STUDY AREA 5

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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).

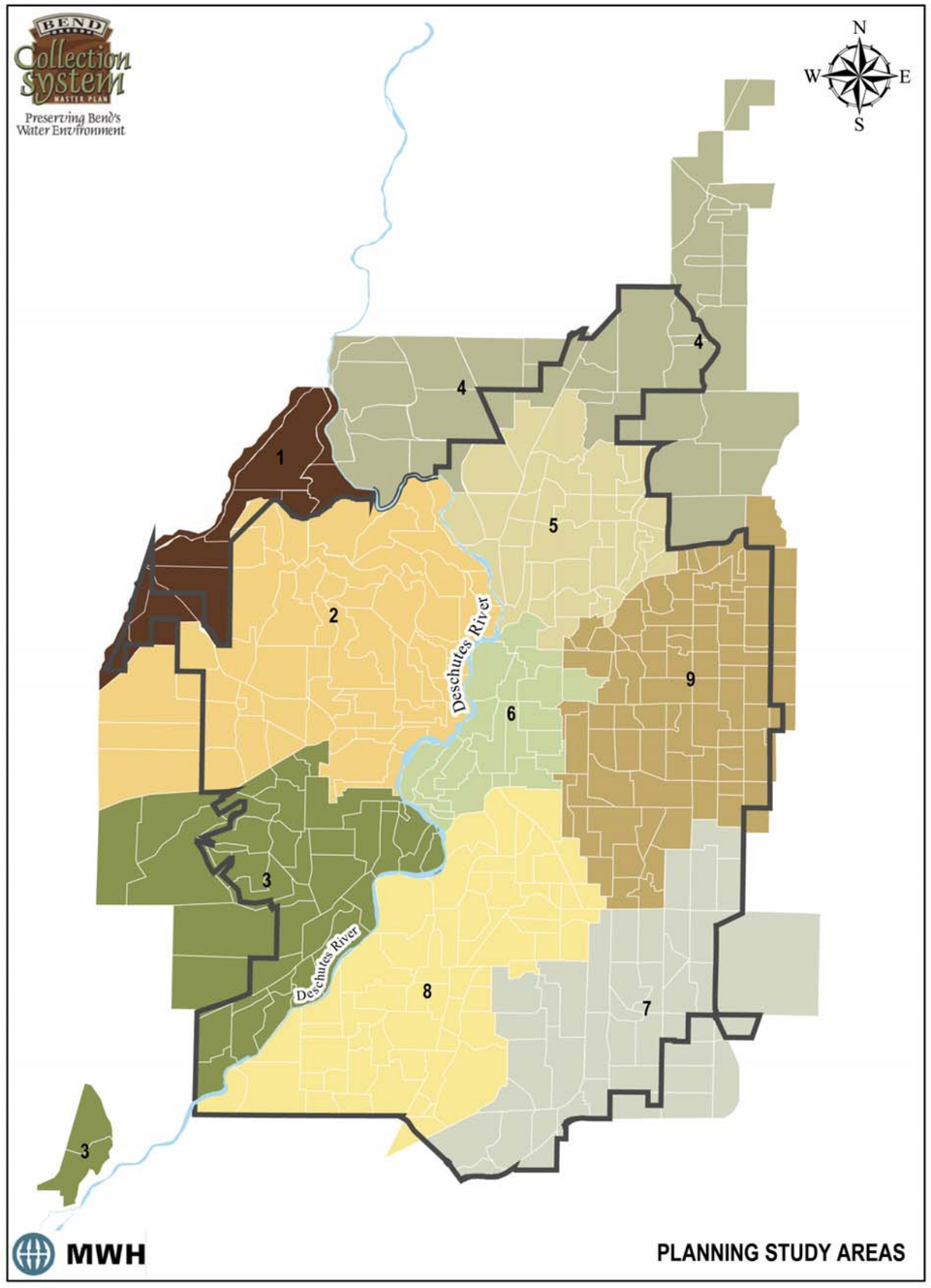


Figure 5-1 – Master Plan Study Areas

STUDY AREA 5

The planning area, which includes both the areas of the UGB and the UAR, is shown in ***Figure 5-1 – 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 5, which is the northern portion of the City. This area is highlighted and labeled in ***Figure 5-1***. As shown, all of Study Area 5 is within the UGB.

