main Connections	1 LS	$24,000	$24,000
7	Electrical w/o Pump Control Panel (2)	1 LS	$33,000	$33,000
8	Site Restoration, including Final Grading and Paving, Fencing, and Landscaping	1 LS	$11,000	$11,000

Subtotal $211,000
Contingency (20%) .... $ 42,000
Subtotal $253,000
Washington State Sales Tax (7.8%) .... $ 20,000
Total Estimated Construction Cost $273,000

Engineering, Construction Administration Cost (25%) .... $ 68,000

TOTAL ESTIMATED PROJECT COST $341,000

(1) All costs in 2014 dollars and rounded to nearest $1,000.
(2) Cost of Pump Control Panel discussed in SCADA Evaluation (see Tables 6-9, 6-10, and 6-11).

COLLECTION SYSTEM SCADA SYSTEM EVALUATION

The status of the City's fourteen pump stations is monitored at the City's Operations Center by a supervisory control and data acquisition (SCADA) system. The SCADA system consists of a MultiTrode OutPost human machine interface (HMI) software package running on a computer located in the City's Operations Center and MultiTrode MT2SPC/MT3SPC SCADA pump controllers installed inside of control panels that are located at the pump stations. The HMI and pump controller communicate using serial radios and a MultiTrode-specific communication protocol.

The MultiTrode pump controllers start and stop the pumps based off of controller set points and the wet well level as measured by the MultiTrode ten segmented level probes. The controllers monitor motor status and wet well level and transmit that information to the City's Operations Center where it is displayed and logged on the HMI. The HMI includes a remote alarm annunciation feature that will call or text message an Operator if an alarm condition exists.

The existing MultiTrode MT2SPC/MT3SPC SCADA pump controllers are no longer being manufactured and will soon become unavailable. The City currently has two spare MT2SPC controllers and one MT3SPC controller.

EXISTING PUMP STATIONS

The existing pump stations monitor status of the following:

- HOA in off position.
- HOA in hand (manual) position.
- HOA in auto position.
- Pump running.
- Pump available.
- Pump fault.
- Pump locked out.
- Motor over temperature.
- Pump seal leak.
- Wet well level (0% to 100% in 10% increments).
- Wet well high level.
- Motor start count (not accurate).
- Wet well low level (is available but not used).

FUTURE PUMP STATIONS

For this evaluation, the pump stations' monitoring will be expanded to include the following:

- Motor start count (accurate).
- Motor run time.
- Motor current.
- Flow out of the wet well (calculated by the pump controller).
- Control panel intrusion.
- Check valve open (requires additional wiring).
- Analog wet well level (requires DuoProbe, 10 segments with 4-20 mA pressure transducer).

SCADA UPGRADE OPTIONS

The existing human machine interface (HMI) computer was recently replaced with new computer hardware running the existing MultiTrode OutPost HMI software. The City's current version of the MultiTrode OutPost HMI software is only compatible with the MultiTrode MT2SPC/MT3SPC SCADA pump controllers which have been discontinued. Therefore, when the City has extinguished its supply of spare controllers it will need to upgrade to new MultiTrode controllers or change to an alternate pump controller. Also, new HMI software will be required to communicate with any new pump controllers.

In this evaluation, it is important to recognize that, in the State of Washington, electrical equipment is required to have a valid Underwriters Laboratories (UL) label. Any new work performed on an existing control panel may void its UL label, which would require hiring a UL representative to inspect the control panel and control panel modifications and relabel the control panel. If violations are noted, they will need to be corrected and the UL representative will need to be hired to reinspect the control panel and relabel it. This process will be repeated until the control panel is relabeled. The cost of each inspection by the UL representative is $1,000 to $2,000 per site visit for a single control panel.

Three options are considered in this evaluation. The first two options would replace the existing MT2SPC/MT3SPC Multitrode controllers with the MultiTrode Outpost III controller. The first option would be for the City to simply replace the controllers with City labor and not replace the control panels. The second option would be to have the MultiTrode replacement performed by a contractor, which would require replacing the control panel. A third option would be for the City to replace the MultiTrode controllers with a programmable logic controller installed in new control panels.

As shown in Table 6-9, the cost of components to replace the entire SCADA system with a new MultiTrode Outpost III HMI system, new MultiTrode pump controller system, and new Ethernet radios is $228,000. This cost is for components and startup only, and assumes the City will install and connect the wiring for the new pump controllers, current transformers, and Ethernet radios and antennas. No engineering or construction administration costs are included with this estimate. MultiTrode and its local distributer would assist with the startup. This option will provide all of the existing pump station statuses plus the following future pump station statuses:

- Motor run time.
- Motor current.
- Flow out of the wet well (calculated by the pump controller).

TABLE 6-9

Option 1 – Upgrade Wastewater Collection System SCADA (MultiTrode City Installation) (1)

No.	Item	Quantity	Unit Price	Amount
1	MultiTrode Outpost III HMI Hardware and Software	1 LS	$56,000	$56,000
2	MultiTrode Pump Controller	14 EA	$5,300	$74,000
3	MultiTrode Motor Protection with Current Transformers	14 EA	$1,800	$25,000
4	MultiTrode Flow Calculation Function	14 EA	$500	$7,000
5	155-Watt 12 VDC Power Supplies (includes one spare)	15 EA	$250	$3,800
6	Ethernet Radios, Antennas, and Cables	15 EA	$2,600	$39,000
7	Startup and Commissioning	1 LS	$7,000	$7,000

Subtotal.. $211,800
Washington State Sales Tax (7.8%).. $ 16,500

TOTAL ESTIMATED PROJECT COST... $228,000

(1) All costs in 2014 dollars and rounded to nearest $1,000.

