



CHAPTER 5

EXISTING WATER SYSTEM FACILITIES

The water system facilities operated and maintained by the Sister Bay Water Utility include:

1. Three groundwater wells and pump stations
2. Two elevated water storage tanks
3. Seven pressure reducing stations
4. Water system controls located in the Wastewater Treatment Plant Administration Building
5. A network of transmission and distribution water mains

The general location and layout of the water system facilities is illustrated in Figure 5-1. A schematic of the water system is illustrated in Figure 5-2. This chapter presents a summary of the design and operating characteristics of the existing water system components.

5.1 EXISTING WELLS

The Sister Bay Water Utility operates three groundwater wells located throughout the Sister Bay area. All of the wells are completed in the deep dolomite aquifer. The rock well yields are reported to range from approximately 450 gpm to 500 gpm. The constructed depths of the deep wells range from 208 to 305 feet. Current specific capacities range from approximately 10 to 16 gpm per foot of drawdown. Table 5-1 summarizes the system supply well data. Table 5-2 presents a summary of the pump and motor data for the Village's supply wells.

5.1.1 Well 1

Well 1 is located on Scandia Road immediately east of STH 42. The well was constructed in 1972 to a total depth of 208 feet. The well contains a 10-inch diameter casing to a depth of 138 feet. The well is grouted to a depth of 138 feet. Well 1's original static water level was reported to be at ground level. Fall 2005 operating conditions included a static water level of 6 feet, with a specific capacity of 10.1 gpm per foot of drawdown.

Well 1 is equipped with a Peerless 6-stage vertical turbine, line shaft pump powered by a 40 horsepower Westinghouse electric motor. The pump is rated for 400 gpm at 250 feet TDH, and is set at 120 feet. Well 1 is pumped directly into the Main Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 1 is disinfected using gas chlorine. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.2 Well 2

Well 2 is located along Smith Drive east of STH 57. The well was constructed in 1972 to a total depth of 305 feet. The well contains a 10-inch diameter casing to a depth of 171 feet. The well is grouted to a depth of 171 feet. Well 2's original static water level was reported to 92 feet below the ground surface.

TABLE 5-1

EXISTING WELL DATA
 SISTER BAY WATER UTILITY
 VILLAGE OF SISTER BAY, WISCONSIN

Well Data	SUPPLY WELLS		
	Well 1	Well 2	Well 3
Year Constructed	1972	1972	2000
Depth (feet)	208	305	262
Well Driller	Miller Well & Pump	Miller Well & Pump	Layne Christensen
Casing: Diameter (in.)	10	10	12
Depth (ft.)	138	171	171
Formation	Silurian Dolomite	Silurian Dolomite	Silurian Dolomite
Grouted Depth (ft.)	138	171	171
Original Construction:			
Static Water Level (ft.)	0	92	19
Pumping Water Level(ft.)	83	157	56
Drawdown (ft.)	83	65	37
Pumping Rate (gpm)	400	450	500
Specific Capacity (gpm/ft)	4.8	6.9	13.5
September 2005 Conditions:			
Static Water Level (ft.)	6	98	27
Pumping Water Level(ft.)	54	128	55
Drawdown (ft.)	48	30	28
Pumping Rate (gpm)	485	480	455
Specific Capacity (gpm/ft)	10.1	16.0	16.3

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TABLE 5-2

EXISTING WELL PUMP DATA

SISTER BAY WATER UTILITY

VILLAGE OF SISTER BAY, WISCONSIN

Pump Data	Supply Wells		
	Well 1	Well 2	Well 3
Type	Vertical Turbine	Vertical Turbine	Vertical Turbine
Manufacturer	Peerless	Peerless	Goulds
Year Installed	1972	1972	2001
Pump Setting (feet)	120	160	180
No. of Stages	6	5	8
<i>Rated Conditions:</i>			
Flow Rate (gpm)	400	400	450
TDH (feet)	250	215	300
Motor Data			
Manufacturer	Westinghouse	U.S. Motors	U.S. Motors
Horsepower	40	30	50
RPM	1800	1800	1800
Voltage	230/460	230/460	230/460
Phase / Cycles	3 / 60	3 / 60	3 / 60
Standby Power:	Yes	Yes	Yes
Type	Generator	Generator	Generator
Fuel	Diesel	Diesel	Diesel
Pump Discharges to:	<i>Distribution System</i>	<i>Distribution System</i>	<i>Distribution System</i>
Pressure Zone:	<i>Main</i>	<i>Main</i>	<i>High Level</i>

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Fall 2005 operating conditions included a static water level of 98 feet, with a specific capacity of 16 gpm per foot of drawdown.