Study Area 5 consists of 2,186 acres (2,604 parcels), which can be subdivided into four categories. *Below is a summary of each category***:**

1. 807 acres (1,636 parcels) that receive sewer service;
2. 285 acres (267 parcels) that are developed but do not receive City sewer service (using a septic system or other type of wastewater service);
3. 642 acres (701 parcels) are undeveloped but are buildable within the UGB; and
4. Area 5 does not have any UAR lands.

EXISTING SEWERS

Study Area 5 currently has 28.10 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 5-1*** 22.6-miles or 80.4% of these gravity sewers are 6 and 8-inch lines serving local neighborhoods. There are only 5.5-miles of trunk sewers that are 10-inch or larger.

Table 5- 1
Study Area 5
Gravity Sewer Statistics

Line Diameter (inches)	Length		Percent of Total
	Linear Feet	Miles	
6	3,351	0.63	2.26
8	115,960	21.96	78.16
10	7,271	1.38	4.90
12	5,310	1.01	3.58
15	2,313	0.44	1.56
18	853	0.16	0.57
21	5,264	1.00	3.55
24	2,414	0.46	1.63
27	1,472	0.28	0.99
36	3,463	0.66	2.33
42	683	0.13	0.46

Note: Data summary as of May 2005

PROJECTS FOR UNSERVED AREAS

There are many areas within Study Area 5 with no sanitary service. For each of these areas, a project has been defined so that every parcel within Study Area 5 can be served.

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

- 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 5-2
Study Area 5 New Sewer Systems
Capital Project Cost Estimates Study

Project ID	Length (feet)	Diameter (inches)	Notes
5.1	7,386	8	Provides sewers to unsewered area
5.2	270	8	Provides sewers to unsewered area
5.3	954	8	Provides sewers to unsewered area
5.4	2,260	8	Provides sewers to unsewered area
5.5	136	8	Provides sewers to unsewered area
5.6	2,946	8	Provides sewers to unsewered area
5.7	235	8	Provides sewers to unsewered area
5.8	114	8	Provides sewers to unsewered area
5.9	245	8	Provides sewers to unsewered area
5.10	161	8	Provides sewers to unsewered area
5.11	2,224	8	Provides sewers to unsewered area
5.12	797	8	Provides sewers to unsewered area
5.13	134	8	Provides sewers to unsewered area
5.14	784	8	Provides sewers to unsewered area
5.15	168	8	Provides sewers to unsewered area
5.16	293	8	Provides sewers to unsewered area Allows removal of Boyd Acres Pump Station
5.17	1,183	8	Provides sewers to unsewered area
5.18	200	8	Provides sewers to unsewered area
5.19	304	8	Provides sewers to unsewered area
5.20	549	8	Provides sewers to unsewered area
5.21	400	8	Provides sewers to unsewered area
5.22	1,809	8	Provides sewers to unsewered area
5.23	742	8	Provides sewers to unsewered area
5.24	270	8	Provides sewers to unsewered area
5.25	460	8	Allows removal of Boyd Acres Pump Station
5.26	4,950	8	Takes Deschutes Co. Jail, and North Fire Pump Stations offline

Table 5-3
Study Area 5 Pump Stations
Existing Installed Information

Pump Station Name	Modeled	Number Of Pumps	Firm Capacity (gpm)	Force Main	
				Diameter (in)	Length (ft)
Canal View	Y	2	120	6	444
Deschutes Business	N	2	100	3	-
Deschutes Co. Jail	N	2	115	4	-
Empire	N	2	50	4	1798
Empire Village	Y	2	125	4	82
Enchantment	N	2	150	4	670
Glenshire	N	2	172	4	665
Majestic	Y	2	265	6	2286
North Fire Station	N	2	80	4	-
Quail Crossing	Y	2	265	6	306
Riverhouse	N	2	400	6	-
Service	N	2	120	4	-

Canal View

The Canal View Pump Station serves an area of 33 acres. This station service area is currently 48% sewered serving 103 of the 217 potential build-out dwelling units. The current (2005) estimated base flow for this station is 14-gpm with a peak hour flow of 38-gpm. The build-out estimated base flow for this station is 23-gpm with a peak flow of 59-gpm. The force main for this pump station is a 444-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 1.4-fps. The design TDH for this station is currently 22-feet. The existing station capacity of 120-gpm will meet the long-term requirements of the service area.

