approximately 22,800 gpd to 57,200 gpd during the non-flood years with an average of 41,500 gpd as shown in Table 6.2.

The third method used to estimate wastewater flow rates utilized data from the flow monitoring performed in August and September of 2010. This method estimated approximately 53,800 gpd as shown in Table 6.3.

Comparing the flow monitoring based estimate (53,800 gpd) to the average daily flow rates from historic pumping, it can be noted that it falls between the average (41,500 gpd) and the maximum average daily flow (57,200 gpd). One would expect this estimated daily flow rate (53,800 gpd) to be between the historic average and maximum average as the monitoring period included the Labor Day Weekend which is one of the busiest weekends for the park. Therefore, this comparison confirms the validity of the flow monitoring data.

Comparing the flow monitoring based average daily flow rate estimate (53,800 gpd) to the estimate based on typical wastewater generation factors (54,200 gpd) shows that the two estimates are 400 gpd different. This comparison shows the two methods to be comparable and validates the typical wastewater generation factors for use in predicting future flows that is required for planning future park expansion.

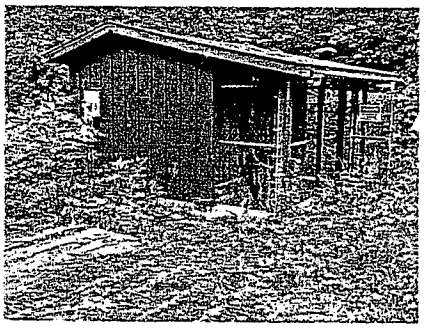
In Table 6.3 includes the total peak flow rate for the North (185 gpm) and South Shore (175 gpm) systems based on flow monitoring. These peak flow rates are important to know because the wastewater pumping station capacities must meet these peak flow rates.

7.0 Pumping Stations

7.1. North Shore Pumping Station Equipment & Conditions

The North Shore Pumping Station is located approximately 1,800 feet north of the North Shore of Devils Lake and adjacent to the creek which parallels the railroad. Over the history of the Park this facility has been upgraded several times. The history of the upgrades is not relevant to this study; however, structural remnants of the upgrades are still present and, to varying degrees, still used today. The location of the North Shore Pumping Station is shown on the **North Shore Sanitary System Map** found in the **Appendix.**

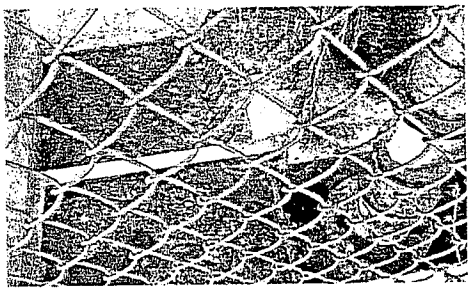
The present configuration of the pumping station is composed of head works, a concrete wet well, a concrete sub-grade dry well housing two dry pit centrifugal pumps. A control room above the dry well houses the pump motors and controls. The control room is enclosed in a wood framed structure with wood siding and a shingled roof that extends over the headworks and wetwell (see pictures following). The pumping station is located adjacent to a concrete septic tank that is currently used as an overflow tank for pumping station wetwell.



North Shore Wastewater Pumping Station Exterior

Two gravity pipes discharge into the pumping station. There are two horizontally parallel sewer lines between SMH #12 and the pumping station. The "upper" sewer line (Pipes 73, 74, 75 & 108 on the System Map) has 6-inch piping and shallow cover with as little as one to two feet in some locations,. This sewer line was intended to provide summer sewer service only and was probably installed at the same time as the pumping station and septic holding tank. The other "deep" sewer line has 8-inch piping and was installed in 1989 (Pipes 71, 72, & 79 on the System Map). This second sewer line was installed to facilitate winter sewer service to the North Shore area. There are plug valves just north of SMH #12 on both the shallow and deep lines (Pipes 71 & 73). These valves allow diversion of flow through the shallower or deeper sewer line between SMH #12 and the pumping station. Pipe 108 connects the shallower sewer line to the pumping station and has an invert at the bottom of the headworks channel. Pipe 79 connects the deeper sewer line directly to the pumping station wet well at an invert approximately 7' feet below the top of the wet well, thereby bypassing the headworks (comminutor and bar screen). This pipe contains a plug valve ten feet south of the pumping station which should be closed when the deeper line is not in use.

