

7. ALTERNATIVE DEVELOPMENT

7.1. Background	1
7.2. Planning Alternative Projects	2
7.3. Master Planning Alternative Development	4
7.3.1. Near-Term Planning Alternatives.....	4
7.3.2. Long-Term Planning Alternatives	8

ALTERNATIVE DEVELOPMENT

Background

The current MMSD model is conveyance of all wastewater to a centralized treatment facility (NSWTP) for treatment with subsequent discharge of the treated effluent to Badfish Creek (75 mgd maximum flow rate) and Badger Mill Creek (3.6 mgd permit-based flow rate). There may be advantages to altering this model by decentralizing treatment through the construction of satellite treatment plants or altering the conveyance system to route wastewater from certain parts of the service area to an existing municipal treatment plant in a nearby community. These advantages could include lower capital costs in the conveyance system and at the NSWTP, reduced operational costs associated with pumping the wastewater and effluent, and environmental benefits realized by returning the effluent closer to the original source of the water.

Implementation of projects to decentralize treatment will take a decade or longer to implement, either because of issues related to the receiving water into which effluent from the satellite plant would be discharged, or due to the length of time it would take to reach agreement with a community with an existing treatment plant. Due to these constraints and the fact that the MMSD has immediate needs to address capacity and condition issues in the conveyance system, there are few near-term decentralization projects that can achieve conveyance system construction cost savings. Projects that address capacity needs of the Nine Springs Valley Interceptor (NSVI) are the exception. Additional capacity in the NSVI will be required in about ten years. This would allow sufficient time to implement a decentralized project in this part of the MMSD's service area. Such a project would have the highest potential to produce capital cost savings in the conveyance system and at the NSWTP where future capacity expansions could be avoided, delayed, or reduced in size. Conveyance capacity needs on the east side of the MMSD are more immediate, and thus decentralized projects in this part of the service area will generally be more costly overall since the opportunity to achieve near-term conveyance system construction cost savings will not be available.

The following key principles were used to develop the projects presented in this chapter:

1. Peak Hourly Flows (PHFs) to Badfish Creek will not exceed the rated 75 mgd of the effluent force main.
2. The growth rate projections for the conveyance system, which include an uncertainty factor to reflect the unknowable location and timing of growth, will be used for determining when loadings to various conveyance components will reach the design capacity.

3. For evaluation purposes, it is assumed that the NSWTP will need to be upgraded to achieve a lower effluent phosphorus concentration in 2020 and a lower total nitrogen effluent concentration in 2030. Also, the solids processing facilities at the NSWTP will require capacity expansion in 2030.
4. Discharge at Badger Mill Creek at a minimum of 3.6 mgd will be maintained for all alternative projects.
5. Average Daily Flows (ADFs) are based on the 2008 MMSD Collection System Evaluation as prepared by CARPC. Peak hourly flows were based on ADF and the Madison Design Curve (MDC).

Projects were developed based on addressing the projected future needs for either the current NSWTP or the existing MMSD conveyance facilities. Projects are presented for the east side of the MMSD system (Service areas for Pumping Stations (PSs) 6, 7, 9, 10, 13, and 14) and the west side of the MMSD system (Service Areas for PSs 1, 2, 3, 4, 5, 8, 11, 12, 15, 16 and 17).

Projects are organized into near-term projects and long-term projects. Near-term projects are those that would address the need for capacity expansion in the conveyance system required in the next ten to twenty years. Long-term projects are those which, while still viable, cannot be implemented prior to the time the collection system capacity improvements would be required. Examples of long-term projects would include those that would discharge highly treated effluent to Lake Mendota or Lake Monona, effluent reuse projects that would be primarily driven by the economic need to reuse water, or turf irrigation projects on a larger scale that would require the development of a distribution network for the highly treated effluent. Details of the master planning alternative development are provided in Appendix G, TM7 – Development of Planning Alternatives.

Planning Alternative Projects

Base on the projected capacity needs for the interceptors and pumping stations on the west side of the MMSD service area, the following 4 alternative projects were identified:

- **Project W1 – Nine Springs Valley Interceptor Relief**
This project includes construction of a new gravity relief sewer paralleling the existing NSVI or construction of a new force main from PS 12 to either PS 11 or the NSWTP. This project will address the capacity deficiency of the existing NSVI during the planning period.
- **Project W2 – Sugar River WWTP**
This project includes construction of a new wastewater treatment plant (WWTP) in the Verona area. The new WWTP would receive wastewater generated in the PS 17 service area and discharge effluent to the Sugar River downstream of its confluence with Badger Mill Creek, or alternatively, to the headwaters of the Sugar River at CTH PD. This project would

eliminate all capacity improvements for the NSVI and PS 12 and PS 11 force mains provided it is constructed prior to 2020.