Deschutes Business

The Deschutes Business Pump Station serves an area of 43 acres. This station service area is a commercial area. The build-out estimated flow for this station is a peak flow of 65-gpm. The force main for this pump station is a 3-inch line. The design velocity in this force main under firm pumping conditions is 4.5-fps. The design TDH for this station is currently 40-feet. The existing station capacity of 100-gpm will meet the long-term requirements of the service area.

Deschutes County Jail

The Deschutes County Jail Pump Station serves an area of 78 acres. This station service area is currently 28% sewered serving 82 of the 292 potential build-out dwelling units. The current (2005) estimated base flow for this station is 11-gpm with a peak hour flow of 41-gpm. The build-out estimated base flow for this station is 50-gpm with a peak flow of 129-gpm. The force main for this pump station is a 50 to 100-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 2.9-fps. The existing station capacity of 115-gpm will ***NOT*** meet the long-term requirements of the service area.

Empire

The Empire Village Pump Station serves an area of 64 acres. The service area for this station is mostly commercial. The build-out estimated flow for this station is a peak flow of 96-gpm. The force main for this pump station is a 1798-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 1.3-fps. The existing station capacity of 50-gpm will ***NOT*** meet the long-term requirements of the service area.

Empire Village

The Empire Village Pump Station serves an area of 14 acres. This station service area is currently 35% sewered serving 64 of the 182 potential build-out dwelling units. The current (2005) estimated base flow for this station is 8-gpm with a peak hour flow of 21-gpm. The build-out estimated base flow for this station is 21-gpm with a peak flow of 65-gpm. The force main for this pump station is an 82-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.2-fps. The design TDH for this station is currently 15-feet. The existing station capacity of 125-gpm will meet the long-term requirements of the service area.

Enchantment

The Enchantment Pump Station serves an area of 96 acres. This station service area is currently 32% sewered serving 129 of the 405 potential build-out dwelling units. The current (2005) estimated base flow for this station is 18-gpm with a peak hour flow of 61-gpm. The build-out estimated base flow for this station is 52-gpm with a peak flow of 137-gpm. The force main for this pump station is a 670-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 3.8-fps. The existing station capacity of 150-gpm will meet the long-term requirements of the service area

Glenshire

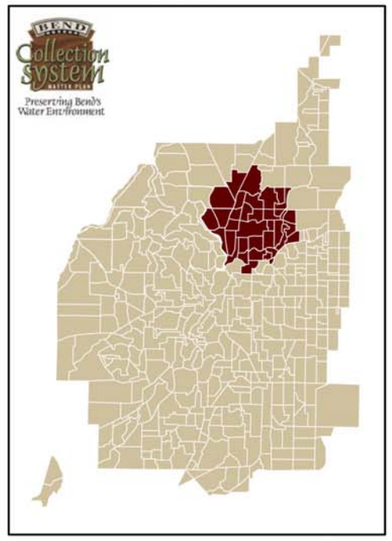
The Glenshire Pump Station serves an area of 38 acres. This station service area is currently 41% sewered serving 215 of the 520 potential build-out dwelling units. The current (2005) estimated base flow for this station is 29-gpm with a peak hour flow of 73-gpm. The build-out estimated base flow for this station is 64-gpm with a peak flow of 152-gpm. The force main for this pump station is a 665-foot long 4-inch line. The design velocity in this force main under firm pumping conditions is 4.4-fps. The existing station capacity of 172-gpm will meet the long-term requirements of the service area.

