STUDY AREA 9

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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; and
- 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. In addition to 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); and
3. System Deficiencies (the correction of current and long-term system capacity deficiencies).

STUDY AREA 9

The planning area which includes both the areas of the UGB and the UAR is shown in ***Figure 9-1 – 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 9, which is the eastern portion of the City. This area is highlighted and labeled in ***Figure 9-1***.

Study Area 9 consists of 3,853 acres (6,403 parcels), which can be subdivided into four categories . Below is a summary of each category**:**

1. 1,748 acres (5,256 parcels) that receive sewer service;
2. 397 acres (523 parcels) that are developed but do not receive City sewer service (using a septic system or other type of wastewater service);
3. 703 acres (624 parcels) are undeveloped but are buildable within the UGB; and
4. 1,005 acres that are outside the UGB, or within the UGB but will not be developed, as it consists of streets, utility corridors, areas zoned as public facilities and unbuildable lands.

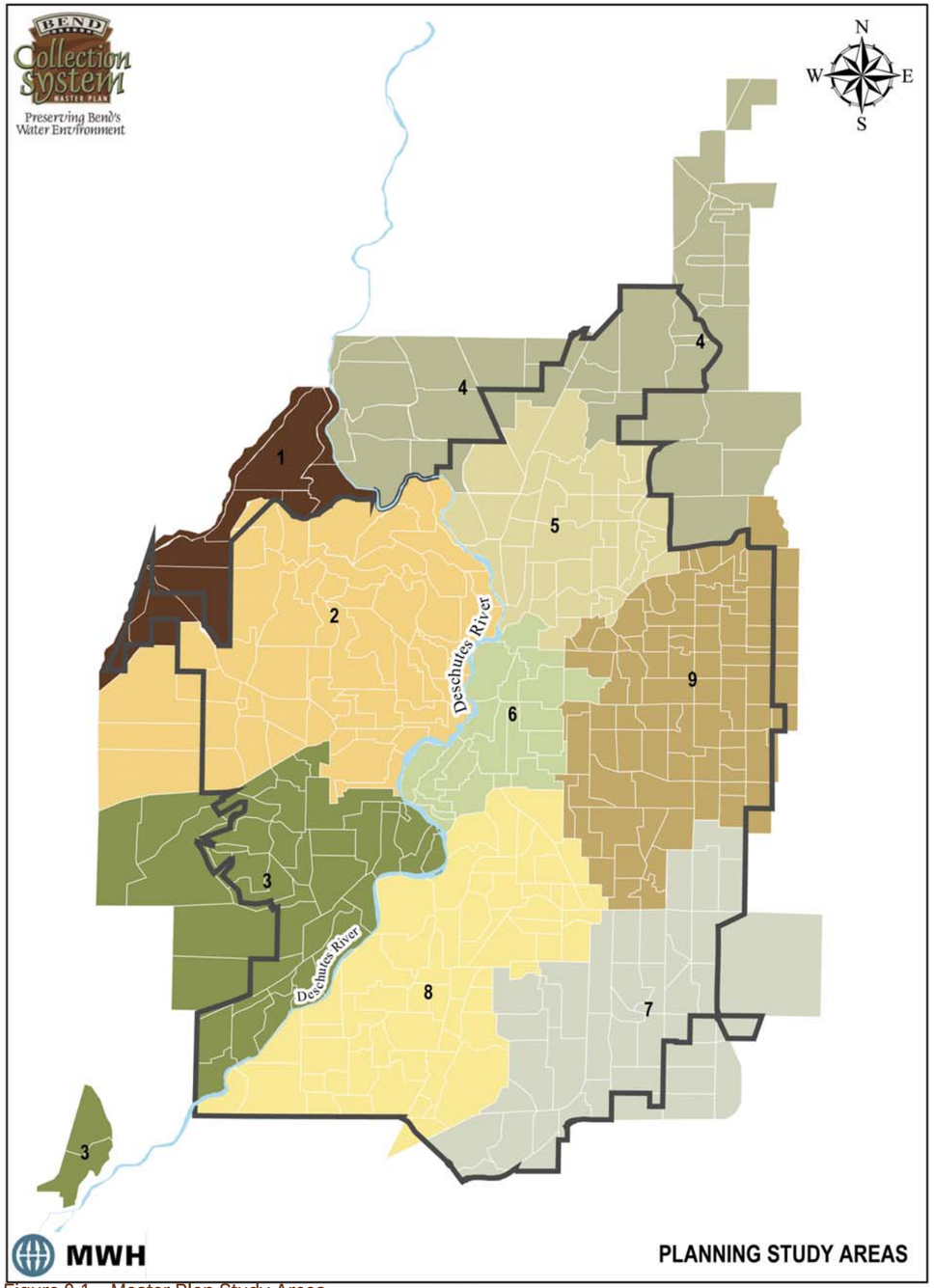


Figure 9-1 – Master Plan Study Areas

EXISTING SEWERS

Study Area 9 currently has 66.5-miles of gravity sewers ranging in size from 6-inches in diameter to 42-inches in diameter. A summary of the total length of gravity sewer by line size is summarized in ***Table 9-1***. 56.2-miles or 84.5% of these gravity sewers are 6 and 8-inch lines serving local neighborhoods. There are only 10.3-miles of trunk sewers that are 10-inch or larger.

Table 9-1
Study Area 9
Gravity Sewer Statistics

Line Diameter (inches)	Length		Percent of Total
	Linear Feet	Miles	
6	16,034	3.04	4.56
8	280,713	53.17	79.89
10	17,817	3.37	5.07
12	12,026	2.28	3.42
15	7,455	1.41	2.12
18	672	0.13	0.19
20	3,803	0.72	1.08
24	2,211	0.42	0.63
27	5,149	0.98	1.47
30	791	0.15	0.23
36	3,341	0.63	0.95
42	1,362	0.26	0.39

Note: Data summary as of May 2005

PROJECTS FOR UNSERVED AREAS

There are many areas within Study Area 9 with no sanitary service. For each of these areas, a project has been defined so that every parcel within Study Area 9 can be served.