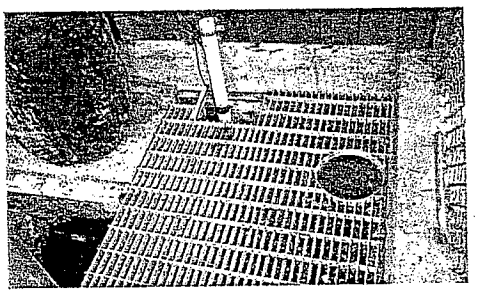
The head works of the North Shore Pumping Station are enclosed with a chain link fence and are exposed to the elements. The head works include a comminutor and stationary bypass bar screen above a concrete wet well. The comminutor is operated by a 1/3 hp 230 volt single phase motor manufactured by General Electric. Almost all of the paint on comminutor and motor has peeled away leaving a rusting metal exterior. The intended function of the comminutor is to grind and shred solids in the wastewater so that they may pass through the pumps. However, the comminutor clogs on a regular basis and a grabbing tool is used to remove solids that are stuck in the open top of the comminutor. A thick layer of solids, debris and algae was observed in the channel upstream of the comminutor and on bypass bar screen which impeded flow through the head works. Below the head works is a 9' x 4' x 12' deep concrete wet well.



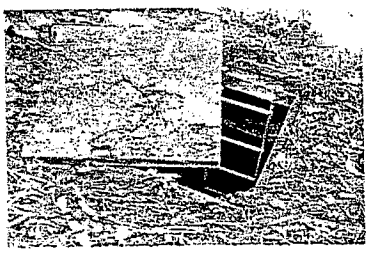
Head Works Channel (Comminutor & Bar Screen)

Comminutor

Inside the wetwell there is an overflow pipe (Pipe 109 on the System Map) with an invert three feet below the top of the wet well which diverts flow into the adjacent concrete septic holding tank. There is a valve located in a concrete vault on the overflow pipe immediately west of the wet well to shut off this overflow pipe. Two float switches in the wet well control pump operation. Based on sketches provided by park staff, the off float is 8 feet below the top of the wet well and the on float is 5'-6" below the top of the wet well resulting in a 2.5' operating range for the pumps. This operating range provides a 673 gallon operating volume. The exposed top portions of the wet well concrete appeared to be in good condition. The interior of the wet well was not observed as it was not dewatered for observation at the time of the site visit.



Wetwell



Wetwell Overflow Pipe Valve Vault

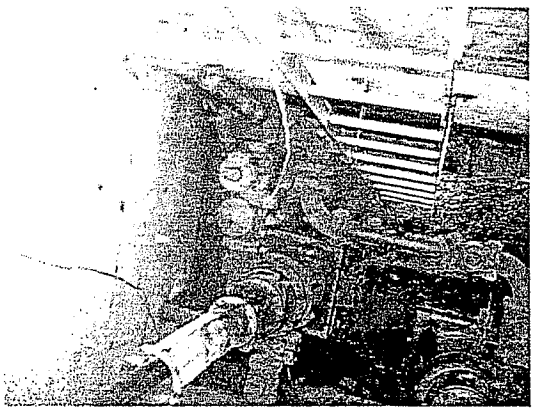
The dry well adjacent to the wet well contains two vertical line shaft driven centrifugal pumps. Per the original 1978 sales records on file at L.W. Allen, the pumps' supplier, the pumps are 4-inch non-clog sewage pumps Model # 5413B32 manufactured by Fairbanks-Morse with 4-inch intake and discharge connections. At the time of the sale, the pumps were rated to provide 200 gpm at a total dynamic head of 128 feet with an 11.25-inch diameter, 2-vane impeller. Per LW Allen, these pumps are capable of passing a 3-inch diameter sphere as required by paragraph NR 110.14(3)(g) of the Wisconsin Administrative Code. Files at LW Allen did not include record of any repairs or replaced parts since the original sale of the pumps in 1978. The expected service life of sewage pumps is 15 to 20 years. Therefore, the 33 year old pumps are 13 to 18 years beyond their expected service life. Based on discussions with Gary Kowalke of Terrytown Plumbing whose company frequently unplugs the pumps, the impellers are worn such that solids accumulate between the impeller and the volute (impeller housing) leading to frequent plugging.

Piping between the wet well, pumps and force main is 4" ductile iron which complies with the minimum pipe diameter (4 inches) required by Paragraph NR110.14(3)(g) of the

Wisconsin Administrative Code. There are shut off valves (plug valves) on the suction piping and shut-off (plug valves) and check valves downstream of each pump. The finish of most of the piping and valves is deteriorated and rust is visible. It appears that the valves date back to construction of the pump station based on records provided by park staff, LW Allen and Terrytown Plumbing. Therefore, they are well beyond their expected 15-20 year service life.

There is a magnetic flow meter adjacent to the east wall of the dry well. Per LW Allen sales records, the flow meter was installed in 1987. There are no service records at LW Allen showing the flow meter has been calibrated since it's installation in 1987.