- **Project W3 – Dual Sugar River Satellite Plants (CTH PD Plant and Nesbitt Road Plant)**
This project would include construction of two new WWTPs in the Verona area and return of effluent to the headwaters of the Sugar River at CTH PD and to Bader Mill Creek at the City of Madison storm water ponds on Nesbitt Road. This project would eliminate all capacity improvements for the NSVI and PS 12 and PS 11 force mains provided it is constructed prior to 2020.
- **Project W4 – Village of Oregon Discharge to PS 11**
This project would include incorporating the Village of Oregon into MMSD’s service area. Flow from the Village of Oregon would be directed to MMSD PS 11 service area and then be pumped to the NSWTP for treatment.

Based on the projected capacity needs for the interceptors and pumping stations on the east side of the MMSD service area and potential expansion of the NSWTP, the following 6 alternative projects were identified:

- **Project E1 – Mendota WWTP**
This project would include construction of a new WWTP north of Lake Mendota near the Yahara River to serve the Yahara River and Six Mile Creek watersheds north of Lake Mendota. Effluent from this plant could provide stream flow augmentation to the Yahara River, be used for infiltration to recharge the groundwater aquifers, or be reused for industry or turf irrigation.
- **Project E2 – Starkweather Creek WWTP**
This project would redirect the gravity flow tributary to PS 13 to a new Starkweather Creek WWTP. Effluent from this plant could provide stream flow augmentation to Starkweather Creek, be used for infiltration to recharge the groundwater aquifers, or be reused by industry or for turf irrigation.
- **Project E3 – PS 13 and PS 14 Service Area WWTP**
This project would redirect the flow tributary to PS 13 and 14 to a new WWTP located northeast of Madison. Effluent from this plant could provide stream flow augmentation to Starkweather Creek, be used for infiltration to recharge the groundwater aquifers, or be reused by industry or for turf irrigation.
- **Project E4 – Stoughton WWTP Expansion**
This project would redirect flow from PS 7 and PS 9 service areas to an expanded Stoughton WWTP. Implementation of this project includes the construction of a parallel treatment plant to treat the wastewater diverted from the MMSD system. Biosolids treatment would be provided by expanding the existing biosolids treatment train at the Stoughton WWTP.
- **Project E5 – Centralized High Quality Effluent Treatment Facilities**

This project would include construction of high quality effluent treatment facilities on the NSWTP property (Refer to Figure 5-2). The high quality effluent could be returned to Badger Mill Creek or other outfalls in the Sugar River watershed, discharged directly to Nine Springs Creek or other surface waters in the Yahara River watershed, used by industry, used for irrigation, used as a water source for infiltration to recharge groundwater, or discharged to maintain wetlands.

- **Project E6 – Sun Prairie WWTP Expansion**

This project would provide sewer service for the portion of the MMSD’s future service area in the Koshkonong Creek watershed by directing flow from this area to the City of Sun Prairie WWTP for treatment.

Master Planning Alternative Development

After the preliminary screening of the identified alternative projects, master planning alternatives, which are combinations of the projects described above, were developed for further evaluation. Those alternatives are classified into two groups: near-term alternatives which could be implemented between 2010 and 2030 and long-term alternatives which could be implemented between 2030 and 2060.

Near-Term Planning Alternatives

Except for Alternative MP-1 (base planning alternative), the following two key principles were incorporated in making the selection of near-term planning alternatives:

- The proposed alternative project must have an implementation date that allows sufficient time for the MMSD to site and construct the alternative project prior to the time necessary to alleviate an existing MMSD capacity need.
- Alternatives must provide sufficient capacity so that any future expansion of the current advanced secondary treatment facilities at the NSWTP beyond the existing 57 mgd capacity will not be required before 2060.

Based on these criteria, two near-term master planning alternatives were selected for further evaluation. Implementation of either of these alternatives between 2010 and 2030 will address the wastewater treatment and conveyance system capacity needs in the MMSD service area:

- **Alternative MP-1 – Westside Conveyance System Expansion:** This alternative would expand the existing conveyance system and continue the current model of centralized treatment at the NSWTP. This alternative includes four variations to pump treated effluent to different receiving water bodies.
- **Alternative MP-2 – Sugar River WWTP:** This alternative would construct a new high quality effluent treatment plant in the Sugar River watershed to treat wastewater generated in the PS 17 service area, and discharge its effluent to the Sugar River. This

alternative includes two variations to discharge treated effluent to different locations of the Sugar River.