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 9-2 – Study Area 5 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 9-2***. 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 9 currently has four 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 9-3***. A list of the pump stations is shown in ***Table 9-3***. *Table 9-3* 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 9-3*:

- 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;
- 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 9-2
Study Area 9 New Sewer Systems
Capital Project Cost Estimates Study

Project ID	Length (feet)	Diameter (inches)	Notes
9.01	3539	8	Provides sewers to unsewered area
9.02	1,781	8	Provides sewers to unsewered area
9.03	3,762	8	Provides sewers to unsewered area
9.04	509	8	Provides sewers to unsewered area
9.05	3,183	8	Provides sewers to unsewered area
9.06	2,836	8	Provides sewers to unsewered area
9.07	7,444	8	Provides sewers to unsewered area
9.08	963	8	Provides sewers to unsewered area
9.09	796	8	Provides sewers to unsewered area
9.10	536	8	Provides sewers to unsewered area
9.11	629	8	Provides sewers to unsewered area
9.12	984	8	Provides sewers to unsewered area
9.13	103	8	Provides sewers to unsewered area
9.14	118	8	Provides sewers to unsewered area
9.15	266	8	Provides sewers to unsewered area
9.16	774	8	Provides sewers to unsewered area
9.17	494	8	Provides sewers to unsewered area
9.18	590	8	Provides sewers to unsewered area
9.19	760	8	Provides sewers to unsewered area
9.20	635	8	Provides sewers to unsewered area
9.21	124	8	Provides sewers to unsewered area
9.22	397	8	Provides sewers to unsewered area
9.23	101	8	Provides sewers to unsewered area
9.24	1,832	8	Provides sewers to unsewered area
9.25	2,606	8	Provides sewers to unsewered area
9.26	241	8	Provides sewers to unsewered area
9.27	1,432	8	Provides sewers to unsewered area
9.28	7,321	8	Provides sewers to unsewered area
9.29	4,992	8	Provides sewers to unsewered area
9.30	760	8	Provides sewers to unsewered area
9.31	1,609	8	Provides sewers to unsewered area
9.32	1,225	8	Provides sewers to unsewered area
9.33	1,954	8	Provides sewers to unsewered area