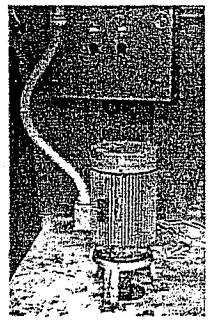
An aluminum access ladder is used to enter the dry well. The floor of the dry well was moist, and wastewater appeared to be leaking from the seal of Pump #2. There is a ventilation fan in the control room with an intake in the dry well and exhaust duct through the side wall of the control room. However, there was a noticeable sewage smell coming through the access opening to the dry well. A rope is connected to the lever of the check valve on Pump #1 to back flush the pump when clogging occurs. The dry well was lacking an automatic heater, dehumidifier and sump pump as required by paragraph NR110.14(3)(b) & (d) of the Wisconsin Administrative Code.



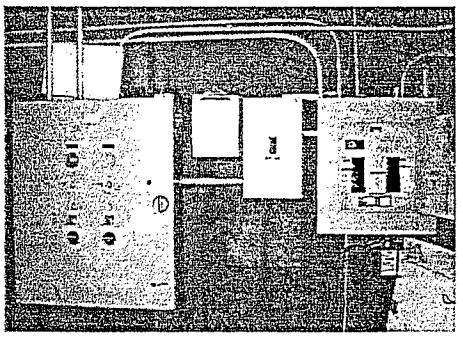
Drywell (west side)

Drywell (east side)

The control room houses the pump motors and pump controls. Each pump is driven by a 20 hp, 1750 rpm, 230/460 volt, 3-phase motor manufactured by Lincoln Motors. The motors are each controlled by a variable frequency drive (VFD) which ramps the pump up to full speed when the "on" float switch is activated and then ramps them down to shut off when the "off" float switch is activated. There is a control enclosure with a "hand" – "off" - "auto" switch and a run time meter for each pump. The pumping flow rate is indicted by an instantaneous flow digital display and totalized flow indicator connected to the flow meter. The controls are in good condition. The VFDs and magnetic flow meter are the current preferred technologies for pump control and flow measurement respectively.

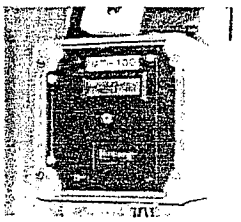


Pump Motor



Controls & Electrical Distribution Panel

VFDs

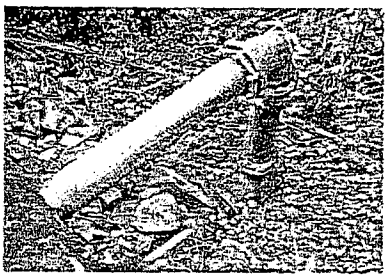


Flow Meter

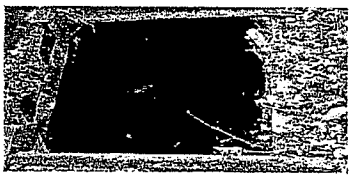
The concrete septic holding tank is located west of the pumping station. The overflow pipe in the pumping station wet well (Pipe 109 on the System Map) discharges into this holding tank. There is a pipe from the holding tank connected to the suction piping of Pump #1 (Pipe 110 on the System Map) to facilitate empting of this tank. The tank is divided into two compartments. The main/south compartment is 15'wide x 46' long x 13' deep. The suction pipe to Pump #1 is 1' above the bottom of the tank floor. Therefore, the main compartment of this tank has a 61,934 gallon capacity. The second/north compartment of the tank is 20' wide x 23' long x 4' deep. This compartment acts as an overflow camber and has a 6" overflow pipe which discharges into a ditch north of the tank. The roof of the holding tank is constructed of precast concrete planks with four openings covered by steel plates. The steel frames of the openings and the plates covering them are severely corroded. Vegetation has grown between the joints in the planks, the surface of the planks has deteriorated, and there is a noticeable deflection of the planks when walked upon. There is a steel plate at the southeast corner of the roof approximately 4' x 8' which covers an area were the concrete planking collapsed. Debris was noted in the tank as viewed through one of the hatches. The condition of the tank walls and floor was not noted as the interior of the tank was not accessed at the time of the site visit. However, if they are of the same age as the roof or older, it is reasonable to assume they are likewise deteriorated and in need of repair or replacement.