Well 2 is equipped with a Peerless 5-stage vertical turbine, line shaft pump powered by a 30 horsepower U.S. Motors electric motor. The pump is rated for 400 gpm at 215 feet TDH, and is set at 160 feet. Well 2 is pumped directly into the Main Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 2 is disinfected using gas chlorine. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.3 Well 3

Well 3 is located at the intersection of Hill Road and North Spring Street. The well was constructed in 2001 to a total depth of 262 feet. The well contains a 12-inch diameter casing to a depth of 171 feet. The well is grouted to a depth of 171 feet. Well 3's original static water level was reported to 19 feet below the ground surface. Fall 2005 operating conditions included a static water level of 27 feet, with a specific capacity of 16.3 gpm per foot of drawdown.

Well 3 is equipped with a Gould 8-stage vertical turbine, line shaft pump powered by a 50 horsepower U.S. Motors electric motor. The pump is rated for 450 gpm at 300 feet TDH, and is set at 180 feet. Well 3 is pumped directly into the High Level Pressure Zone distribution system. The station is served by a standby diesel generator that can supply power to the well pump motor in the event of an emergency.

Water pumped from Well 3 is disinfected using sodium hypochlorite. The pump discharge piping includes a check valve to prevent backflow, flow meter for quantifying pumpage and a pressure gauge for monitoring station discharge pressure. The station is in good structural condition, and the building, pumping and electrical equipment have been well maintained and are in good condition.

5.1.4 Historical Well Performance

The historical performance of each water supply well was analyzed. Available well and pump operating and performance data was collected and reviewed. The performance indicators include static and pumping water levels, pumping rate, and well specific capacity. The performance of each well with respect to each of the performance indicators is graphically summarized in Appendix A.

Seasonal declines in static water levels are apparent in each well due to high pumpage rates in summer. However, no long-term static water level decline trend is noticeable in the graphs of each well. Additionally, no significant well or pump operating concerns were observed during the inspection of the pumping facilities or during a review of the historical well performance information in Appendix A.

5.2 EXISTING BOOSTER PUMP FACILITIES

The Sister Bay Water Utility operates two booster pumping stations that supply water to the High Level Pressure Zone. Table 5-3 presents a summary of the pump and motor data for the Village's booster stations. The following sections briefly summarize the design and operating characteristics of each station.

TABLE 5-3

**EXISTING BOOSTER PUMP DATA
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN**

Pump Data	BOOSTER STATION			
	<i>Sister Bay</i>		<i>Liberty Grove</i>	
	Pump 1	Pump 2	Pump 1	Pump 2
Pump Type	Vertical Centrifugal	Vertical Centrifugal	Vertical Centrifugal	Vertical Centrifugal
Manufacturer	Aurora	Aurora	Weinman	Weinman
<u><i>Rated Conditions:</i></u>				
Flow Rate (gpm)	500	500	100	100
TDH (ft.)	101.8	101.8	96	96
<i>Pump Discharges to:</i>	<i>Distribution System</i>	<i>Distribution System</i>	<i>Distribution System</i>	<i>Distribution System</i>
<i>Pressure Zone:</i>	<i>High Level</i>	<i>High Level</i>	<i>High Level</i>	<i>High Level</i>
Pump Motor Data				
Manufacturer	Marathon	Marathon		
Horsepower	20	20	5	5
Phase / Cycles	3 / 60	3 / 60	3 / 60	3 / 60
RPM	1750 - Variable	1750 - Variable	1750 - Variable	1750 - Variable
Standby Power:	Yes	Yes	Yes	Yes
Type	Generator	Generator	Generator	Generator
Fuel	Diesel	Diesel	Diesel	Diesel

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5.2.1 Sister Bay Booster Station

The Sister Bay Booster Station is located inside the Well 2 pump station facility. The station is equipped with two identical Aurora vertical centrifugal pumps, powered by a 20 horsepower Marathon electric motor. The pumps are rated for 500 gpm at 102 feet TDH. Both booster pumps are equipped with variable frequency drives. The standby diesel generator that supplies emergency power to the Well 2 pump motor can also supply power to booster pump motors in the event of an emergency. Water levels in the Jungwirth Tower control the operation of the booster pumps.