Hollow Pines #1

The Hollow Pines #1 Pump Station serves an area of 54 acres. This station service area is currently 42% sewered serving 132 of the 315 potential build-out dwelling units. The current (2005) estimated base flow for this station is 18-gpm with a peak hour flow of 52-gpm. The build-out estimated base flow for this station is 36-gpm with a peak flow of 92-gpm. The force main for this pump station is a 2350-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.6-fps. The existing station capacity of 140-gpm will meet the long-term requirements of the service area.

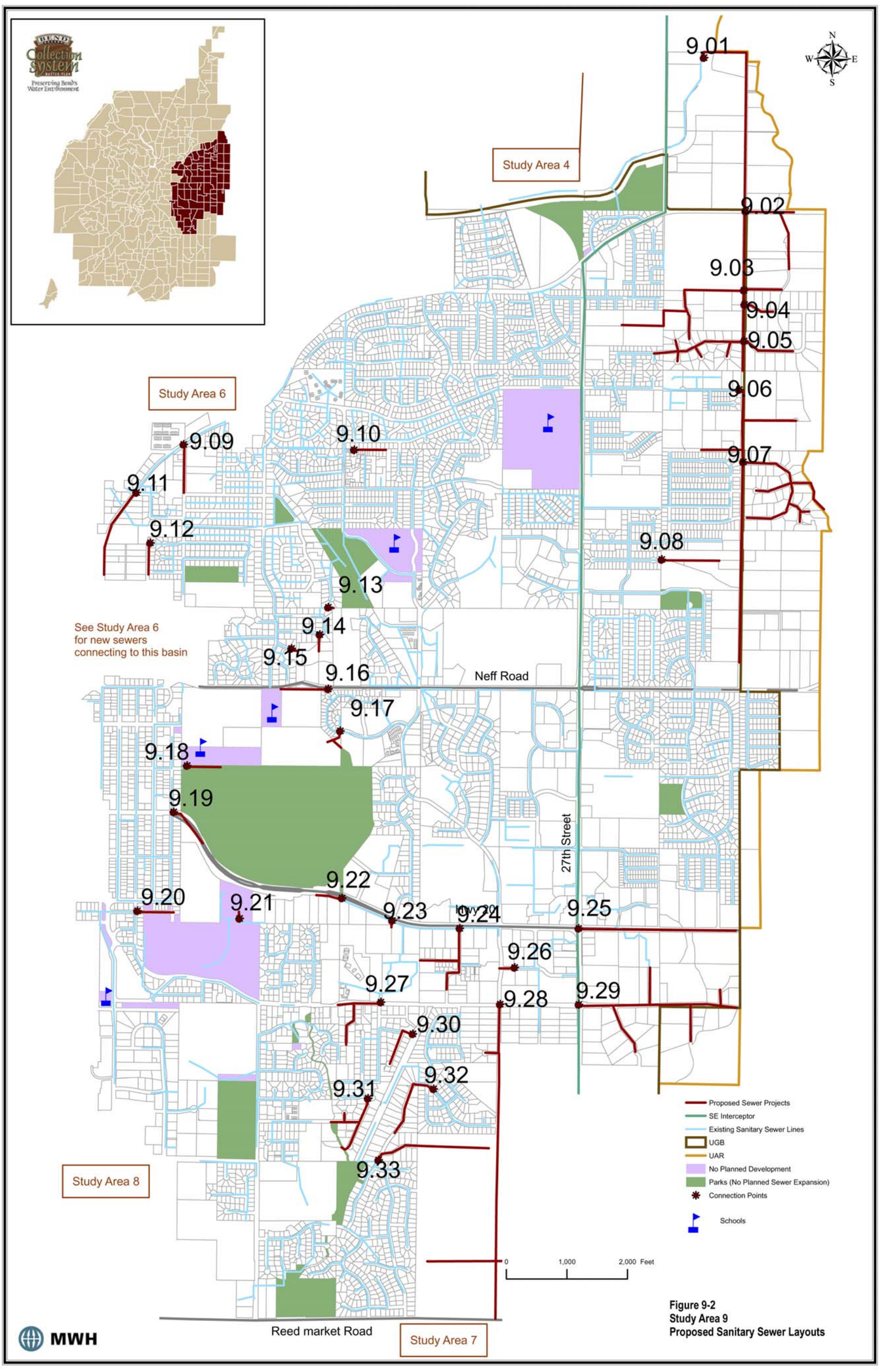


Figure 9-2
Study Area 9
Proposed Sanitary Sewer Layouts

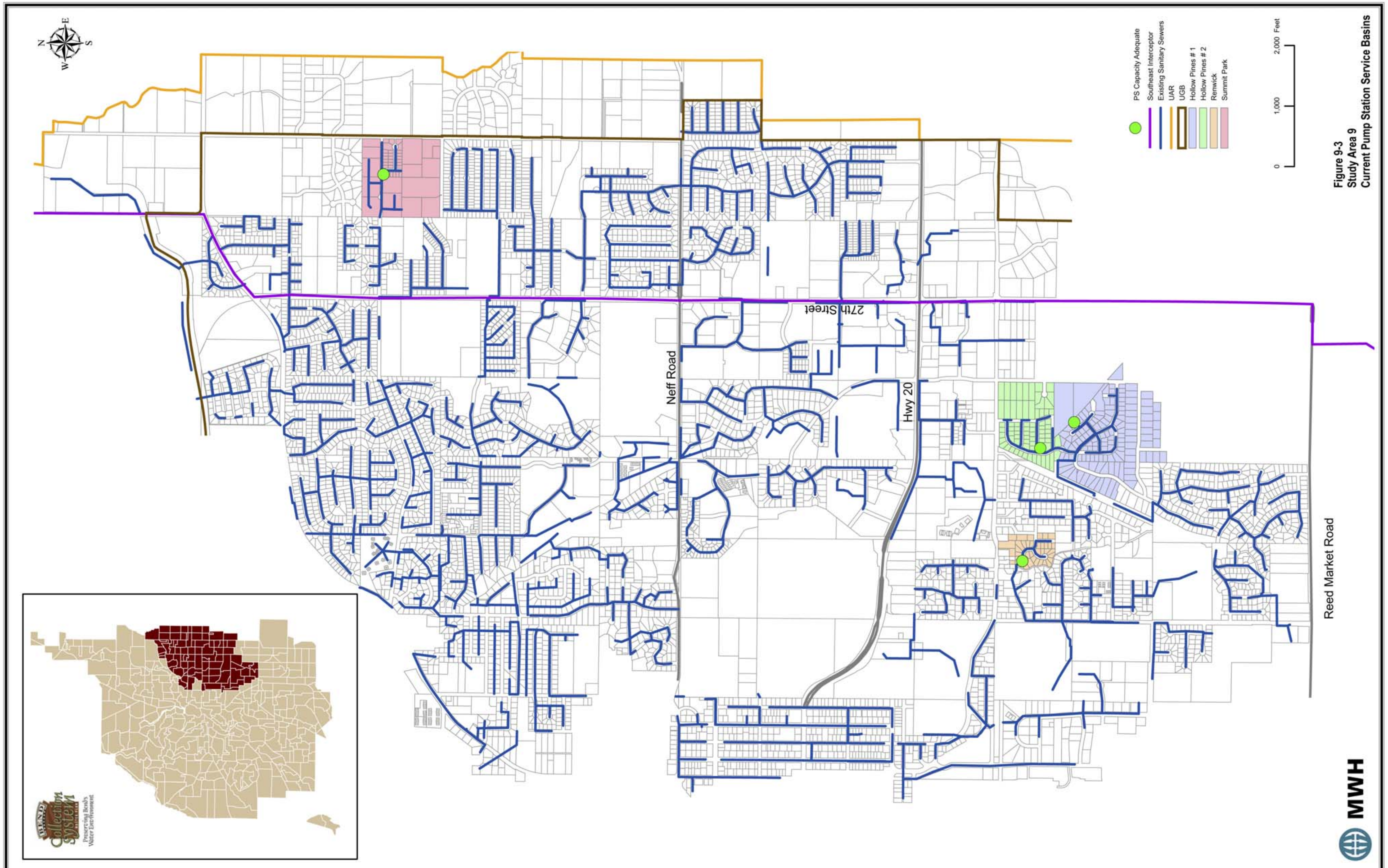


Figure 9-3
Study Area 9
Current Pump Station Service Basins

Table 9-3
Study Area 9 Pump Stations
Existing Installed Information

Pump Station Name	Modeled	Number Of Pumps	Firm Capacity (gpm)	Force Main	
				Diameter (in)	Length (ft)
Hollow Pines #1	N	2	140	4	2350
Hollow Pines #2	N	2	95	4	700
Renwick	N	2	40	3	358
Summit Park	N	2	125	4	262

Hollow Pines #2

The Hollow Pines #2 Pump Station serves an area of 23 acres. This station service area is currently 26% sewered serving 30 of the 144 potential build-out dwelling units. The current (2005) estimated base flow for this station is 4-gpm with a peak hour flow of 14-gpm. The build-out estimated base flow for this station is 17-gpm with a peak flow of 43-gpm. The force main for this pump station is a 700-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 2.4-fps. The existing station capacity of 95-gpm will meet the long-term requirements of the service area.