Septic Holding Tank (looking south)

Septic Holding Tank (looking north)


Septic Tank Overflow Pipe


Access Hatch


Access Hatch

7.2. North Shore Pumping Station Capacity

On August 19, 2010, the flow rates, as shown on the flow meter, produced by each pump were observed over the duration of a pumping cycle. Pumping rates will decline over the duration of a pumping cycle as the static head that the pump must overcome increases as the liquid level in the wet well decreases. Information provided park staff from 1987 when the force main to the City of Baraboo was first installed indicated maximum pumping rates of 770 gpm and 835 gpm for Pump Nos. 1 & 2 respectively. The pumping rates provided by the pumps as observed on 8-19-10 and compared to the 1987 maximums are shown in Table 7.2.

Table 7.2 – North Pumping Station Average Pumping Rates

(Per 8-19-2010 & 1987 Flow Meter Observations)

Pump No.	Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	1987 Maximum Flow Rate (gpm)
1	308	150	450	770
2	207	138	295	835

Comparison of the 1987 maximum flow rates to those observed on August 19, 2010 shows a noticeable decrease in pumping capacity. This decreased pumping capacity may indicate excessive wear has occurred in the pumps, and possibly solids build up in the force main.

7.3. North Shore Pumping Station Recommended Improvements

Recommended improvements for the North Shore Pumping Station should address the deteriorated and nonfunctioning comminutor and bar screen, the deteriorated valves and piping in the dry well, leaking seal of Pump #2, frequent plugging of the pumps which are 13-18 years beyond their expected service life, lack of an automatic heater, dehumidifier and sump pump in the dry well as required by paragraph NR110.14(3)(b) &(d) of the Wisconsin Administrative Code, and the deteriorated and hazardous condition of the septic holding tank. Also, the improvements should address flood proofing the pumping station as required by Subchapters NR 116.16 & 116.17 of the Wisconsin Administrative Code.

Improvement Alternative I – Equipment Replacement in the Existing Pumping Station:

Pumps:

The first alternative for improvements includes replacement of the existing pumps with new solids handling pumps capable of passing spheres at least 3 inches in diameter per the requirements of NR 110.14(3)(g). The same model as the original pumps are still actively manufactured by Fairbanks-Morse and new pumps with new impellers may eliminate the frequent clogging of the existing pumps.

Alternatively, new pumps capable of cutting and passing any materials encountered by the pumps could be installed. Any pump not capable of passing spheres at least 3 inches in diameter is required per NR 110.14(3)(g) to be approved by the Wastewater Section of the WDNR. The N-impeller series pumps manufactured by ITT Flygt feature an impeller with a hardened and sharpened leading edge. These pumps have been used successfully at many prisons, sports stadiums and other facilities were numerous and frequent solids are encountered. The use of N-Impeller pumps has been approved by the Wastewater Section of the Division of Watershed Management at the WDNR. Another option is a C-series chopper pump as manufactured by Tsurumi. However, this pump has not yet been approved by the DNR Wastewater Section for use as a solids handling pump. Similar chopper pumps from local vendors may be available for usage.

New pumps designed to be non-clog, or capable of cutting and passing any materials encountered, would allow the comminutor and by-pass bar screen to be removed. The septic holding tank could be abandoned as well.

Controls, Access and Safety Improvements to Meet Current Code Requirements:

The improvements should also include replacement of the deteriorated piping and valves with a recommended minimum diameter of six inches. The dry well access ladder should be replaced with one that is compliant with current OSHA standards for fixed ladders. An automatic heater, dehumidifier and sump pump should be added to the dry well per paragraph NR110.14(3)(b) & (d) of the Wisconsin Administrative Code.

A automatic telephone dialer, radio conveyed system, or telemetry system should be added to the controls to convey power failure, pump failure and high water level alarm conditions to comply with the requirements of paragraph NR110.14(3)(i) of the Wisconsin Administrative Code.

A water-tight hatch could be added to the dry well, and a concrete top slab with inverted "j" tube for ventilation, water-tight hatch and caution sign per NR110.14(3)(b)4. could be added to the wet well to flood-proof these structures. However, the current wood construction of the above ground control room would require building a berm around the facility above the local flood elevation to provide flood protection for the pumping station.

The **Opinion of Probable Construction Cost** for this improvement alternative is shown in **Table 7.3-I** found in the **Appendix.**

Improvement Alternative II – New Submersible Pump Station

This option includes demolition of the existing wastewater pumping station and septic holding tank and replacing them with a new submersible pump station complying with all requirements of Subchapter NR 110.14 of the Wisconsin Administrative Code. The new

station would include a circular concrete wet well manhole, a separate adjacent concrete valve vault and a free standing stainless steel control panel.