5.2.2 Liberty Grove Booster Station

The Liberty Grove Booster Station is located inside the Well 3 pump station facility. The station is equipped with two identical Weinmann vertical centrifugal pumps, powered by 5 horsepower electric motors. The pumps are rated for 100 gpm at 96 feet TDH. Both booster pumps are equipped with variable frequency drives. The standby diesel generator that supplies emergency power to the Well 3 pump motor can also supply power to booster pump motors in the event of an emergency. System pressures in the High Level Zone control the operation of the booster pumps.

5.3 EXISTING STORAGE FACILITIES

The Sister Bay Water Utility operates two elevated storage facilities that provide pressure equalization for each pressure zone, provide stored water for fire protection and other emergencies, and provides a means for controlling the well and booster pumps. Table 5-4 presents a summary of the pump and motor data for the Village's booster stations. The following sections briefly summarize the design and operating characteristics of each storage tank.

5.3.1 Highway 57 Standpipe

The standpipe was constructed in 1972 immediately adjacent to Well 2 by the Brown Tank Company. The tank has a water storage volume of 100,000 gallons. The standpipe is 19 feet in diameter and has an overflow elevation of 730 feet USGS (48 feet above ground). The water level in the standpipe is maintained to provide system pressures in the Main Pressure Zone.

5.3.2 Jungwirth Tower

The Jungwirth Tower was constructed in 1996 on Jungwirth Court by the Caldwell Tank Company. The tank has a water storage volume of 150,000 gallons. The tower is approximately 110 feet high, and has an overflow elevation of 826 feet USGS. The water level in the tower is maintained to provide system pressures in the High Level Pressure Zone.

5.4 EXISTING PRESSURE REDUCING STATIONS

The Sister Bay Water Utility operates seven pressure reducing stations that provide additional water to the low level Pressure Zone in the event of a low pressure or fire fighting emergency. Three of the stations are located along the pressure boundary in northern and central Sister Bay. Two stations are located in the western area of the Village and serve the low lying areas to the east of the Jungwirth Tower.

TABLE 5-4

**EXISTING ELEVATED STORAGE TANK DATA
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN**

	Standpipe	Jungwirth Tower
<i>Village Location</i>	NW of STH 57 and Smith Drive	Jungwirth Courth west of N. Highland Road
<i>Pressure Zone Served</i>	Main Zone	High Level Zone
<i>Year Constructed</i>	1972	1996
<i>Constructed By</i>	Brown Tank Co.	Caldwell Tank
<i>Type</i>	Standpipe	Single Pedestal Sphere
<i>Storage Reservoir Material</i>	Steel	Steel
<i>Maximum Storage Volume (gal)</i>	100,000	150,000
<i>Height to Overflow (feet)</i>	48	109.5
<i>Overflow Elevation (feet USGS)</i>	730	826
<i>Base Elevation (feet USGS)</i>	682	716.5
<i>Diameter (feet)</i>	19	40
<i>Head Range (feet)</i>	48	30

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The exact pressure settings of the stations is uncertain, but they were designed to open upon a low pressure reading on the downstream side of the valve (Main Pressure Zone side), while also maintaining a required minimum upstream pressure in the High Level Pressure Zone. During the inspections performed for this study, it was observed that the older pressure reducing station located on STH 42 near the intersection of Meadow Lane was not functional.

5.5 WATER DISTRIBUTION SYSTEM

The Village's water distribution system provides a means of transporting and distributing water from the supply sources to Utility customers and other points of usage. The distribution system must be capable of supplying adequate quantities of water at reasonable pressures throughout the service area under a range of operating conditions. Furthermore, the distribution system must be able to provide not only uniform distribution of water during normal and peak demand conditions, but must also be capable of delivering adequate water supplies for fire protection purposes.

The Village of Sister Bay's water system is comprised of approximately 17 miles of water mains ranging in size up to 12 inches in diameter. The current water main size inventory is summarized in Table 5-5. Of the 17 miles of water main, 3 percent are 10 inches in diameter or larger. These large diameter water mains represent the system's primary transmission facilities. The LGSD No. 1 distribution system is comprised of over 4 miles of water mains ranging in size up to 8 inches in diameter. The current water main size inventory is summarized in Table 5-6. Of these 4 miles of water main, 79 percent are 8 inches in diameter.

The 2005 water main inventory based on pipe age for the entire water system (including Liberty Grove Sanitary District) is summarized in Table 5-7. The pipe age summary was developed through the development of the Sister Bay water system computer model. Over 70 percent of the existing distribution system was installed prior to 1990. The entire water distribution system is composed of ductile iron pipe.