Renwick

The Renwick Pump Station serves an area of 8 acres. This station service area is currently 69% sewered serving 38 of the 55 potential build-out dwelling units. The current (2005) estimated base flow for this station is 5-gpm with a peak hour flow of 13-gpm. The build-out estimated base flow for this station is 6-gpm with a peak flow of 15-gpm. The force main for this pump station is a 358-foot long 3-inch line. The design velocity in this force main under firm pumping conditions is 1.8-fps. The existing station capacity of 40-gpm will meet the long-term requirements of the service area.

Summit Park

The Summit Park Pump Station serves an area of 36 acres. This station service area is currently 12% sewered serving 18 of the 157 potential build-out dwelling units. The current (2005) estimated base flow for this station is 3-gpm with a peak hour flow of 14-gpm. The build-out estimated base flow for this station is 19-gpm with a peak flow of 50-gpm. The force main for this pump station is a 262-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.

PUMP STATION UPGRADES

Pump station capacities were evaluated to determine if upgrades are required to ensure that adequate pumping capacity is available to prevent Sanitary Sewer Overflows (SSOs) in the system. The station capacity has been developed to also ensure that adequate redundancy is provided. None of the pump stations in this area requires upgrades.

REMOVAL OF EXISTING PUMP STATIONS

Each of the existing pump stations was evaluated to determine if they could be removed cost effectively from service. 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. The pump stations that can be removed from service are shown in ***Table 9-4***.

Table 9-4
Recommended Pump Station Decommissioning

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
9.PS01	Summit Park	Construction of new 500-foot 8" gravity sewer	$78,500	Following completion of the SE Interceptor on 27th Street
9.PS02	Summit Park	Removal of Pump station	$15,000	On completion of Project 9.PS02

Summit Park

The Summit Park Pump Station can be removed from service with the construction of a 500-foot 8-inch gravity sewer that discharges to the SE Interceptor on 27th Street. The estimated project cost to construct the gravity sewer to remove the station from service is $78,500. The estimated cost to remove the pump station is $15,000. A present value analysis of this project was done to determine the cost-effectiveness of this project. In this analysis it was assumed that the project would occur in the year 2015. Growth in the area would grow at a constant growth rate until build-out of the area occurs in 2032. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $193,000 and $485,000, respectively. Based on the same assumptions, the 20-year and-50 year present values for removing the pump station in 2015 are $177,000 and $194,000, respectively. This analysis shows that replacement of the pump station is cost effective when the SE Interceptor is constructed.

SYSTEM CAPACITY 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 9-4***. The line segments shown in this figure are those that were modeled in the INFOSWMM hydraulic model.