The wet well would contain two submersible solids handling sewage pumps each capable of pumping at the anticipated peak hourly flow rate. Flow monitoring completed as part of this study indicated a peak flow rate of 185 gpm (See Table 6.3 above). Therefore, it is recommended that the new pumps match the rated capacity of the original pumps (200 gpm @128' TDH). The pumps would be capable of passing spheres at least 3 inches in diameter per the requirements of NR 110.14(3)(g), or they should be a pump capable of cutting and passing any materials encountered by the pumps. These pumps should be similar to those recommended in Improvement Alternative I above. Pump lifting cables and a lift rail system would enable removal of the pumps from the wet well without entry into the wet well.

Plug valves and check valves on the discharge pipes from the pumps would be contained in a separate below grade concrete valve vault. Piping in the valve vault would include by-pass piping with a quick disconnect coupling to facilitate connection of a portable pump if required in an emergency.

The controls would be housed in a stainless steel free-standing enclosure. Control components would include automatic level controller with alternation of the pumps, external alarm light and audible horn, automatic telephone dialer or radio conveyed alarm system, and interlocked utility and emergency power circuit breakers with an external receptacle for connection of a portable emergency power generator.

Both the wet well and valve vault would be constructed with water-tight hatches to flood—proof the structures.

The new pump station could be constructed west of the existing station and septic holding tank and the gravity sewer from manholes A, 40, and 8 could be rerouted to the new wet well. The shallow gravity line (Pipes 73, 74, 75 & 108) could then be abandoned as well as manhole #9.

The **Opinion of Probable Construction Cost** for this improvement alternative is shown in **Table 7.3-II** found in the **Appendix.**

RECOMMENDATIONS:

Immediate Recommendation:

If an immediate solution to the current pump plugging problem is desired, it is recommended that submersible pumps capable of running under a dry-pit condition be obtained (dry-pit submersibles). These types of pumps can be installed in the dry-well of the current lift station and operated as dry-pit pumps. These pumps could then be relocated to the new submersible pump station once it has been constructed and be operated as submersible pumps.

Long Term Recommended Improvement Alternative:

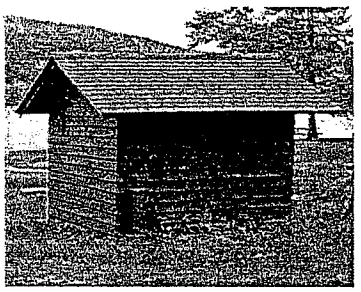
Considering that Improvement Alternative I does not provide complete flood-proofing of the pumping station and that additional service life would be realized with a completely new pumping station, **Improvement Alternative II – New Submersible Pump** Station is recommended for the long term reliability of the North Pump Station.

A portable emergency electrical generator sized to operate the North Shore pumping station be procured to provide emergency operation as required by paragraph NR 110.14(12)(b) of the Wisconsin Administrative Code.

7.4. South Shore Pumping Station Equipment & Conditions

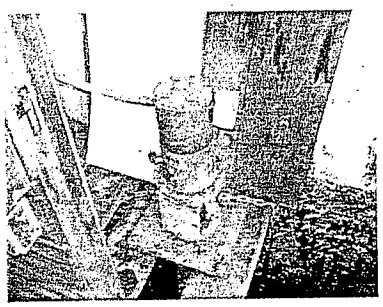
The South Shore Pumping Station is located approximately 100 feet east of the South Shore of Devils Lake and 150 feet northeast of the Red Oak Shelter building. This area, and the pumping station, was inundated with flood water in 2008 and 1993. The location of the South Shore Pumping Station is shown on the **South Shore Sanitary System Map** found in the **Appendix.**

The South Shore Pumping Station is composed of head works, a concrete wet well, a concrete sub-grade dry well housing two dry pit centrifugal pumps. A control room is located above the dry well housing the pump motors and controls. The control room is enclosed in a wood framed structure with wood siding and a shingled roof.



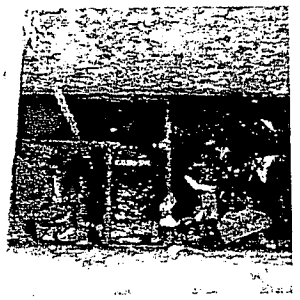
South Shore Wastewater Pumping Station Exterior

The head works of the South Shore Pumping Station are enclosed in a room adjacent to the control room and are 6 feet lower than the floor of the control room. The head works include a comminutor and stationary bypass bar screen above a concrete wet well. The comminutor is operated by a 1/3 hp 230 volt single phase motor manufactured by General Electric. Almost all of the paint on comminutor and motor has peeled away leaving a rusting metal exterior. The function of the comminutor is to grind and shred solids in the wastewater so that they may pass through the pumps. However, a large amount of debris was observed in the head works channel and bypass screen. There is a door frame, without a door, in the wall between the control room and the head works room. No caution sign, as required by Paragraph NR110.14(3)(b)4. of the Wisconsin Administrative Code, near the entrance to the head works room. The ceiling over the head works room, and the adjacent control room, is open to the roof trusses. Since the head works room (and entire structure) is open to the wet well below, hazardous and potentially explosive gases could be present in the head works room. Current code requires the wet well to be completely separated from the control room, common walls to be a gas tight, and a separate exterior entrance for the head works and/or wet well.



