STUDY AREA 3

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INTRODUCTION

The City of Bend is the provider of wastewater collection and treatment service within the City of Bend Urban Growth Boundary (UGB). The 2006 Collection System Master Plan was developed in cooperation with the City of Bend Public Works Department to provide the roadmap for the providing service to all existing users, existing developed areas that have not yet connected to the system and for new development. This includes areas outside of the UGB but within the Urban Area Reserve (UAR). The key principles that the plan was based on were:

- Protect the public health and maintain the quality of the water environment within and around the City of Bend.
- Provide ongoing system capacity and reliability to minimize the risk of Sanitary Sewer Overflows (SSOs).
- Provide planning based on approved General Plan
- Expand existing system using a phased approach as capacity and/or service is needed.
- Provide infrastructure capacity for existing developed areas that currently are not provided with sanitary service
- Provide gravity-based collection system, reducing operational risk and long term life-cycle operations costs for the City wastewater collection system
- Develop a long-term plan for sanitary service within the existing UGB and UAR service areas

The results and recommendations of the Master Plan are summarized in the 2006 Collection System Master Plan Report. As part of the Master Plan Report, nine Study Area Plans were developed to provide a detailed summary of the plans for providing sanitary service to each parcel. These plans consist of three components:

1. Projects for Unserved Areas (local gravity sewers needed to provide service to currently-developed parcels that do not have City sewer service);
2. Pump Stations (recommendations on the long-term operation of each pump station);
3. System Deficiencies (the correction of current and long-term system capacity deficiencies).

STUDY AREA 3

The planning area, which includes both the areas of the UGB and the UAR, is shown in ***Figure 3-1 – Master Plan Study Areas***. To organize and simplify the presentation of the information developed in the Master Plan, the planning area has been divided into nine Study Areas. This document provides the information for Study Area 3, which is the southwestern portion of the City, located on the west side of the Deschutes River. This area is highlighted and labeled in ***Figure 3-1***.

Study Area 3 consists of 3,920 acres (3,199 parcels), which can be subdivided into four categories**. *Below is a summary of each category*:**

1. 824 acres (1,948 parcels) that receive sewer service;

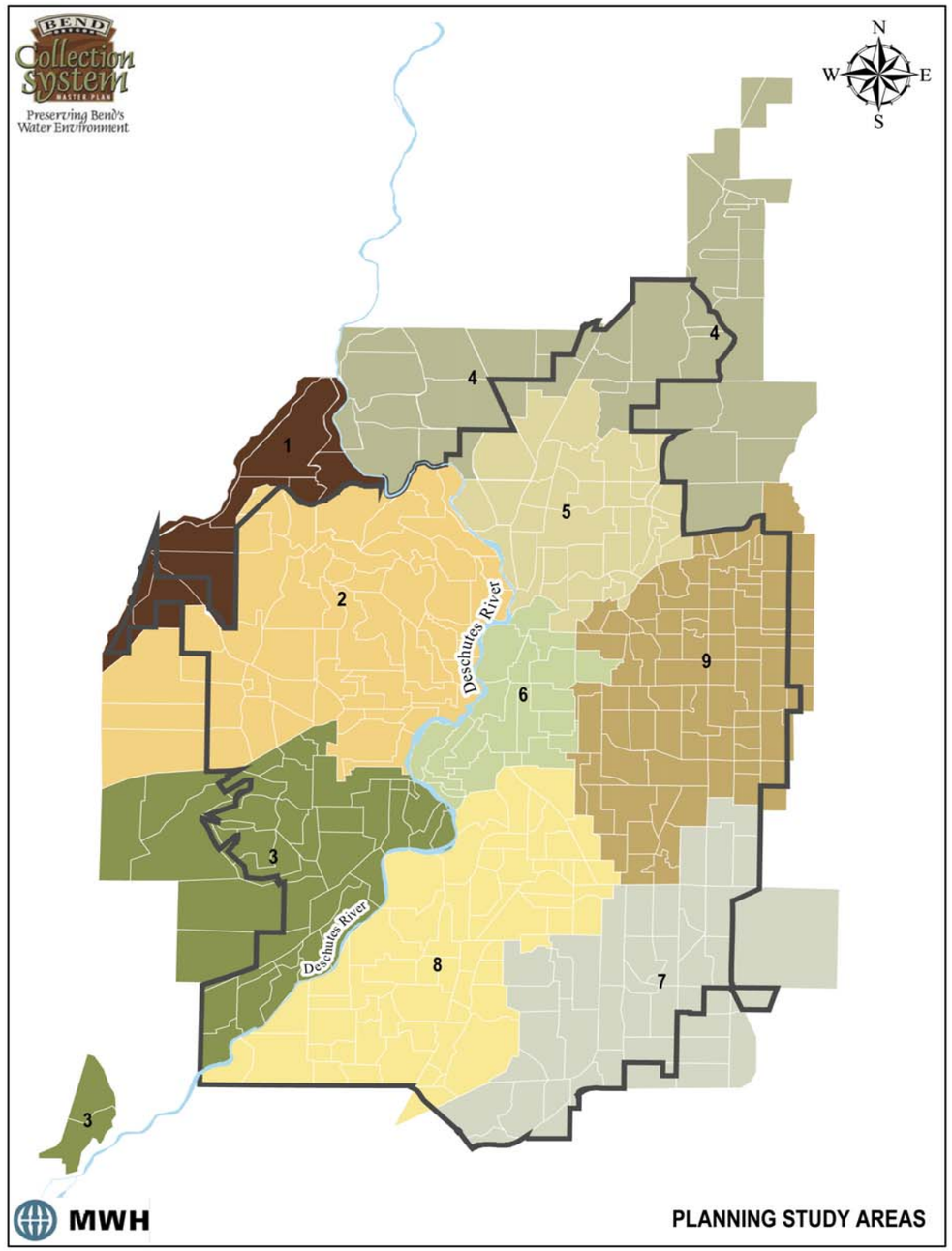

Figure 3-1 – Master Plan Study Areas

2. 166 acres (400 parcels) that are developed but do not receive City sewer service (using a septic system or other type of wastewater service)
3. 1,253 acres (801 parcels) are undeveloped but are buildable within the UGB.
4. Aproximately 1,655 acres are outside the UGB,but within the UAR. For this Master Plan the UAR lands were considered to be 70% developable.