EXISTING

This analysis showed two existing capacity deficiencies in Study Area 9. These capacity deficiencies are defined as Capital Projects 9-7 and 9-8. The line segments and the breakdown of the estimated cost for the projects to correct these deficiencies are shown in ***Table 9-5***. These projects 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. Six capacity deficiencies were found in the system in addition to the two existing deficiencies. The segments of the collection system requiring improvements are Capital Projects 9-1 through 9-6. The line segments and the breakdown of the estimated cost to correct the deficiencies for each of the projects are given in ***Table 9-5.***

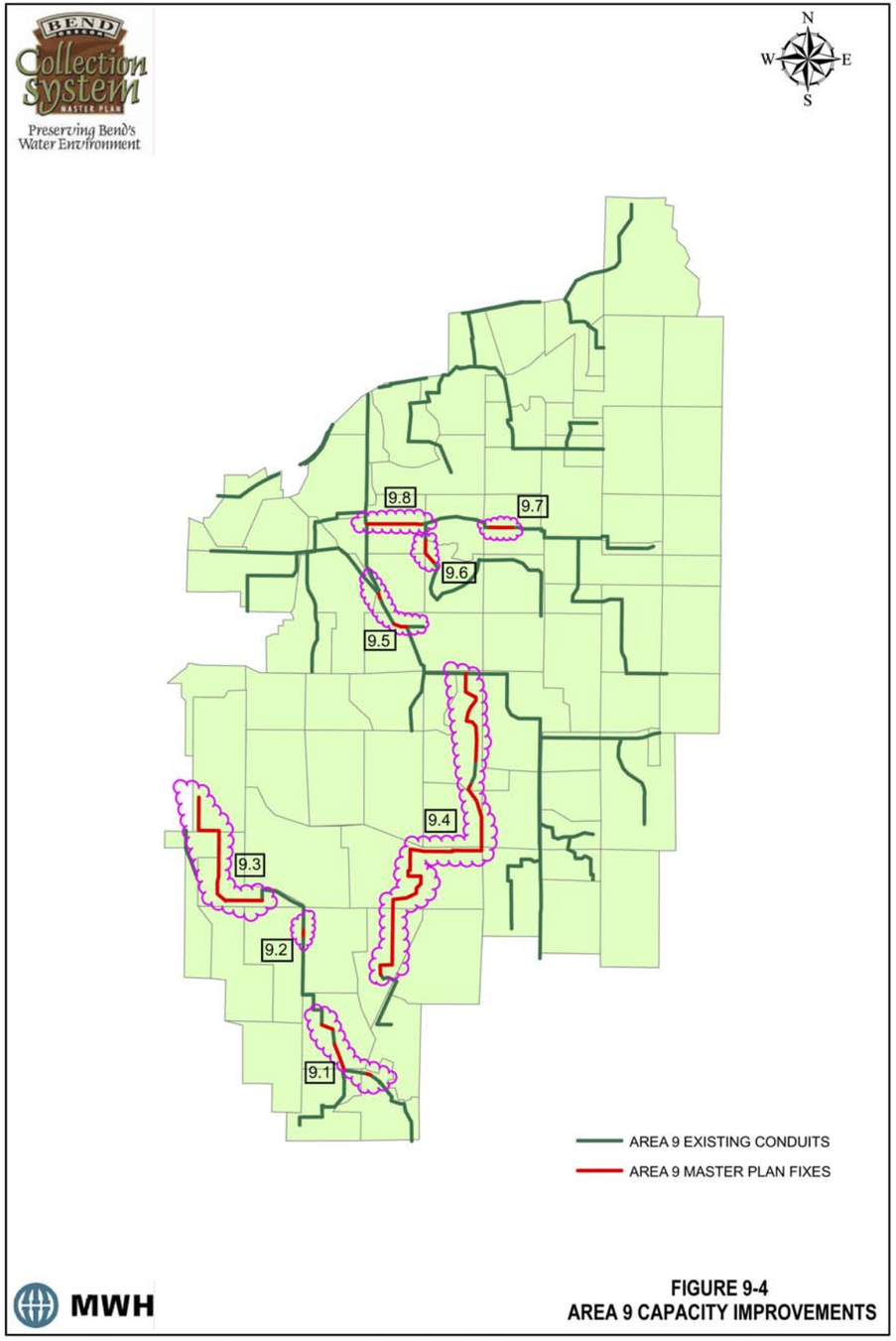


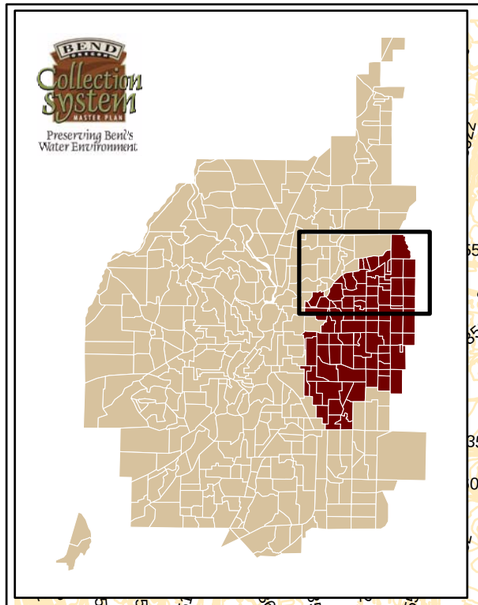
FIGURE 9-4
AREA 9 CAPACITY IMPROVEMENTS

Table 9-5
Study Area 9 System Deficiencies
Capital Project Cost Estimates

Project ID	Manhole ID From	Manhole ID To	Quantities				Unit Costs						Total			
			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 ($)
9-1	34-58-2A	34-58-6	8	10	703	2	8.85	70.00	11.60	3640	1000	7.35	89,211	35,684	37,468	162,363
	34-58-7	3C1.5-10	10	12	268	1	12.75	72.00	11.60	3640	1000	7.35	35,590	14,236	14,948	64,775
	Total	-	-	-	-	-	-	-	-	-	-	-	**124,801**	**49,920**	**52,416**	**227,138**
9-2	3C1.5-3	3C1.5-2	8	10	136	0	8.85	70.00	11.60	3640	1000	7.35	17,258	6,903	7,249	31,410
	Total	-	-	-	-	-	-	-	-	-	-	-	**17,258**	**6,903**	**7,249**	**31,410**
9-3	3C1-4	3C1-2	12	15	797	2	18.80	77.00	11.60	3640	1000	7.88	115,071	46,028	48,330	209,429
	3C1-2	42-38-2	8	15	18	0	18.80	77.00	11.60	3640	1000	7.88	2,599	1,040	1,092	4,730