5.6 WATER SYSTEM CONTROLS

The water system controls are located in the Control Room at the Sister Bay wastewater treatment plant. The existing controls consist of a computer-based telemetry control panel, allowing operators to operate and control pumps, and monitor and trend elevated tank levels. System well and booster pumps are scheduled and automatically sequenced by operators using a pump selection matrix system that uses water levels in the elevated tanks for pump operating control. Additional well and/or booster pumps are operated based on decreasing water levels in the tanks.

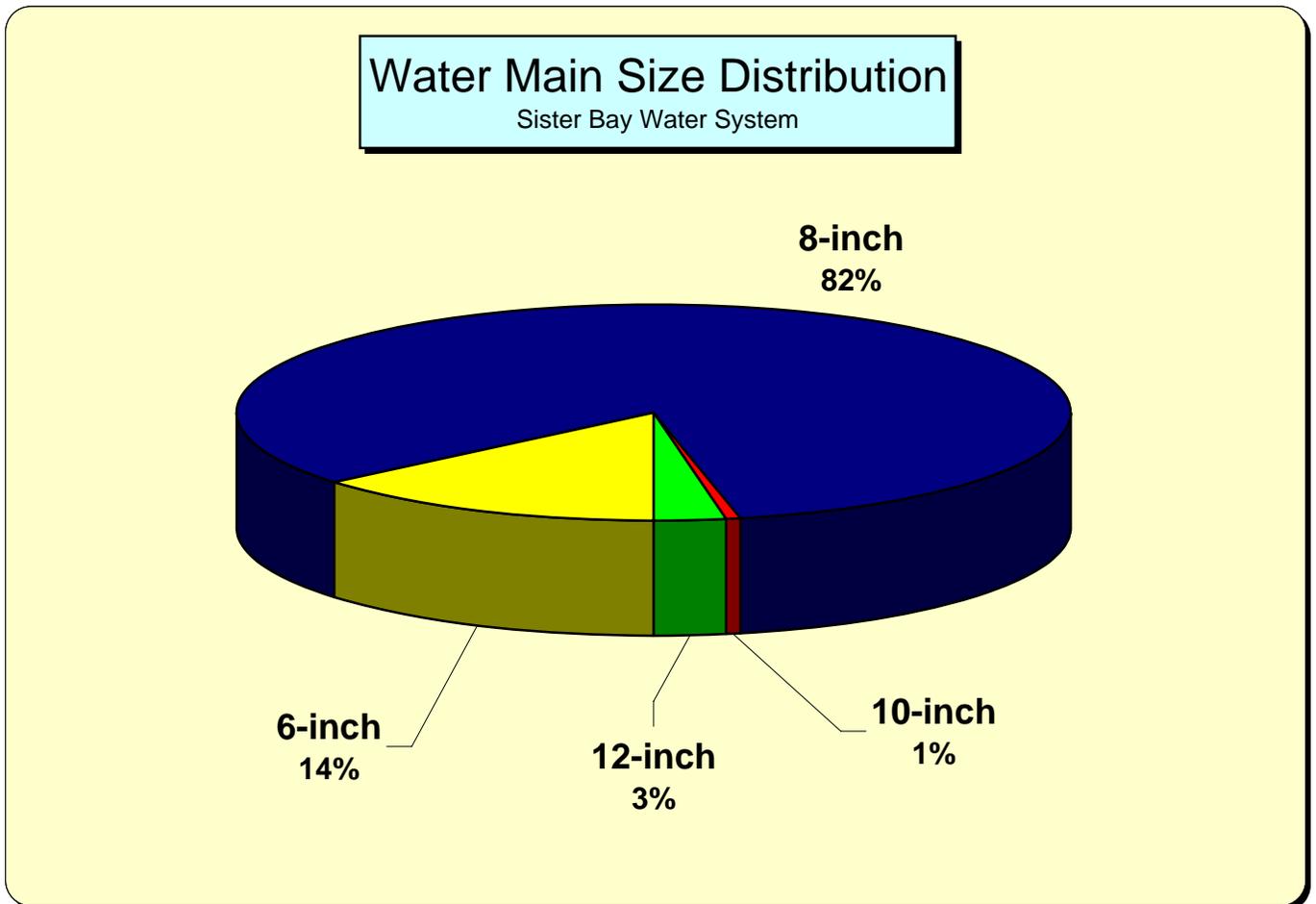
The water level in the Standpipe serves as the primary control for Wells 1 and 2 well pump operation. The Jungwirth Tower serves as the primary control for Well 3 and the Sister Bay and Liberty Grove Booster Station pumps.