Majestic

The Majestic Pump Station serves an area of 84 acres. This station service area is currently 62% sewered serving 303 of the 489 potential build-out dwelling units. The current (2005) estimated base flow for this station is 42-gpm with a peak hour flow of 112-gpm. The build-out estimated base flow for this station is 55-gpm with a peak flow of 170-gpm. The force main for this pump station is a 2286-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 3.0-fps. The design TDH for this station is currently 39-feet. The existing station capacity of 265-gpm will meet the long-term requirements of the service area

North Fire Station

The North 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 4-inch line. The design velocity in this force main under firm pumping conditions is 2.0-fps. The service



Proposed Sewer Projects
Connection Points
Existing Sanitary Sewer Lines
Proposed Pump Station Basins
UGB
UAR
No Planned Development
Deschutes River

Cooley Road
Hwy 97
Connects to existing sewers. See Study Area 4
Study Area 4
Study Area 4
Study Area 2
Study Area 6
Study Area 9
See Study Area 6 for new sewers connecting to this basin
5.01
5.02
5.03
5.04
5.05
5.06
5.07
5.08
5.09
5.10
5.11
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5.21
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5.23
5.24
5.25
5.26

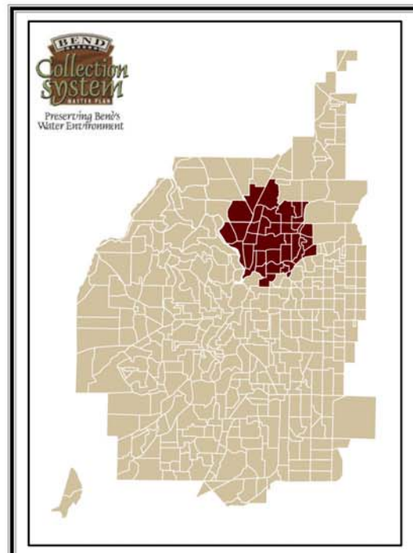
N
W
E
S
0 1,000 2,000 Feet

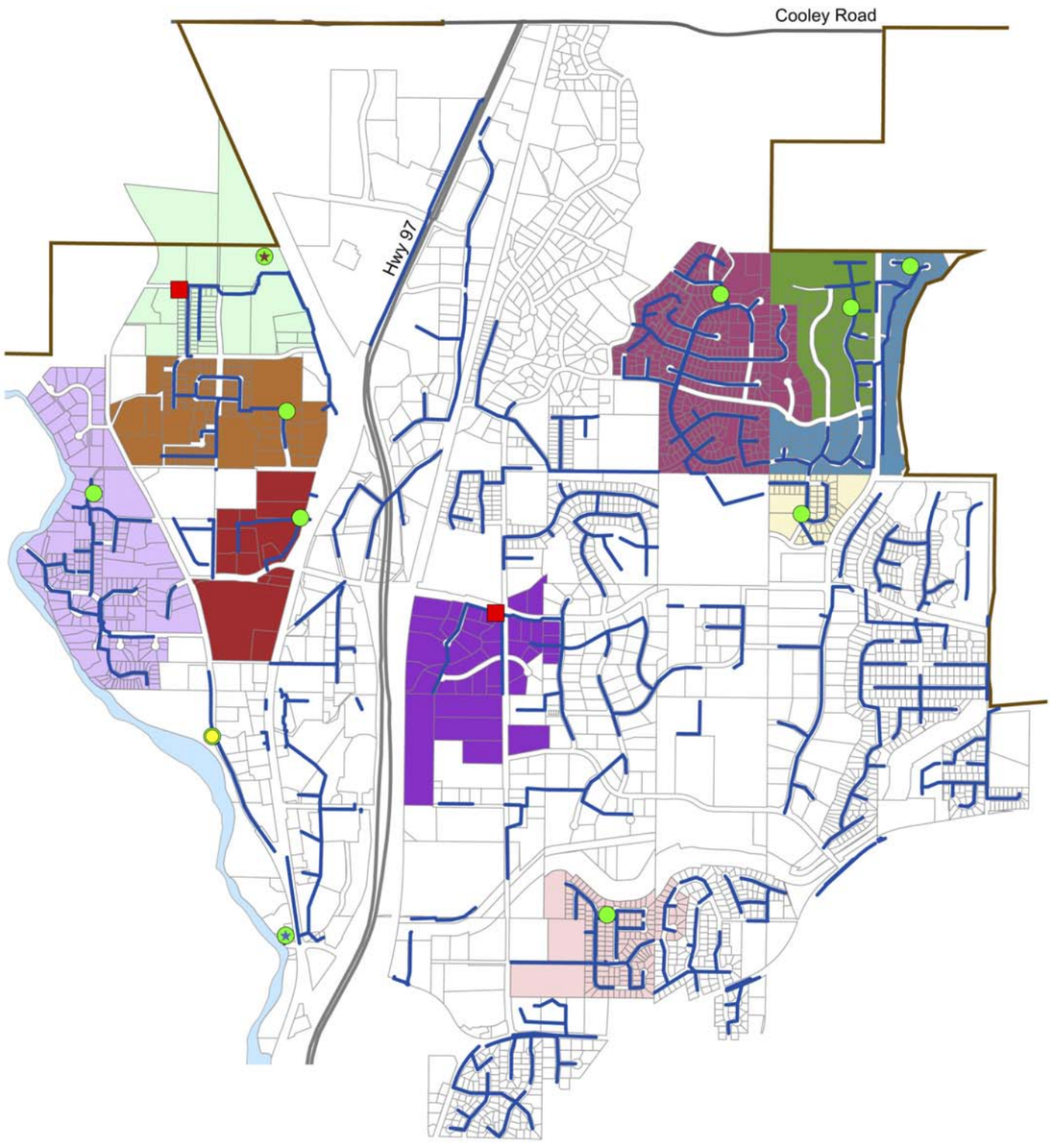
Notes

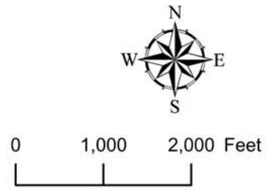
1. 5.25 removes Boyd Acres PS from service
2. 5.08 and 5.26 removes Deschutes County Jail PS and North Fire Station PS from service

MWH

Figure 5-2
Study Area 5
Proposed Sanitary Sewer Layouts







- North Fire Station
- Riverhouse
- Sawyer Park Regional Pump Station
- PS Capacity Adequate
- PS Capacity Upgrade Required
- Existing Sewers
- UGB
- Deschutes River
- Canal View
- Deschutes Business
- Deschutes County Jail
- Empire
- Empire Village
- Enchantment
- Glenshire
- Majestic
- Quail Crossing
- Service

MWH

Figure 5-3
Study Area 5
Current Pump Station Service Areas

requirements for this station will not change in the future so this station will meet the long-term requirements of the service area.

Quail Crossing