	42-38-2	42-38-11	12	15	3122	8	18.80	77.00	11.60	3640	1000	7.88	450,754	180,302	189,317	820,373
	Total	-	-	-	-	-	-	-	-	-	-	-	**568,424**	**227,370**	**238,739**	**1,034,532**
9-4	44-30-5	35-18-A3	8	10	6534	16	8.85	70.00	11.60	3640	1000	7.35	829,165	331,666	348,249	1,509,080
	35-18-A3	35-18-A4	8	12	313	1	12.75	72.00	11.60	3640	1000	7.35	41,566	16,627	17,458	75,651
	35-18-A4	35-18-B1	8	10	97	0	8.85	70.00	11.60	3640	1000	7.35	12,309	4,924	5,170	22,403
	35-18-B4	35-3-B6	10	12	1020	3	12.75	72.00	11.60	3640	1000	7.35	135,456	54,182	56,892	246,530
	Total	-	-	-	-	-	-	-	-	-	-	-	***1,018,496***	***407,399***	***427,769***	**1,853,664**
9-5	34-23-D	34-17-4	15	18	297	1	17.00	87.00	11.60	3640	1000	8.40	45,471	18,188	19,098	82,757
	34-17-1	1913	15	18	100	0	17.00	87.00	11.60	3640	1000	8.40	15,310	6,124	6,430	27,864
	Total	-	-	-	-	-	-	-	-	-	-	-	***60,781***	***24,312***	***25,528***	**110,621**
9-6	B2-9	B2-7	10	12	538	1	12.75	72.00	11.60	3640	1000	7.35	71,446	28,579	30,007	130,032
	Total	-	-	-	-	-	-	-	-	-	-	-	***71,446***	***28,579***	***30,007***	**130,032**
9-7	A4	47-2-1A	8	10	515	1	8.85	70.00	11.60	3640	1000	7.35	65,354	26,141	27,448	118,943
	Total	-	-	-	-	-	-	-	-	-	-	-	***65,354***	***26,141***	***27,448***	**118,943**
9-8	B2-3	13-35-1A	12	15	359	1	18.80	77.00	11.60	3640	1000	7.88	51,832	20,733	21,770	94,335
	13-35-1A	46-40-H1	12	18	515	1	17.00	87.00	14.50	3640	1000	8.40	80,340	32,136	33,743	146,219
	46-40-H1	B-9	12	15	334	1	18.80	77.00	11.60	3640	1000	7.88	48,223	19,289	20,254	87,766
	Total	-	-	-	-	-	-	-	-	-	-	-	***180,395***	***72,158***	***75,767***	**328,320**
Total All Projects																**3,834,660**