TABLE 5-5

WATER MAIN SIZE DISTRIBUTION
 SISTER BAY WATER UTILITY
 VILLAGE OF SISTER BAY, WISCONSIN

Diameter (inches)	Approximate Total Length ¹ (feet)	Percentage of Total
6	11,512	13.9%
8	68,659	82.8%
10	480	0.6%
12	<u>2,269</u>	<u>2.7%</u>
Total	82,920	100.0%

¹ Source: Sister Bay Water Utility 2004 PSC Annual Report



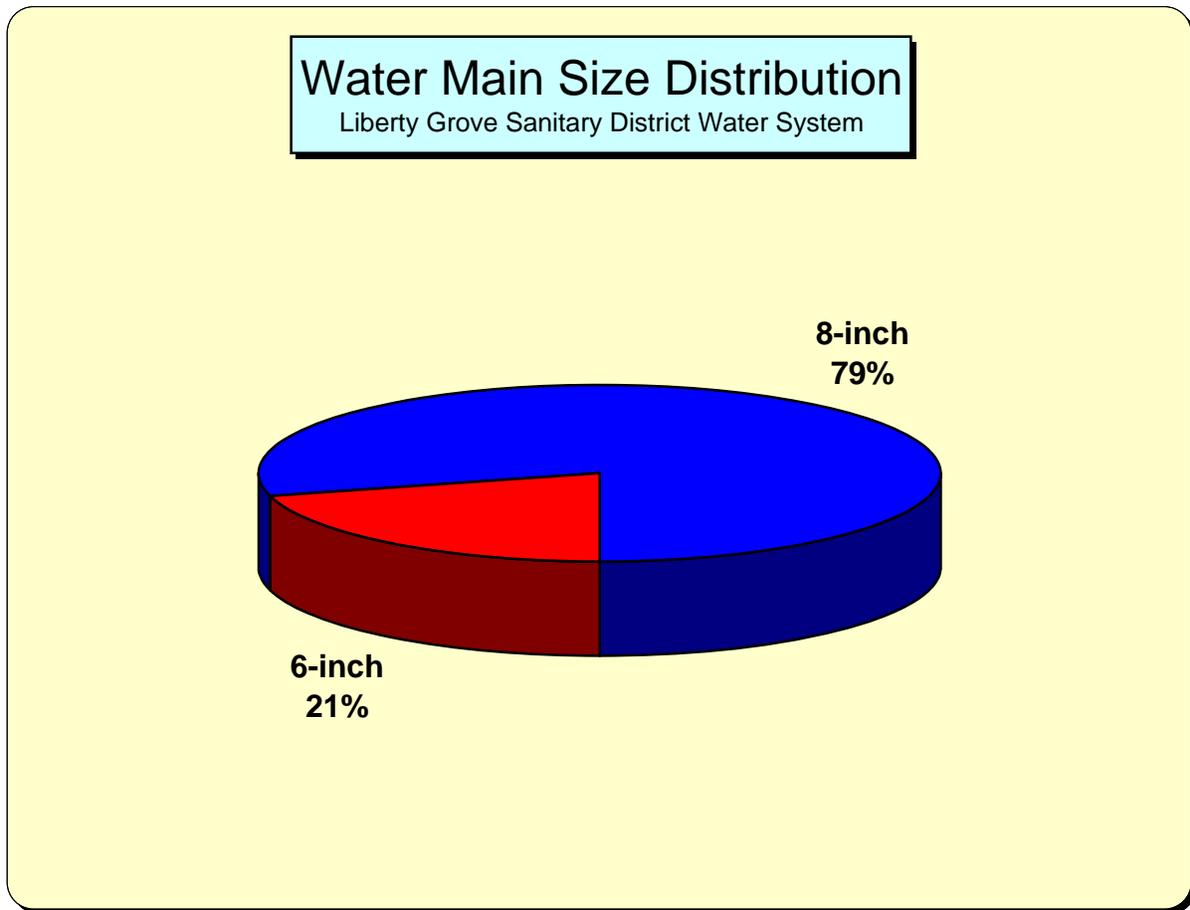
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TABLE 5-6

WATER MAIN SIZE DISTRIBUTION
LIBERTY GROVE SANITARY DISTRICT NO. 1
VILLAGE OF SISTER BAY, WISCONSIN

Diameter (inches)	Approximate Total Length¹ (feet)	Percentage of Total
6	4,674	20.8%
8	<u>17,808</u>	<u>79.2%</u>
Total	22,482	100.0%