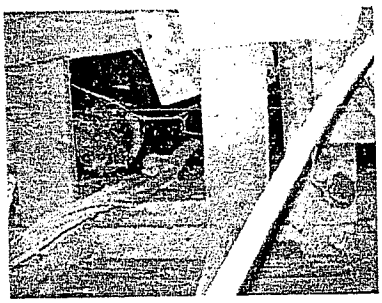
Head Works Room/Comminutor

Head Works

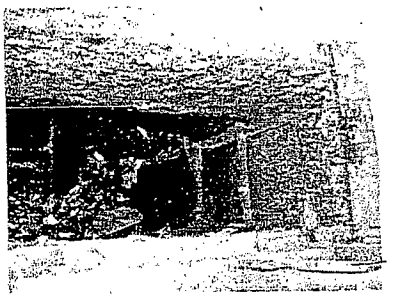


Head Works Comminutor & Bar Screen

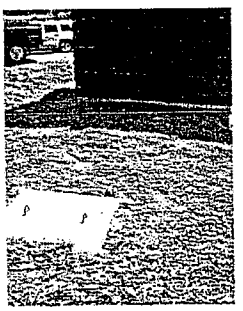
Below the head works is a 20' x 11' x 11' deep concrete wet well. The head works channel, comminutor and bypass screen sit 6 feet below the top of the wet well. Two gravity pipes (Pipe 106 & Pipe 107 on the **South Shore Sanitary System Map** found in the **Appendix)** discharge into the head works channel. One pipe is from the west and one from the east. There is a 4' tall wall in the wet well which vertically aligns with the outside edge of the head works room. This wall separates the part of the wet well below the head works room from the part that is buried outside. Based on sketches provided by Park staff, normal operating pump on liquid level is set at of 3.95' which provides an approximate wet well operating volume of 6,500 gallons. This operating volume provides a detention time in excess of 30 minutes which is the maximum allowed by current code. There is a ventilation fan in the head works room with an intake in the wet well and exhaust duct through the side wall of the head works room. The exposed top portions of the wet well concrete appeared to be pitted and crumbling. There was a deteriorated permanent fixed ladder into the wet well from the head works room which is not currently allowed per Paragraph NR 110.14((3)(b)3. of the Wisconsin Administrative Code. The interior of the wet well beyond the head works room was not observed as it was not dewatered for observation at the time of the site visit. However, based on conditions of the portions of the wet well visible in the head works room, it is reasonable to assume that the rest of the wet well may be of the same deteriorating condition also in need of repair or replacement.



Wetwell (below wood framing)



Wetwell/Access Ladder



Septic Holding Tank/Access Hatch

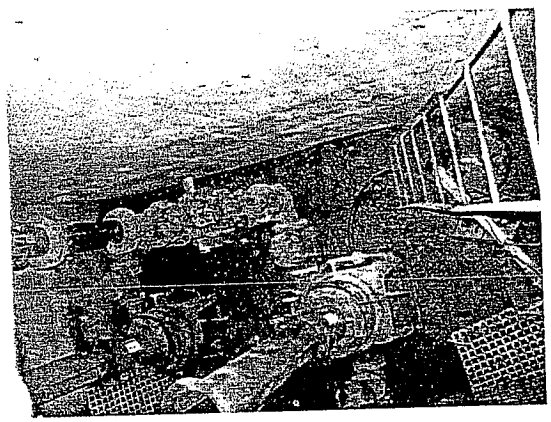
The dry well adjacent to the wet well contains two vertical line shaft driven centrifugal pumps. Per sales records on file at L.W. Allen, the pumps' supplier, the current pumps were sold and installed in 2001. These pumps are 3-inch sewage pumps Model # B5423K-T30 manufactured by Fairbanks-Morse with 3-inch intake and discharge connections. At the time of the sale, the pumps were rated to provide 200 gpm at a total dynamic head of 90 feet with a 10.34-inch diameter, 1-vane impeller. Per LW Allen, these pumps are not capable of passing a 3-inch diameter sphere as required by paragraph NR 110.14(3) (g) of the

Wisconsin Administrative Code. Files at LW Allen did not include record of any repairs or replaced parts since the original sale of the pumps in 2001. The expected service life of sewage pumps is 15 to 20 years. Therefore, the 10 year old pumps are within their expected service life. Based on discussions with park staff and Gary Kowalke of Terrytown Plumbing who frequently unplugs the pumps, the 3-size size of the pumps leads to solids becoming stuck in the passages of the pump causing frequent plugging.