Construction Costs based on ENR-CCI of 8449

APPENDIX



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27th Street
Neff Road

Proposed Sewer Projects
Connection Points
SE Interceptor
Existing Sanitary Sewer Lines
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Schools

0 1,000 2,000 Feet

MWH

Figure A.9-1
Study Area 9
Proposed Sanitary Sewer Layouts

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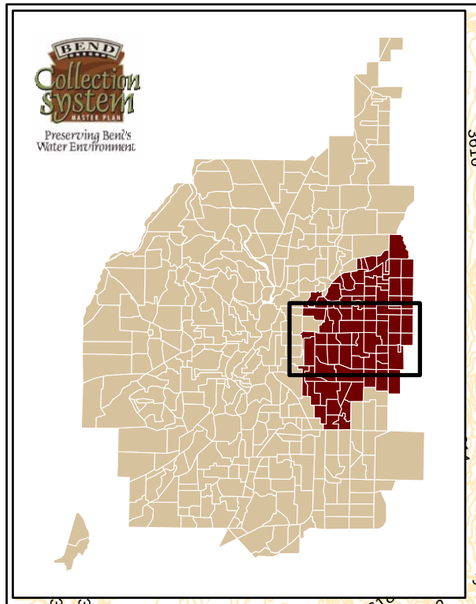

MWH

- Proposed Sewer Projects
- Connection Points
- SE Interceptor
- Existing Sanitary Sewer Lines
- UGB
- UAR
- No Planned Development
- Parks (No Planned Sewer Expansion)
- Schools

0 1,000 2,000 Feet

Figure A.9-2
Study Area 9
Proposed Sanitary Sewer Layouts

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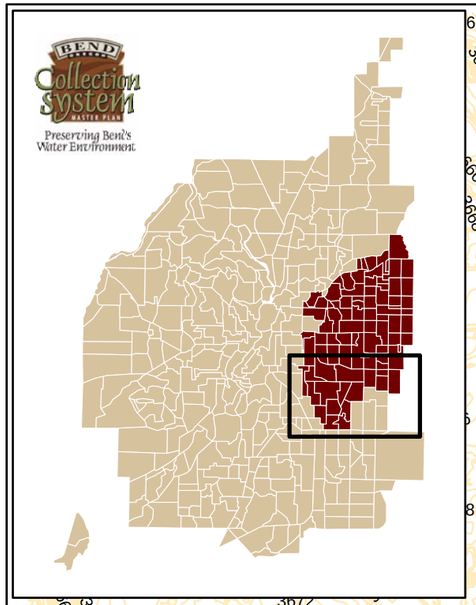

Proposed Sewer Projects
Connection Points
SE Interceptor
Existing Sanitary Sewer Lines
UGB
UAR
No Planned Development
Parks (No Planned Sewer Expansion)
Schools

0 1,000 2,000 Feet

MWH

Figure A.9-3
Study Area 9
Proposed Sanitary Sewer Layouts

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