¹ Source: Liberty Grove Sanitary District No. 1 2004 PSC Annual Report



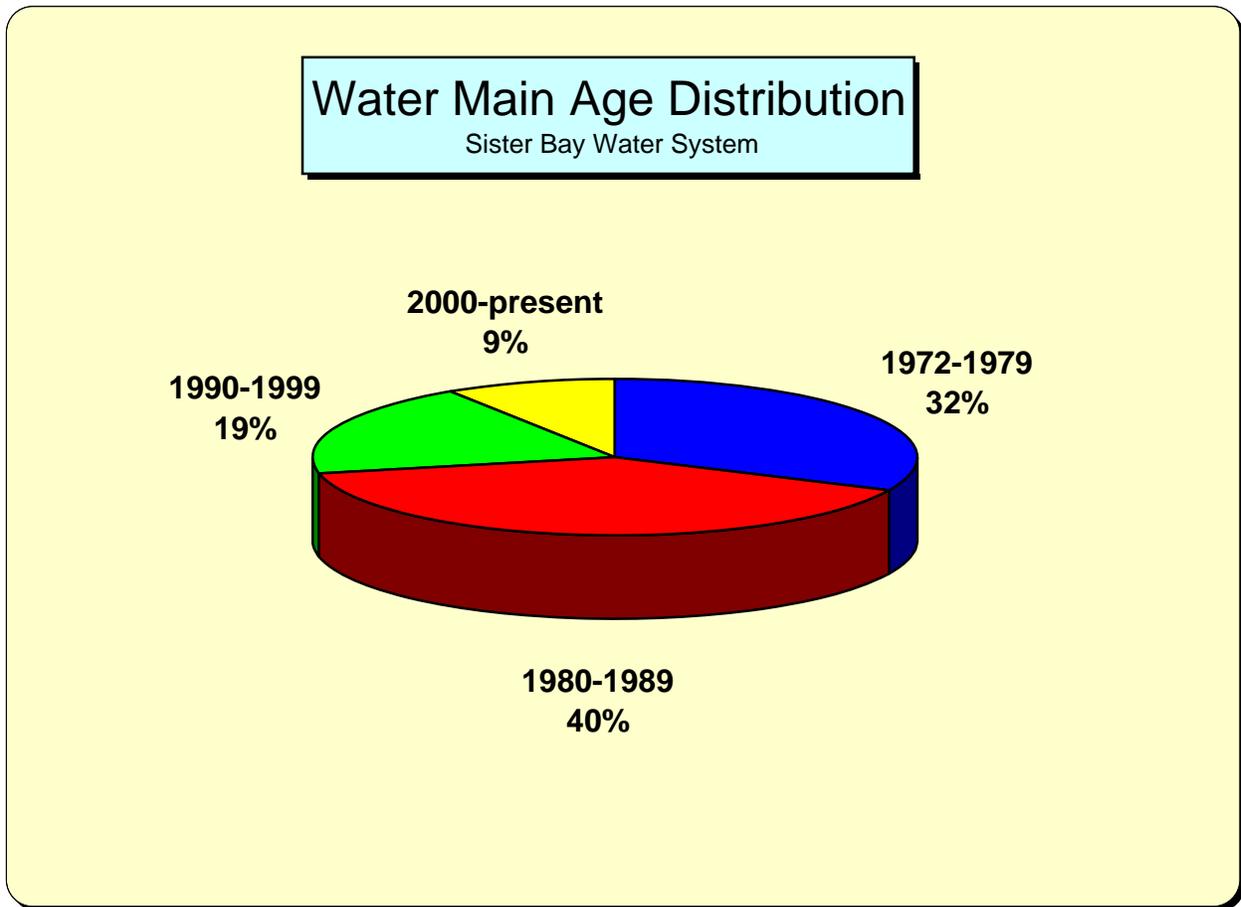
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TABLE 5-7

WATER MAIN AGE DISTRIBUTION
SISTER BAY WATER UTILITY
VILLAGE OF SISTER BAY, WISCONSIN

Pipe Material	Approximate Total Length¹ (feet)	Percentage of Total
1972-1979	37,127	31.9%
1980-1989	46,153	39.7%
1990-1999	22,515	19.3%
2000-present	<u>10,584</u>	<u>9.1%</u>
Total	116,379	100.0%

¹ Source: 2005 Sister Bay water system computer model (including Liberty Grove S.D.)



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