EXISTING SEWERS

Study Area 3 currently has 35.35 miles of gravity sewers ranging in size from 4 inches in diameter to 21-inches in diameter. A summary of the total length of gravity sewer by line size is summarized in ***Table 3-1***. 28.9-miles or 81.8% of these gravity sewers are 4, 6 and 8-inch lines serving local neighborhoods. There are only 6.45-miles of trunk sewers that are 10-inch or larger.

Table 3-1
Study Area 3
Gravity Sewer Statistics

Line Diameter (inches)	Length		Percent of Total
	Linear Feet	Miles	
4	41	0.01	0.02
6	5,473	1.04	2.93
8	147,069	27.85	78.80
10	11,439	2.17	6.13
12	1,015	0.19	0.54
15	12,348	2.34	6.62
18	8,624	1.63	4.62
21	617	0.12	0.33

Note: Data summary as of May 2005

PROJECTS FOR UNSERVED AREAS

There are many areas within Study Area 3 with no sanitary service. For each of these areas, a project has been defined so that every parcel within the Study Area 3 UGB can be served. Service for parcels outside of the UGB was not specifically defined because the location of streets and sewer easements are not known. The flows that will be generated from parcels located in the UAR were included in the analysis of the sewer system capacity, so the build-out capacity for all of the system sewers includes the flows that will be generated in the UAR. An emphasis was placed on providing service through a gravity system, unless it was either not technically feasible or cost prohibitive.

CRITERIA FOR LATERAL SEWERS

Determination of the feasibility of gravity sewer laterals to service currently unsewered areas in the Bend system depends on several factors. These include:

- The depth of the existing connection manhole or cleanout;
- The distance from the connecting manhole to the most distant property parcel to be served;
- The average slope of the terrain between the parcel to be served and the connecting manhole;
- Diameter adequate for estimated flows;
- Minimum grades used for gravity sewers (i.e. – 8” @ 0.004 ft/ft, 12” @ 0.0028 ft/ft, etc) to allow a minimum velocity of 2 ft/sec;
- The depth of gravity sewer designs will not be driven by the existence or potential existence of basements in structures;
- Gravity sewer service is possible when the finished floor of the structure to be serviced is at least 3 feet above the invert of the main in the street; and
- Surface features or conflicting utilities that would prevent the installation of gravity sewers were not evaluated.

The existing topography within the UGB is limited to 2-foot contours. The inverts for existing manhole or cleanouts were not always available, therefore some assumptions were made regarding the feasibility of extending gravity sewers to the unsewered parcels. The proposed sanitary sewer layouts for projects to provide service to the unsewered areas within the UGB were developed within the guidelines and limitations of the available information. Confirming field work to ascertain the elevation difference between the connecting manhole and the parcel(s) to be served, along with confirmation of the connecting manhole depth, must be done prior to design of these proposed projects.

SANITARY SEWER PROJECT DEVELOPMENT

The sanitary sewer projects are shown in ***Figure 3-2 – Study Area 3 Proposed Sanitary Sewer Layout***. Each project has been given a Project ID. The Project ID is based on the number format of X-Y. This number is based on the following codes:

- X – Study Area Number
- Y – Project Number within the Study Area

This Project ID system will be used to identify each of these projects during system development. Each project has been summarized in ***Table 3-2***. A more detailed figure of the study area proposed projects with the 2-foot topography overlay is provided in the ***Appendix***.

PUMP STATIONS

Study Area 3 currently has six pump stations. Detailed pump station analysis is available in TM 3.8; this section summarizes the process and results. The service area for each of these pump stations is shown in ***Figure 3-3***. A list of the pump stations is shown in ***Table 3-3***. *Table 3-3* also identifies which pumps were included in the model. The capacity for each pump station was evaluated to determine if the existing station has adequate capacity for future growth conditions. For stations that were modeled, the dynamic peak flow determined by the InfoSWMM model was used as the peak flow. For stations that were not modeled, first the current and future service area for each station was determined. Next, the number of dwelling units and base flow for each service area was determined based on the land area and zoning based on the criteria outlined in TM 3.1 – Planning Criteria. Finally, the peak flow was calculated by applying peaking factors and an RDII flow of 150 gallons/acre/day. The following terms and peaking factors were used in the evaluation of each pump station that supports *Table 3-3*:

- Modeled – Yes means that pump station is included in the INFOSWMM hydraulic model. No means it has not been included in the model;
- Firm Capacity – The firm capacity is the capacity of the station with one pump out of service to act as a redundant pump. This is a regulatory requirement;
- Installed Capacity – The installed capacity is the pump station capacity with all pumps operating;
- Base Flow –winter season flow based on area zoning;
- RDII Flow –flow due to inflow into the system during heavy rainfall; and
- Peak Flow – The peak hour flow for non-modeled pumps was estimated as the base flow multiplied by a diurnal peaking factor of 1.8 and the seasonal peaking factor of 1.25 to which the RDII flow was added.