The Quail Crossing Pump Station serves an area of 38 acres. This station service area is currently 17% sewered serving 25 of the potential build-out 149 dwelling units. The current (2005) estimated base flow for this station is 3-gpm with a peak hour flow of 15-gpm. The build-out estimated base flow for this station is 17-gpm with a peak flow of 46-gpm. The force main for this pump station is a 306-foot long 6-inch line. The design velocity in this force main under firm pumping conditions is 3.0-fps. The design TDH for this station is currently 47-feet. The existing station capacity of 265-gpm will meet the long-term requirements of the service area.

Riverhouse

The Riverhouse Pump Station currently serves the Riverhouse Hotel and Restaurant, only. All of the flows that previously went to this station were redirected to the Sawyer Park Regional Pump Station, when it was placed into operation. This 400-gpm pump station is adequate to meet the requirements of the current service and no additional connections are anticipated.

Service

The Service Pump Station serves an area of 57 acres. This station service area is currently 28% sewered serving 54 of the 194 potential build-out dwelling units. The current (2005) estimated base flow for this station is 8-gpm with a peak hour flow of 30-gpm. The build-out estimated base flow for this station is 33-gpm with a peak flow of 86-gpm. The force main for this pump station is a 4-inch line. The design velocity in this force main under firm pumping conditions is 3.1-fps. The existing station capacity of 120-gpm will 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 5-4***.

Table 5-4
Recommended Pump Station Upgrades

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
5.PS01	Deschutes County Jail	Installation of New Pumps	$25,300	When capacity is reached
5.PS02	Empire	Installation of New Pumps	$25,300	When capacity is reached

Deschutes County Jail

The existing station capacity of 115-gpm is less than the estimated peak flow of 129-gpm. This may require replacement of the pumps with larger pumps, depending on the RDII of the service area. The City should monitor the operation of this station during peak RDII flow events to determine if there is a future need to upgrade the station. Installing new pumps with a capacity of 130-gpm is estimated to cost $25,300.