Piping between the wet well, pumps and force main appears to be 4" ductile iron which complies with the minimum pipe diameter (4 inches) required by Paragraph NR110.14 (3)(g) of the Wisconsin Administrative Code. There are shut off valves (plug valves) on the suction piping and shut-off (plug valves) and check valves downstream of each pump. The finish of most of the piping and valves is deteriorated and rust is visible. It appears that the shut-off valves (plug valves) date back to construction of the pump station. However, the check valves were replaced in 2001 by Terrytown Plumbing. Therefore, the check valves are within their 15-20 year service life, while the shut-off (plug) valves are beyond their expected 15-20 year service life.

There is a magnetic flow meter in the vertical pipe connected to the horizontal pump discharge manifold. Per LW Allen sales records, the flow meter was installed in 1987. There are no service records at LW Allen showing the flow meter has been calibrated since it's installation in 1987.

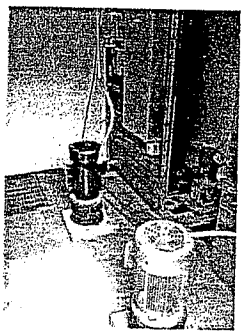
An aluminum ladder is used for access into the dry well, is not secured to the wall, and has one bent side rail. The floor of the dry well was moist, and there appeared to be a thin mat of rust. The dry well is lacking an automatic heater and dehumidifier as required by paragraph NR110.14(3)(d) of the Wisconsin Administrative Code.



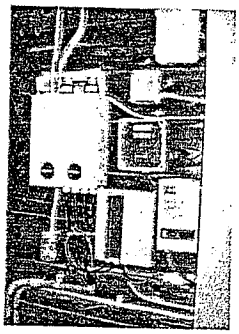
Drywell

The control room houses the motors for the two pumps as well as the controls. Each pump is driven by a 10 hp, 1740 rpm, 208-230/460 volt, 3-phase motor. The motor for Pump 1 was installed in 1983 while the Pump #2 motor was replaced in 1991 and is a high efficiency motor manufactured by Marathon Electric. The motors are each controlled by a variable frequency drive (VFD) which ramps the pump up to full speed when the "on" float switch is activated and then ramps them down to shut off when the "off" float switch is activated. There are "on" and "off" switch and a run time meter for each pump. There is an instantaneous flow digital display along with a totalized flow indicator connected to the flow meter. Although it is an unconventional arrangement to have the pump switches in

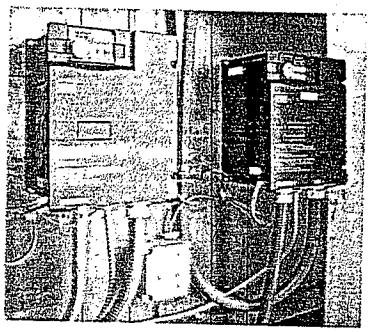
separate boxes instead of one common enclosure, the controls are in good condition. The VFDs and magnetic flow meter are the current preferred technologies for pump control and flow measurement respectively.



Control Room/Pump Motors



Controls



VFDs

7.5. South Shore Pumping Station Capacity

On August 19, 2010, the flow rates, as shown on the flow meter, produced by each pump were observed over the duration of a pumping cycle. Pumping rates will decline over the duration of a pumping cycle as the static lift that the pump must overcome increases as the liquid level in the wet well decreases. Information provided park staff from 1987 when the force main to the City of Baraboo was first installed indicated maximum pumping rates of 301 gpm and 294 gpm for Pump Nos. 1 & 2 respectively. The pumping rates provided by the pumps as observed on 8-19-10 and compared to the 1987 maximums are shown in Table 7.5 below.

Table 7.5 – South Pumping Station Average Pumping Rates

(Per 8-19-2010 & 1987 Flow Meter Observations)

Pump No.	Average Flow Rate (gpm)	Minimum Flow Rate (gpm)	Maximum Flow Rate (gpm)	1987 Maximum Flow Rate (gpm)
1	236	225	250	301
2	280	270	290	294

Comparison of the 1987 maximum flow rates to those observed on August 19, 2010 shows a noticeable decrease in pumping capacity for Pump #1. This decreased pumping capacity may indicate excessive wear has occurred in the pump.

7.6. South Shore Pumping Station Recommended Improvements

Recommended improvements for the South Shore Pumping Station should address the deteriorated and nonfunctioning comminutor and bar screen, lack of gas-tight separation between the head works/wet well and control room as required by Paragraph NR 110.04(3)(b) of the Wisconsin Administrative Code, lack of separate entrance to the wet well

as required by Paragraph NR 110.04(3)(b), deteriorated valves and piping in the dry well, frequent plugging of both pumps, and flood proofing the pumping station as required by NR 116.16 & 116.17.