The application of this criteria determined if the pump station will meet the build-out flow of its respective service area or not. For stations where the installed capacity will not serve the build-out flows, the time at which the stations will reach capacity was not part of this evaluation. This must be determined by the respective growth rate in each pump station's service area. The respective service area data for the estimated growth rates was not available for this evaluation.

Table 3-2
Study Area 3
Proposed Sanitary Sewer Projects

Project ID	Length (feet)	Diameter (inches)	Notes
3.01	183	8	Provides sewers to unsewered area
3.02	540	8	Provides sewers to unsewered area
3.03	590	8	Provides sewers to unsewered area
3.04	924	8	Provides sewers to unsewered area Access for 36 Acre landlocked - easement req.
3.05	1,546	8	Provides sewers to unsewered area
3.06	2,664	8	Provides sewers to unsewered area
3.07	3,103	8	Provides sewers to unsewered area
3.08	3,648	8	Provides sewers to unsewered area
3.09	5,667	8	Provides sewers to unsewered area Easement in R/R ROW, collects Private Develop - no roads
3.10	6,335	8	Provides sewers to unsewered area
3.11	7,120	8	Provides sewers to unsewered area
3.12	TBD*	TBD	Middle Connection for Tetherow Development
3.13	TBD	TBD	North Connection for Tetherow Development
3.14	TBD	TBD	South Connection for Tetherow Development

*Note: TBD = To be decided

Bachelor Village

The Bachelor Village Pump Station serves an area of 57 acres. This station service area is currently at 9% sewered serving 13 of the 140 potential build-out dwelling units. The current (2005) estimated base flow for this station is 2-gpm with a peak hour flow of 16-gpm. The build-out estimated base flow for this station is 17-gpm with a peak flow of 50-gpm. The force main for this pump station is an 862-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.2-fps. The existing station capacity of 125-gpm will meet the long-term requirements of the service area.

Table 3-3
Study Area 3 Pump Stations
Existing Installed Information

Pump Station Name	Modeled	Number Of Pumps	Firm Capacity (gpm)	Force Main	
				Diameter (in)	Length (ft)
Bachelor Village	N	2	125	4	862
Main Fire Station	N	2	80	2	525
Shevlin	Y	2	280	6	351
Sunrise Village #1	Y	2	250	6	258
Touchmark	N	-	425	6	497
Widgi Creek	Y	2	450	6	13,660

Main Fire Station

The Main Fire Station Pump Station is a small station that serves the Main Fire Station. This station has two 80-gpm pumps with one of the pumps a redundant unit. The force main for this pump station is a 524-foot long, 2-inch line. The design velocity in this force main under firm pumping conditions is 8.2-fps. The service requirements for this station will not change in the future so this station will meet the long-term requirements of the service area. Therefore, there is no recommendation to upgrade this force main with an operating velocity higher than the 6.0-fps capacity criteria.

Shevlin Pump Station

The Shevlin Pump Station serves an area of 137 acres. This station service area is mixed riverfront zoning classification. The build-out estimated base flow for this station is 69-gpm with a peak flow of 182-gpm. The force main for this pump station is a 351-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 3.2-fps. The existing station capacity of 280-gpm will meet the long-term requirements of the service area.

Sunrise Village #1

The Sunrise Village #1 Pump Station serves an area of 693 acres. This station service area is currently at 25% sewered serving 395 of the 1611 potential build-out dwelling units. The current (2005) estimated base flow for this station is 55-gpm with a peak hour flow of 268-gpm. The build-out estimated base flow for this station is 222-gpm with a peak flow of 660-gpm. The force main for this pump station is a 258-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 2.8-fps. The current station capacity of 250-gpm is ***NOT*** adequate for build-out conditions.

Touchmark

The Touchmark Pump Station serves an area of 27 acres. This station service area is currently lightly sewered with the potential of serving 174 dwelling units at build-out. The build-out estimated base flow for this station is 63-gpm with a peak flow of 167-gpm. The force main for this pump station is a 497-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 4.8-fps. The design TDH for this station is currently 90-feet. The existing station capacity of 425-gpm will meet the long-term requirements of the service area.

Widgi Creek Pump Station

The Widgi Creek Pump Station serves an area of 230 acres. This station is outside of the current UGB, so no information is available to determine the existing service conditions. This station service area has the potential build-out of 1023 dwelling units. The build-out estimated base flow for this station is 129-gpm with a peak flow of 420-gpm. The force main for this pump station is a 13,660-foot long 6-inch line.
The design flow for this pump station is 450-gpm. The design velocity in this force main under firm pumping conditions is 5.1-fps. The design TDH for this station is currently 110-feet. A flow test conducted by City staff showed the actual capacity of this station to be 297-gpm. Based on the flow test, this station does ***NOT*** have the capacity to meet the long-term requirements of the service area.

PUMP STATION UPGRADES

Pump station upgrades will be required to ensure that adequate pumping capacity is available to ensure that there are no Sanitary Sewer Overflows (SSOs) in the system. The station capacity has been developed to ensure that adequate redundancy is provided. A list of pump station upgrades is shown in ***Table 3-4*****.**

Table 3-4
Recommended Pump Station Upgrades

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
3.PS01	Sunrise Village #1	Flygt NP3102.090-464, 5 Hp, 4” Volute	$80,000	When capacity is reached
3.PS02	Wigi Creek	Station design is for acceptable capacity. A flow test performed by City staff showed station not able to pump design capacity. Based on further evaluation, the cause of the reduced flow needs to be determined	N/A	Evaluate in near term

Sunrise Village #1

The design velocity in the force main under firm pumping conditions is 2.8-fps. The current station capacity of 250-gpm is ***NOT*** adequate for build-out conditions. The station will need to be upgraded to meet the peak flow of 660-gpm when the service area reaches build-out. This will require the installation of new pumps and associated equipment at an estimated cost of $80,000. The upgraded pumps will pump at a velocity of 7.5-fps under peak flow conditions. This will result in a TDH of 40-feet. This velocity will be acceptable due to the low TDH.