Empire

The existing station capacity of 50-gpm will not meet the long-term requirements of the service area. The pumps will need to be replaced with new 100-gpm pumps to provide for the long-term needs of the service area. The existing force main is adequate as the new design velocity at 100-gpm will be 2.6-fps at a TDH of 31-feet. The estimated cost for installing new pumps in this station is $25,300.

REMOVAL OF EXISTING PUMP STATIONS

Each of the existing pump stations was evaluated to determine if they could be removed from service by construction of a gravity sewer. 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 5-5***.

Table 5-5
Recommended Pump Station Decommissioning

Project ID	Pump Station Name	Upgrade	Cost ($)	Period
5.PS03	Deschutes County Jail	8” Gravity Sewers discharging to the North Interceptor	$25,000	Following construction of Projects 5.08 and 5.26
5.PS04	Majestic	New 1800-foot 8” Sewer	$281,000	Following removal of the Summer Meadows Pump Station and following construction of Project 4.14
5.PS05	Majestic	Removal of the Pump station	$25,000	On completion of Project 5.PS04
5.PS06	North Fire Station	8” Gravity Sewers discharging to the North Interceptor	$25,000	Following construction of Projects 5.08 and 5.26

Deschutes County Jail and North Fire Station

The Deschutes County Jail Pump Station can be removed from service with the construction of two 8” gravity sewer projects that discharge to the North Interceptor (Projects 5.08 and 5.26). These projects will also allow for removal of the North Fire Station Pump Station. These gravity sewers will provide gravity service to currently unsewered areas north and west of the intersection of Highway 20 and Highway 97 as well as provide service to the currently unsewered areas to the southwest of the pump station prior to the sewer’s discharge into the new North Interceptor. The driver for these projects will be the desire to sewer a number of currently unsewered parcels adjacent to the proposed route of the gravity sewers. Therefore, the only cost to remove the pump station from service is the removal itself, estimated at $25,000.

Majestic

The Majestic Pump Station can be removed from service with the construction of an 1800-foot 8” gravity sewer. This new gravity sewer will connect the station influent sewer to the Summer Meadows Pump Station basin located to the north. The Summer Meadows Pump Station will be removed from service with a gravity sewer that will flow by gravity to the new North Interceptor. The estimated project cost to

construct the gravity sewer to connect the Majestic Pump Station influent sewer to the Summer Meadows gravity system is $281,000. The estimated cost to remove the pump station is $25,000. 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 proceed at a constant rate until build-out of the area occurs in 2045. Based on these assumptions, the 20-year and 50-year present values for continuing operation of the station (starting in 2006) are $265,000 and $651,000, respectively. This includes the cost of a pump station capacity upgrade in the year 2015. Based on the same assumptions, the 20-year and 50-year present values for removing the pump station in 2015 are $421,000 and $445,000, respectively. This analysis shows that replacement of the pump station is cost effective in the long run, following the removal of the Summer Meadows Pump Station from service.

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 5-4***. The line segments shown in this figure are those that were modeled in the INFOSWMM hydraulic model.

EXISTING

This analysis showed three existing capacity deficiencies in Study Area 5. These capacity deficiencies are defined as Capital Projects 5-1, 5-4 and 5-6. The line segments and the breakdown of the estimated cost for the projects to correct these deficiencies are shown in ***Table 5-6***. 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. Three capacity deficiencies were found in the system in addition to the three existing deficiencies. The segments of the collection system requiring improvements are Capital Projects 5-2, 5-3 and 5-5. The line segments and the breakdown of the estimated cost to correct the deficiencies for each of the projects are given in ***Table 5-6.***