Immediate Recommendation:

If an immediate solution to the current pump plugging problem is desired, it is recommended that submersible pumps capable of running under a dry-pit condition be obtained (dry-pit submersibles). These types of pumps could be installed in the dry-well of the current lift station and operated as dry-pit pumps. Then they could be relocated to the new submersible pump station once it has been constructed and be operated as submersible pumps.

Long Term Recommendation:

Due to the deteriorated conditions of the equipment and wet well structure, lack of separation between the wet well/head works and control room and frequent past flooding, complete replacement of this pumping station is recommended. This includes demolition of the existing wastewater pumping station and wet well/septic holding tank and replacing them with a new submersible pump station complying with all requirements of Subchapter NR 110.14 of the Wisconsin Administrative Code. The new station would include a circular concrete wet well manhole, a separate adjacent concrete valve vault and a free standing stainless steel control panel.

The wet well would contain two submersible solids handling sewage pumps each capable of pumping at the anticipated peak hourly flow rate. Flow monitoring completed as part of this study indicated a peak flow rate of 175 gpm (See Table 6.3 above). Therefore, it is recommended that the new pumps match the rated capacity of the original pumps (200 gpm @ 90' TDH). Similar to the recommendations made for the North Shore Pumping Station, the pumps would be capable of passing spheres at least 3 inches in diameter per the requirements of NR 110.14(3)(g), or they should be capable of cutting and passing any materials encountered by the pumps. Pump lifting cables and a lift rail system would enable removal of the pumps from the wet well without entry into the wet well.

Plug valves and check valves on the discharge pipes from the pumps would be contained in a separate below grade concrete valve vault. Piping in the valve vault would include by-pass piping with a quick disconnect coupling to facilitate connection of a portable pump if required in an emergency.

The controls would be housed in a stainless steel free-standing enclosure. Control components would include automatic level controller with alternation of the pumps, external alarm light and audible horn, automatic telephone dialer or radio conveyed alarm system, and interlocked utility and emergency power circuit breakers with an external receptacle for connection of a portable emergency power generator.

Both the wet well and valve vault could be constructed with water-tight hatches to flood-proof the structures.

The new pumping station could be constructed approximately 50 feet west of SMH S7 with the station's wet well constructed over Pipe 7 and the valve vault just northeast of the wet well. This location would move the pumping station out of the frequently flooded area.

Pipes 5, 6 and 13 could be reconstructed to drain to the new stations wet well and Pipes 106 and 107 could be abandoned along with Manholes S5, S6 and the existing pumping station.

It is recommended that a portable emergency electrical generator sized to operate the South Shore pumping station be procured to provide emergency operation as required by paragraph NR 110.14(12)(b) of the Wisconsin Administrative Code.

The **Opinion of Probable Construction Cost** for this improvement alternative is shown in **Table 7.6-I** found in the **Appendix.**

8.0 Wastewater Force Main

8.1. Force Main Background

In 1970, the North Shore and South Shore wastewater pumping stations conveyed wastewater through a six-inch ductile iron pipe force main to Sewage Treatment Lagoons east of the South Shore pumping station and north of the railway. The force main piping between the North Shore and the South Shore (approximately 10,200 LF) was placed parallel to the Chicago & Northwestern Railway along the east shore of Devil's Lake. There are many locations were the pipe was buried less than 2 ft and in some places only 6 inches below the ground surface because of dense rock.

In 1986, the Sewage Treatment Lagoons were abandoned, and the force main was reconfigured such that the South Shore pumping station conveys its wastewater toward the North Shore pumping station. In addition, 6" C-900 PVC pipe was installed from the North Shore pumping station to the City of Baraboo wastewater collection system to the north such that the South Shore and North Shore pumping stations convey their wastewater in this common force main to the City of Baraboo collection system.

8.2. Force Main Velocity

Using flow rates from the North Shore and South Shore pumping stations, shown in Table 7.2 and Table 7.5, the force main flow velocities were determined and are shown in Table 8.2.

Table 8.2 – North Pumping Station Average Pumping Rates

Pump No.	Average Velocity (fps)	Minimum Velocity (fps)	Current Maximum Velocity (fps)	1987 Maximum Velocity (fps)
North 1	3.4	1.7	5.0	8.5
North 2	2.3	1.5	3.2	9.2
South 1	2.4	2.3	2.6	3.1
South 2	2.9	2.8	3.0	3.0

Note that the South Shore Pumps pump through