Widgi Creek Pump Station

A flow test conducted by City staff showed the actual capacity of this station to be 297-gpm. Based on the flow test, this station does ***NOT*** have the capacity to meet the long-term requirements of the service area. An investigation of the cause for the actual operating capacity being less than the design capacity needs to be performed. Based on the results of this test, if a peak flow capacity of greater than 420-gpm is not possible with the existing pumps, the existing pumps in the station need to be changed to meet the required 420-gpm build-out flow requirement. No cost estimate for upgrading these pumps was developed due to the uncertainty of the existing operating conditions.

REMOVAL OF EXISTING PUMP STATIONS

To remove the pump stations from service, a new gravity trunk will need to be constructed to transport the flow from the existing pump station influent sewer to another point in the collection system. Each of the pump stations were evaluated to determine if they could be cost effectively removed from service. It was determined that none of the stations could be removed from service with the construction of a gravity sewer.

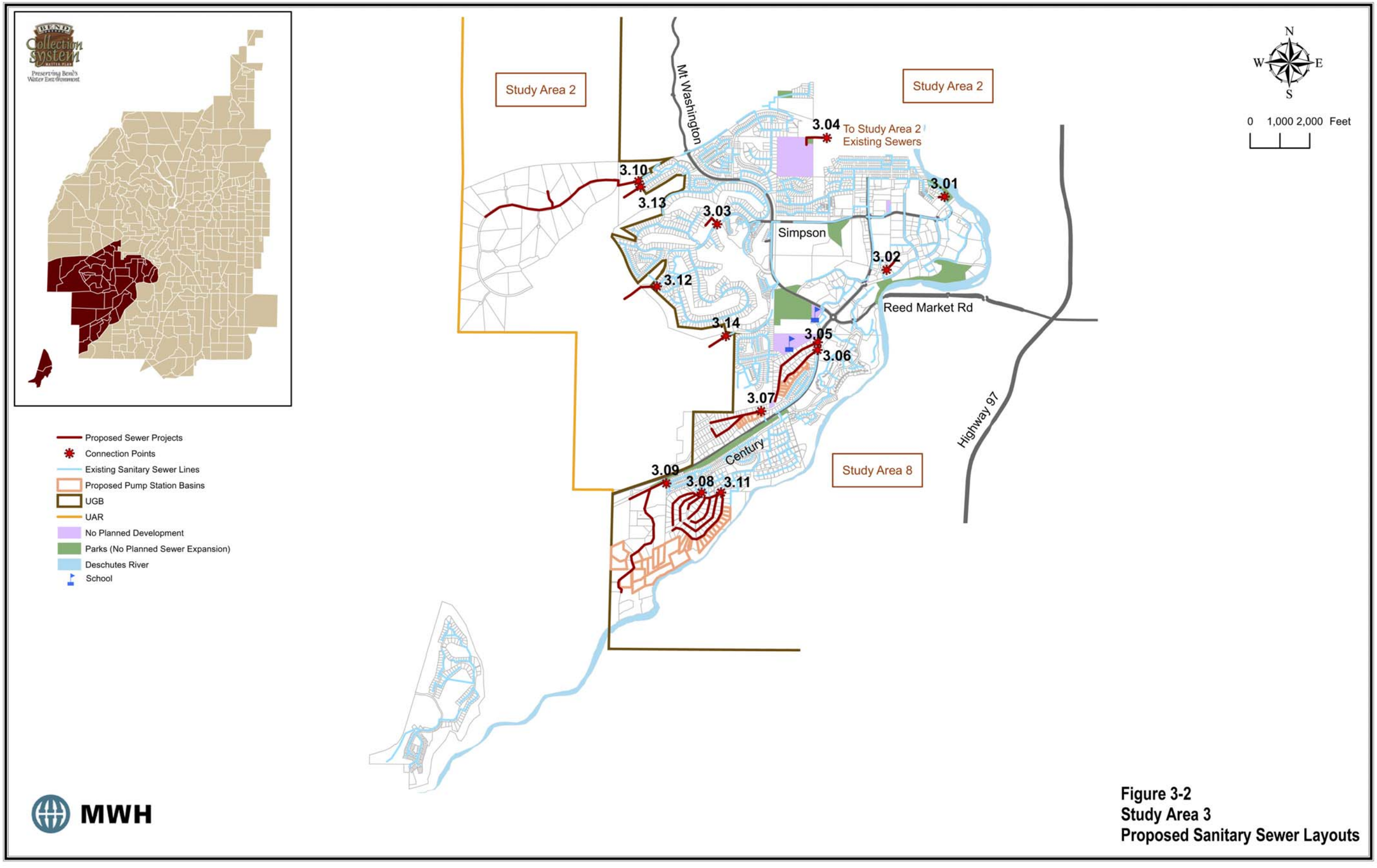

Figure 3-2
Study Area 3
Proposed Sanitary Sewer Layouts

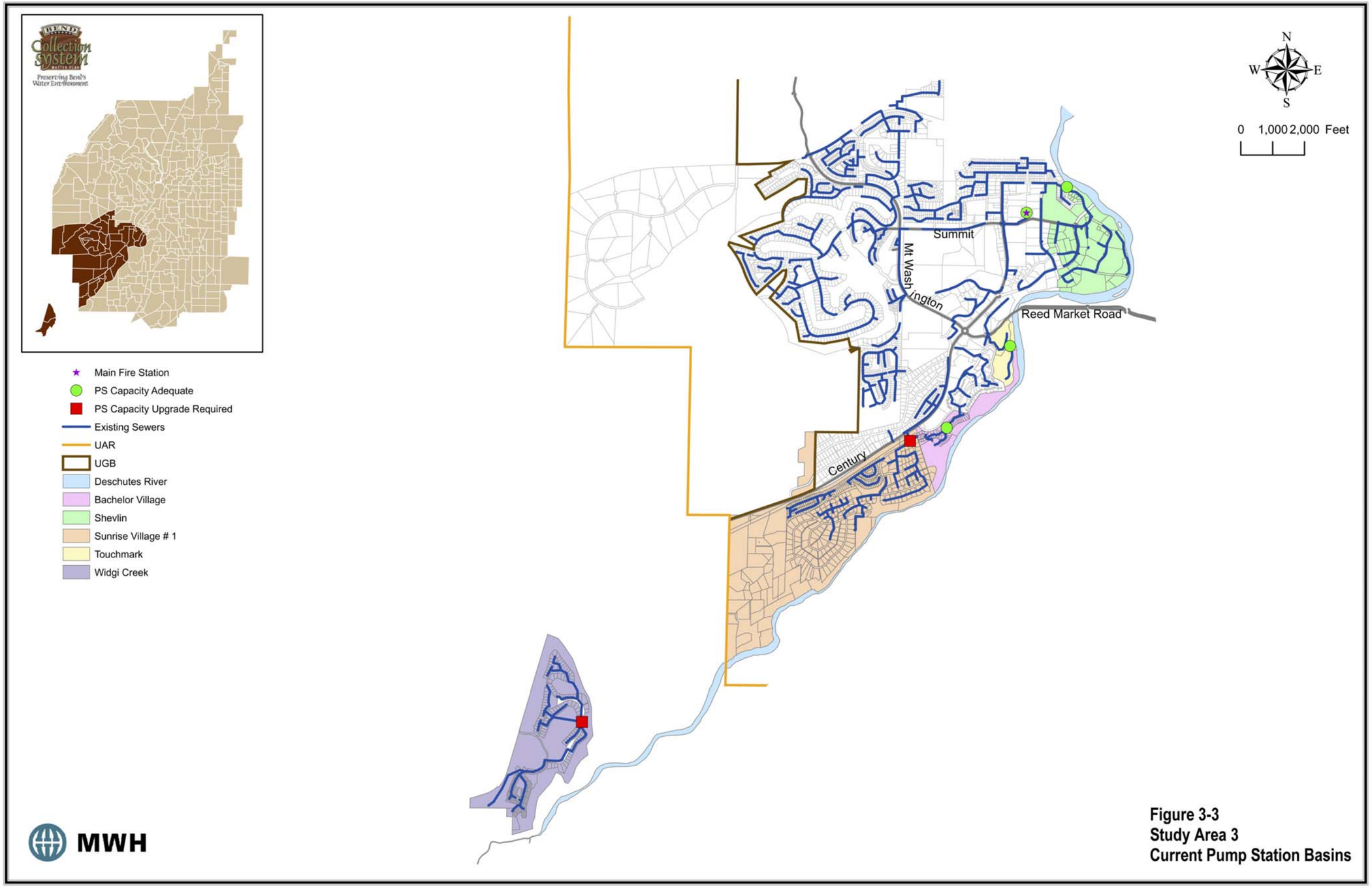

Figure 3-3
Study Area 3
Current Pump Station Basins

SYSTEM DEFICIENCIES