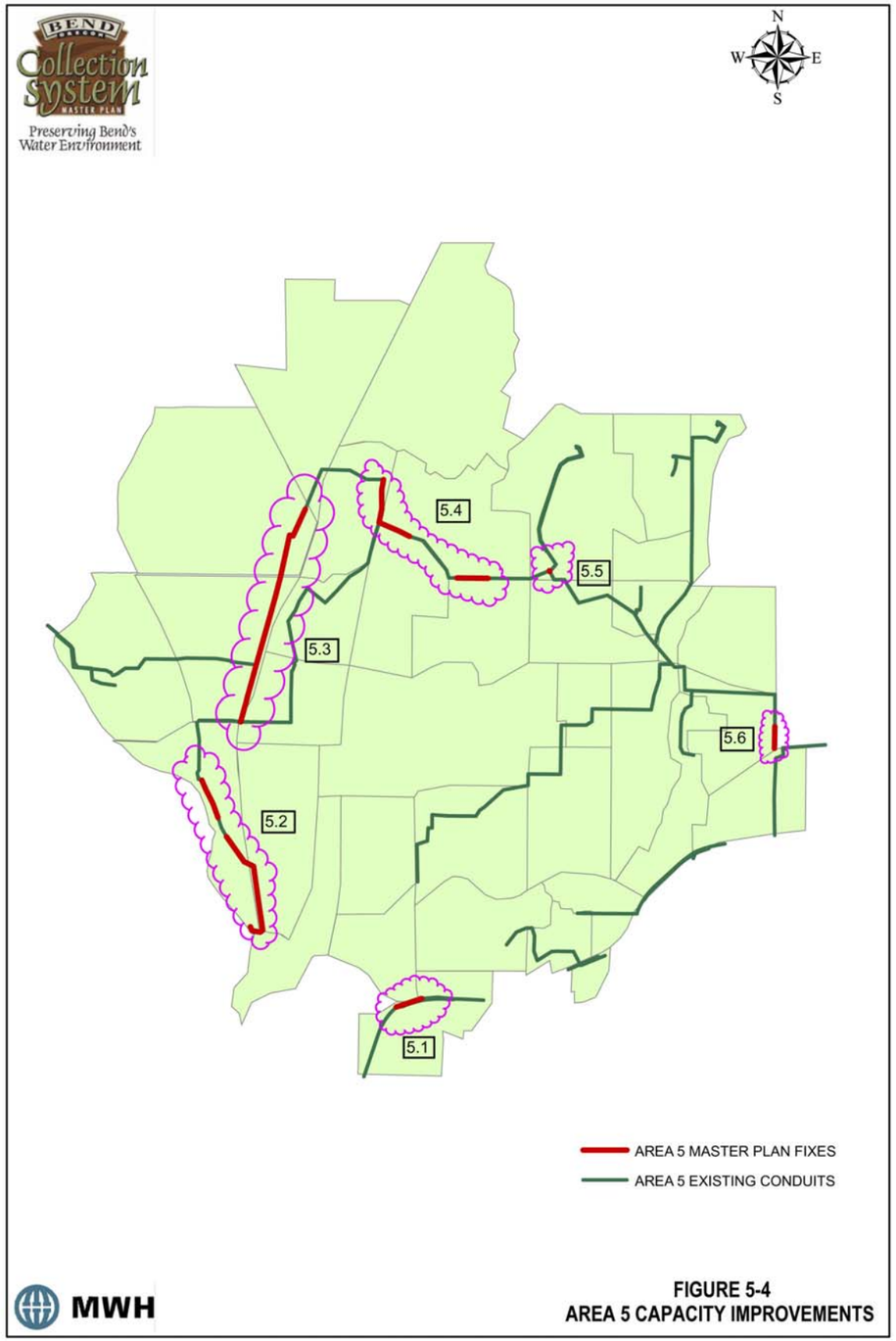
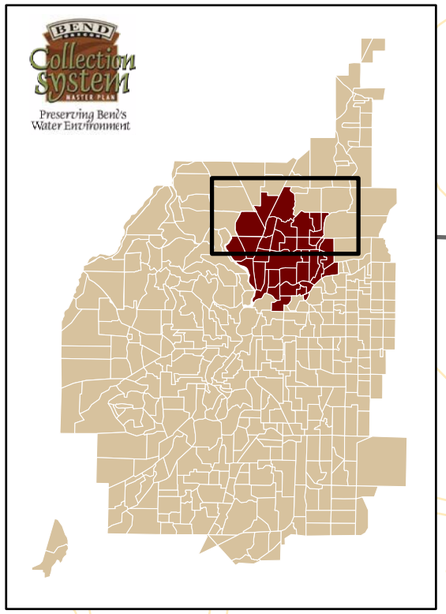