If the City were to elect to have the MultiTrode installation work performed by others, the control panels would need to be replaced to meet the electrical code. As shown in Table 6-10, the cost of including new control panels with the MultiSmart intelligent pump station manager, new HMI MultiTrode Outpost III HMI system, removal of the existing control panels, and installation on the new control panels, HMI and MultiSmart configuration, and startup is $707,000 (includes engineering to prepare bid documents, assumes the City provides construction administration). This estimate includes removing the existing control panel and installing the new control panel, configuring, and startup. This option will provide all of the existing pump station statuses plus the following future pump station statuses:

- Motor run time.
- Motor current.
- Flow out of the wet well (calculated by the pump controller).
- Control panel intrusion.

TABLE 6-10

Option 2 – Upgrade Wastewater Collection System SCADA (MultiTrode Contractor Installation)(1)

No.	Item	Quantity	Unit Price	Amount
1	MultiTrode Outpost III HMI Hardware and Software	1 LS	$56,000	$56,000
2	Control Panel NEMA 3RX 304L SS, MultiTrode Pump Controller, Radio, Antenna, 24 VDC Power Supply and DC-UPS, and Motor Starters	14 EA	$35,000	$490,000
3	Installation and Ancillary Materials and Work	14 EA	$5,000	$70,000
4	Startup and Commissioning	1 LS	$7,000	$7,000

Subtotal $623,000
Washington State Sales Tax (7.8%) .... $ 49,000
Total Estimated Construction Cost $672,000

Engineering (Prepare Bid Documents) .... $ 35,000

TOTAL ESTIMATED PROJECT COST $707,000

(1) All costs in 2014 dollars and rounded to nearest $1,000.

The City could also upgrade their existing pump station controls to utilize a programmable logic controller (PLC) in lieu of the MultiTrode controller. This option is potentially a more reliable long-term solution to the City's SCADA needs because it would provide greater flexibility to add additional control features and it would not rely on a single controller manufacturer. As shown in Table 6-11, the estimated cost of new control panels with programmable logic controller (PLC) and operator interface terminal (OIT), new HMI hardware and Wonderware HMI software, programming, and startup is $820,000, which includes removing the existing control panel, installing the new control panel, HMI, PLC, and OIT programming and startup. This option will provide all of the existing pump station statuses plus the following future pump station statuses:

- Motor run time.
- Motor current.
- Flow out of the wet well (calculated by PLC).
- Control panel intrusion.

TABLE 6-11

Option 3 – Upgrade Wastewater Collection System SCADA (PLC Contractor Installation)[1]

No.	Item	Quantity	Unit Price	Amount
1	HMI Hardware and Software	1 LS	$26,000	$26,000
2	Telemetry PLC Panel (might not need with Ethernet)	1 LS	$15,000	$15,000
3	HMI Programming and Startup	1 LS	$33,000	$33,000
4	Control Panel NEMA 3RX 304L SS, PLC, Radio, Antenna, 24 VDC Power Supply and DC-UPS, Motor Starters	14 EA	$37,500	$525,000
5	Installation and Ancillary Materials and Work	14 EA	$5,000	$70,000
6	PLC Programming and Startup	15 EA	$3,600	$54,000

Subtotal $723,000
Washington State Sales Tax (7.8%) .... $ 57,000
Total Estimated Construction Cost $780,000

Engineering (Prepare Bid Documents) .... $ 40,000

TOTAL ESTIMATED PROJECT COST $820,000

(1) All costs in 2014 dollars and rounded to nearest $1,000.

COLLECTION SYSTEM IMPROVEMENT COSTS

As the hydraulic analysis indicated, there are two collection system capacity deficiencies for the gravity conveyance system and no deficiencies for the force mains. Table 6-12 summarizes estimated costs for the gravity collection system improvements.

The City also intends to continue and complete the relining of gravity sewers in the older part of the City. The total remaining length of piping to be relined is 4,420 feet. The estimated cost for this work is $221,000 based on $50/ft, with the City performing all engineering and construction administration in house.

TABLE 6-12

Gravity Collection System Improvements [1]

No.	Item	Quantity	Unit Price	Amount
1	Basin 1 – Replace 900 LF of 8-inch pipe w/10-inch pipe from MH 1-5 to LS 1	900 LF	$180	$162,000
2	Basin 3 – Replace 217 LF 8-inch pipe with 12-inch pipe (after verifying downstream pipe is 12 inches)	217 LS	$200	$43,400

Subtotal $205,400
Contingency (20%) .... $ 41,000
Subtotal $246,400
Washington State Sales Tax (7.8%) .... $ 19,200

Total Estimated Construction Cost $265,600

Engineering (Prepare Bid Documents – assumes City does Construction Administration) .... $ 27,000

TOTAL ESTIMATED PROJECT COST $293,000

(1) All costs in 2014 dollars and rounded to nearest $1,000.