The City's Collection System was evaluated to determine if there were any deficiencies under existing and build-out flows. The analysis was performed using the calibrated 2005 INFOSWMM hydraulic model. Each deficiency was analyzed to determine how the deficiency could be eliminated. Alternative methods that were evaluated to eliminate each deficiency were: 1) Rerouting of flow to other points in the system, 2) Upsizing the existing lines and 3) Parallel sewers. The most cost effective alternative was identified as a capital project for removal of the deficiency. Capacity deficiencies under existing and build-out flows are shown schematically in ***Figure 3-4***. The line segments shown in this figure are those that were modeled in the INFOSWMM hydraulic model.

EXISTING

This analysis showed one existing capacity deficiency in Study Area 3. This capacity deficiency is defined as Capital Project 3-3. The line segment and the breakdown of the estimated cost for the project to correct this deficiency is shown in ***Table 3-5***. This project will provide adequate capacity to meet the required capacity through system build-out.

FUTURE

The system was also evaluated under build-out flow conditions with the proposed interceptor system. Seven capacity deficiencies were found in the system in addition to the one existing deficiency. The segments of the collection system requiring improvements are Capital Projects 3-1, 3-2 and 3-4 through 2-8. The line segments and the breakdown of the estimated cost for each project to correct these deficiencies are given in ***Table 3-5.***