FIGURE 5-4
AREA 5 CAPACITY IMPROVEMENTS

Table 5-6
Study Area 5 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 ($)
5-1	A2-60	A2-59	24	30	425	1	30.00	132.00	14.50	8345	1000	11.00	97,054	38,822	40,763	176,638
	Total	-	-	-	-	-	-	-	-	-	-	-	***97,054***	***38,822***	***40,763***	**176,638**
5-2	9-240-2	SP8	12	15	1931	5	18.80	77.00	11.60	3640	1000	7.88	278,798	111,519	117,095	507,412
	SP-10	SP-13	12	15	651	2	18.80	77.00	11.60	3640	1000	7.88	93,991	37,597	39,476	171,064
	Total	-	-	-	-	-	-	-	-	-	-	-	***372,789***	***149,116***	***156,571***	**678,476**
5-3	1_6_1	43_7_22	6	8	3586	9	5.65	67.00	11.60	3640	1000	7.35	432,830	173,132	181,789	787,751
	Total	-	-	-	-	-	-	-	-	-	-	-	***432,830***	***173,132***	***181,789***	**787,751**
5-4	43-7-17	CRC-1	8	10	955	2	8.85	70.00	11.60	3640	1000	7.35	121,190	48,476	50,900	220,565
	CRC-1	AA-1	8	12	268	1	12.75	72.00	11.60	3640	1000	7.35	35,590	14,236	14,948	64,775
	43-7-6	64-27-1	12	15	494	1	18.80	77.00	11.60	3640	1000	7.88	71,324	28,529	29,956	129,809
	Total	-	-	-	-	-	-	-	-	-	-	-	***228,104***	***91,241***	***95,804***	**415,149**
5-5	43-7-3	TD1	15	18	15	0	17.00	87.00	11.60	3640	1000	8.40	2,297	919	965	4,180
	Total	-	-	-	-	-	-	-	-	-	-	-	***2,297***	***919***	***965***	**4,180**
5-6	34-59-1	34-59-2	21	24	351	1	22.00	107.00	14.50	8345	1000	9.45	68,028	27,211	28,572	123,811
	Total	-	-	-	-	-	-	-	-	-	-	-	***68,028***	***27,211***	***28,572***	**123,811**
Total All Projects																**2,186,005**

APPENDIX



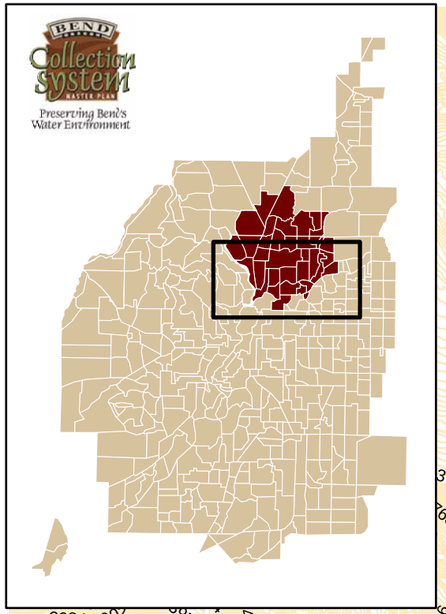
Proposed Sewer Projects
Connection Points
Existing Sanitary Sewer Lines
Proposed Pump Station Basins
UGB
UAR
No Planned Development
Deschutes River

0 1,000 2,000 Feet

MWH

Figure A.5-1
Study Area 5
Proposed Sanitary Sewer Layouts

N
W E
S



Proposed Sewer Projects
Connection Points
Proposed Pump Station Basins
Existing Sanitary Sewer Lines
UGB
No Planned Development

0 1,000 2,000 Feet

MWH

Figure A.5-2
Study Area 5
Proposed Sanitary Sewer Layouts

N W E S