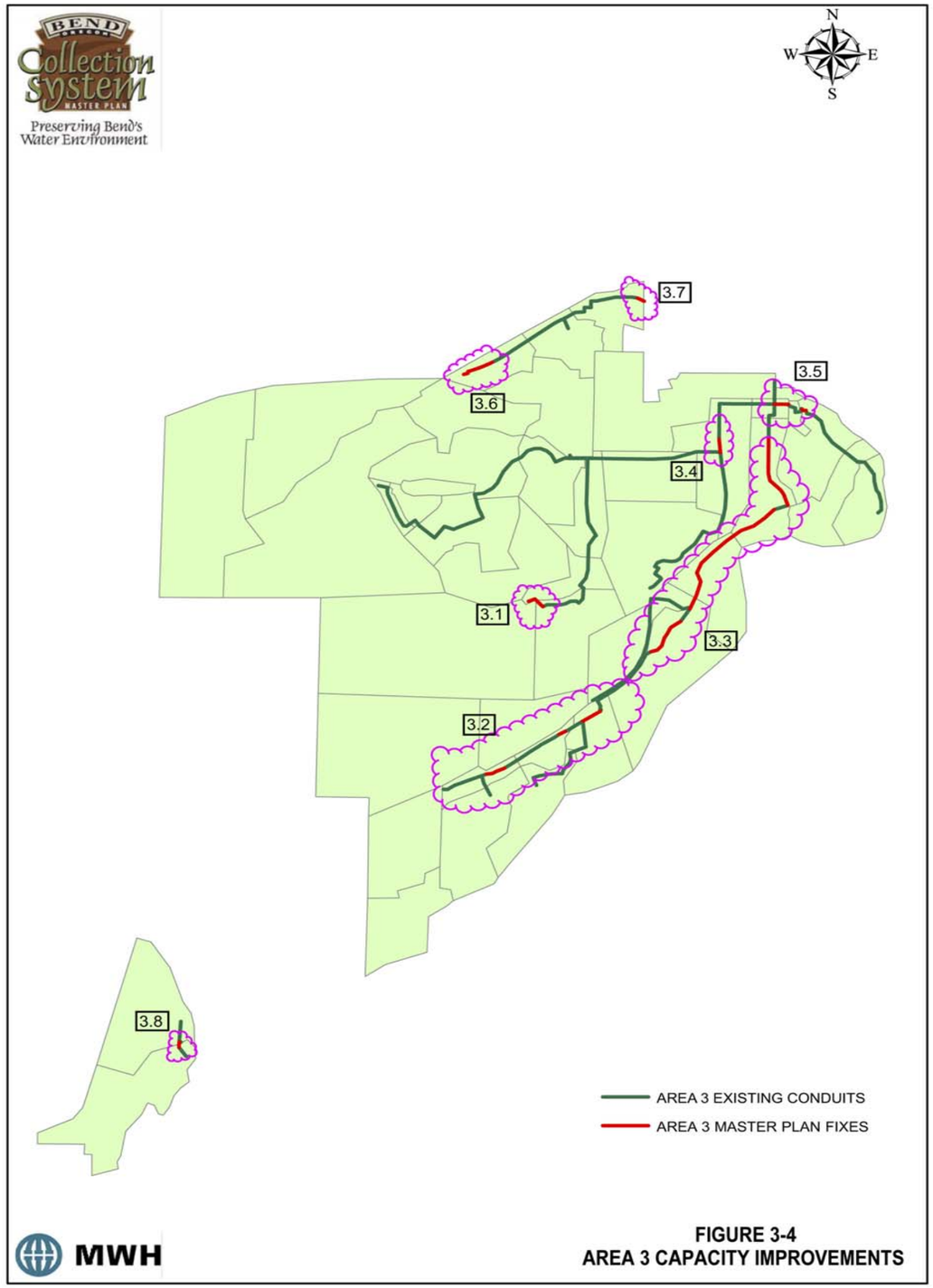

FIGURE 3-4
AREA 3 CAPACITY IMPROVEMENTS

Table 3-5
Study Area 3 System Deficiencies
Capital Project Cost Estimates

Capital Project ID	Manhole ID From	Manhole ID To	Quantities				Unit Costs						Totals			
			Existing Diameter (in)	Upgraded Diameter (in)	Length (ft)	Manholes (#)	Materials ($/ft)	Installation ($/ft)	Bypass Pumping ($/ft)	Manholes ($/each)	Reconnection ($/each)	Restoration ($/ft)	Subtotal ($)	Engr/Legal/ Admin @40%	Contingency @30%	Total ($)
3-1	14-23-A16	14-23-A14	8	12	446	1	12.75	72.00	11.60	3640	1000	7.35	59,229	23,692	24,876	107,796
													59,229	***23,692***	***24,876***	**107,796**
3-2	58-37-1	58-37-A5	8	10	473	1	8.85	70.00	11.60	3640	1000	7.35	60,024	24,009	25,210	109,243
	3_13_2	3_13_1	8	10	167	0	8.85	70.00	11.60	3640	1000	7.35	21,192	8,477	8,901	38,570
	E-3	42-4-E2	8	15	504	1	18.80	77.00	11.60	3640	1000	7.88	72,768	29,107	30,562	132,437
	Total	-	-	-	-	-	-	-	-	-	-	-	***153,984***	***61,593***	***64,673***	**280,250**
3-3	9-231-1	11-284-20	8	10	1141	3	8.85	70.00	11.60	3640	1000	7.35	144,793	57,917	60,813	263,523
	11-284-19	60-10-1A	10	15	660	2	18.80	77.00	11.60	3640	1000	7.88	95,291	38,116	40,022	173,429
	11-284-C12	11-284-SW3-C	10	12	333	1	12.75	72.00	11.60	3640	1000	7.35	44,222	17,689	18,573	80,485
	60-10-1A	11-284-C16	8	15	364	1	18.80	77.00	11.60	3640	1000	7.88	52,554	21,022	22,073	95,649
	11-284-C16	11-284-C12	10	15	1579	4	18.80	77.00	11.60	3640	1000	7.88	227,976	91,190	95,750	414,916
	11-284-SW3-C11	11-284-SW3-C9	10	15	663	2	18.80	77.00	11.60	3640	1000	7.88	95,724	38,290	40,204	174,218
	11-284-CB	11-284c3	10	15	1012	3	18.80	77.00	11.60	3640	1000	7.88	146,113	58,445	61,367	265,925
	11-284c3	BIP-5	10	12	936	2	12.75	72.00	11.60	3640	1000	7.35	124,301	49,720	52,206	226,227
	Total	-	-	-	-	-	-	-	-	-	-	-	***930,974***	***372,389***	***391,008***	**1,694,372**
3-4	F1-23	F1-22	15	18	352	1	17.00	87.00	11.60	3640	1000	8.40	53,891	21,556	22,634	98,082
	Total	-	-	-	-	-	-	-	-	-	-	-	***53,891***	***21,556***	***22,634***	**98,082**
3-5	2_25_13	55_17AC	8	10	110	0	8.85	70.00	11.60	3640	1000	7.35	13,959	5,584	5,863	25,405
	F2.6-1	F1-15	8	12	347	1	12.75	72.00	11.60	3640	1000	7.35	46,082	18,433	19,354	83,869
	Total	-	-	-	-	-	-	-	-	-	-	-	***60,041***	***24,017***	***25,217***	**109,274**
3-6	14-41-23	58-4-S3	8	10	796	2	8.85	70.00	11.60	3640	1000	7.35	101,012	40,405	42,425	183,843
	Total	-	-	-	-	-	-	-	-	-	-	-	***101,012***	***40,405***	***42,425***	**183,843**
3-7	47-20-4	46-42-A7	8	10	185	0	8.85	70.00	11.60	3640	1000	7.35	23,477	9,391	9,860	42,727
	Total	-	-	-	-	-	-	-	-	-	-	-	***23,477***	***9,391***	***9,860***	**42,727**
3-8	14-1-C1	14-1-A1	6	8	143	0	5.65	67.00	11.60	3640	1000	7.35	17,260	6,904	7,249	31,413
	Total	-	-	-	-	-	-	-	-	-	-	-	***17,260***	***6,904***	***7,249***	**31,413**
Total All Projects																**2,547,757**

Construction Costs based on ENR-CCI of 8449

APPENDIX

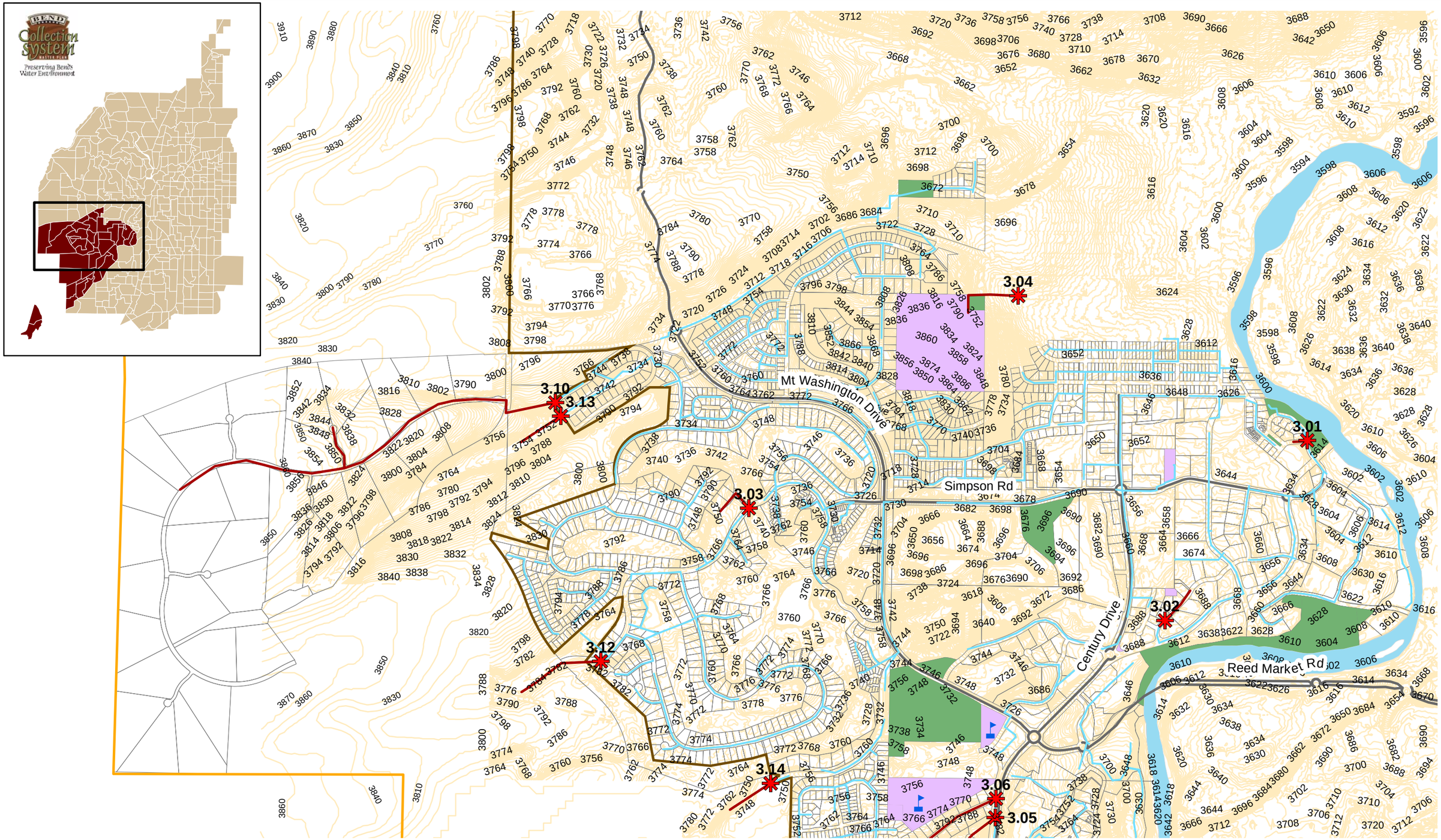

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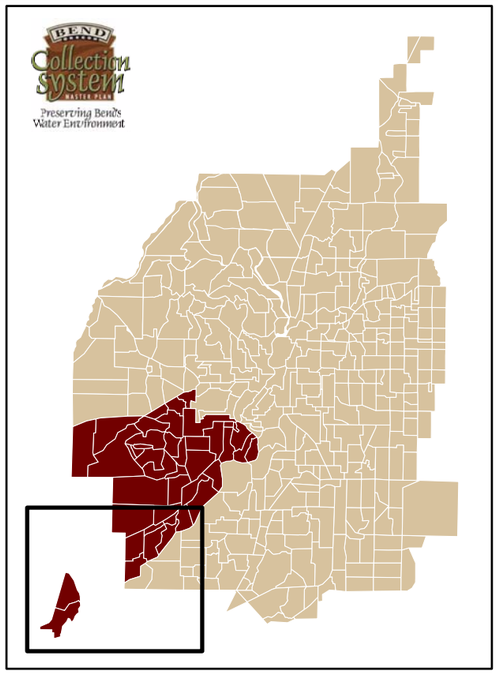
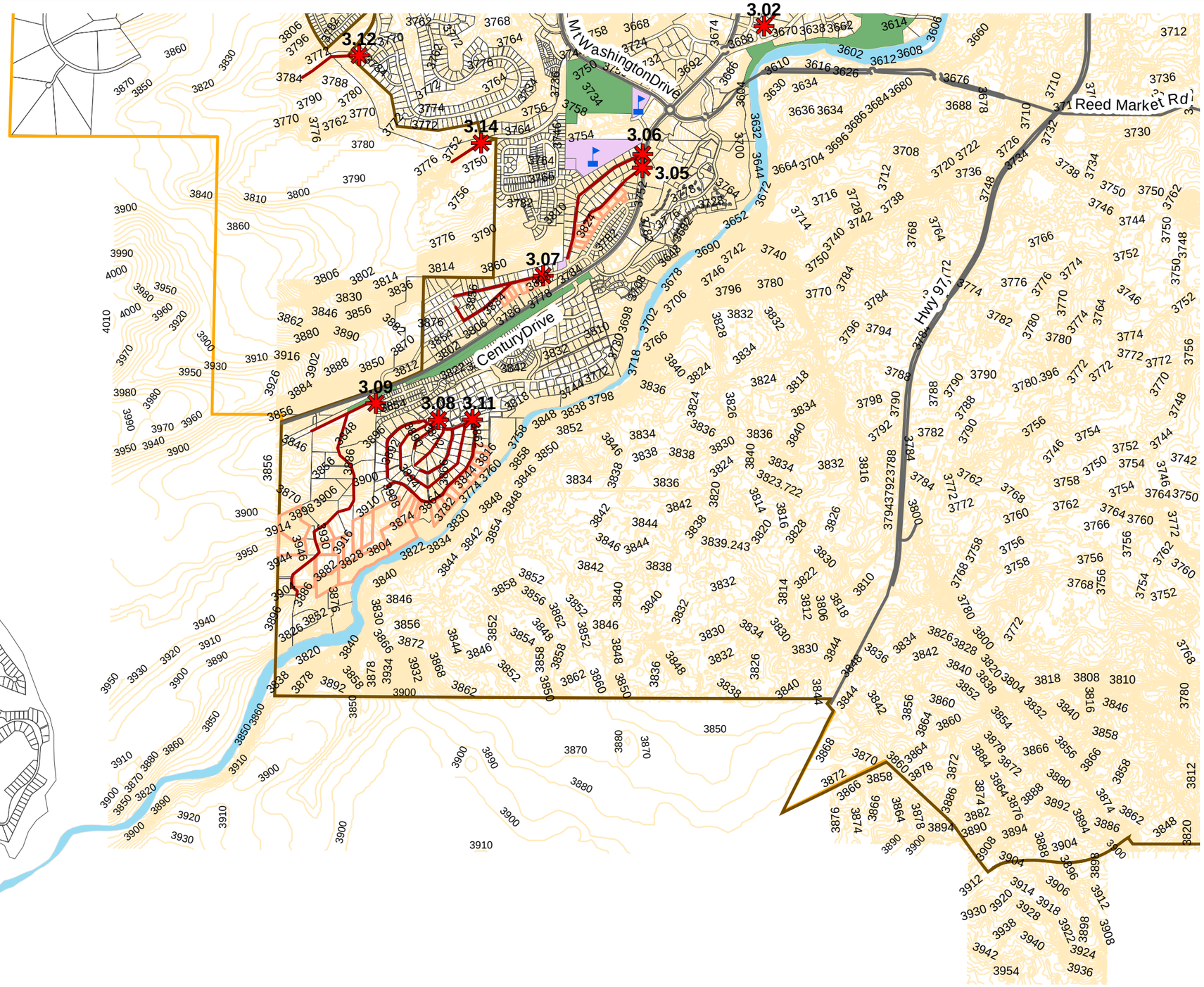
Figure A.3-1
Study Area 3
Proposed Sanitary Sewer Layouts





Proposed Sewer Projects
Connection Points
Existing Sanitary Sewer Lines
Proposed Pump Station Basins
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Deschutes River
School

0 1,000 2,000 Feet

MWH

Figure A.3-2
Study Area 3
Proposed Sanitary Sewer Layouts

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