The Alternative MP-1 includes the following 4 variations:

- **Alternative MP-1A** – This alternative includes returning 3.6 mgd of effluent from the NSWTP to Badger Mill Creek through the existing outfall in Badger Prairie Park, and returning the rest of the effluent to Badfish Creek. This alternative represents the current operation by MMSD. It serves as the base alternative to be compared to other alternatives.
- **Alternative MP-1B** – This alternative includes returning a total of 7.9 mgd of effluent consisting of 3.6 mgd of regular effluent (effluent generated by the existing processes) and 4.3 mgd of high quality effluent (effluent generated by future high quality effluent processes) from the NSWTP to Badger Mill Creek through the existing outfall in Badger Prairie Park. The rest of the effluent will be returned to Badfish Creek. The regular effluent and the high quality effluent will be blended and pumped to the Badger Mill Creek outfall location through the existing effluent force main. This alternative represents a centralized effluent reuse and watershed balance solution (i.e. it returns water to the watershed from where it was withdrawn).
- **Alternative MP-1C** – This alternative includes returning 7.9 mgd of effluent to the Badger Mill Creek outfall location through the existing force main with 3.6 mgd being discharged to Badger Mill Creek directly and 4.3 mgd being discharged downstream of the confluence of Badger Mill Creek and Sugar River through a new pumping station and a new force main at the vicinity of the existing Badger Mill Creek outfall. The rest of the effluent from the NSWTP will be returned to Badfish Creek. The regular effluent and the high quality effluent will be blended and pumped to the Badger Mill Creek outfall location through the existing effluent force main. This alternative represents a centralized effluent reuse and watershed balance solution. It could achieve similar effluent reuse and watershed balance benefits as the decentralized alternative (MP-2A) discussed later.
- **Alternative MP-1D** – This alternative includes returning 7.9 mgd of effluent to the Badger Mill Creek outfall location through the existing force main with 3.6 mgd being discharged to Badger Mill Creek directly and 4.3 mgd being discharged to the Sugar River at the County Highway PD (CTH PD) through a new effluent pumping station and a new force main in the vicinity of the existing Badger Mill Creek outfall. The rest of the effluent will be returned to Badfish Creek. The regular effluent and the high quality effluent will be blended and pumped to the Badger Mill Creek outfall location through the existing effluent force main. This alternative represents a centralized effluent reuse and watershed balance solution. It could achieve similar effluent reuse and watershed balance benefits as the decentralized alternative (MP-2B) discussed later.

For alternatives MP-1B, 1C, and 1D, 7.9 mgd of effluent needs to be pumped to the existing Badger Mill Creek outfall. Preliminary analysis shows that the existing 20" force main has sufficient capacity for the increased flow, but new pumps would be needed. The layouts of these alternatives are shown in Figures 7-1 through 7-4. The major component projects included in these alternatives are presented in Table 7-1.

Table 7-1 Component Projects of Master Planning Alternative MP-1

Facility Name	Component Project	MP-1A	MP-1B	MP-1C	MP-1D
PS11	Condition improvement and firm pumping capacity expansion. The cost for this improvement is already budgeted and included in the scheduled PS 11 condition improvement project.	Yes	Yes	Yes	Yes
PS11	Install a new 36" diameter force main parallel to the existing force main.	Yes	Yes	Yes	Yes
PS12	Condition improvement and firm pumping capacity expansion. The cost for this improvement is already budgeted and included in the scheduled PS 12 condition improvement project.	Yes	Yes	Yes	Yes
PS17	Firm pumping capacity expansion to average daily flow of 4.37 mgd and peak flow of 13.6 mgd.	Yes	Yes	Yes	Yes
PS17	Force main expansion	Yes	Yes	Yes	Yes
NSVI	Expand capacity of interceptor section from PS11 to PS12.	Yes	Yes	Yes	Yes
NSVI	Expand capacity of section upstream of PS12.	Yes	Yes	Yes	Yes
NSVI	Relining the entire length of the NSVI	Yes	Yes	Yes	Yes
Badger Mill Creek Effluent Pumps	Expand the current average effluent pumping capacity to 7.9 mgd.	No	Yes	Yes	Yes
Sugar River Effluent Pumping Station	Construction of a new pumping station at the vicinity of the Badger Mill Creek outfall with an average capacity of 4.3 mgd.	No	No	Yes	Yes
Sugar River Force Main	Construction of a new force main for the new effluent pumping station to downstream of confluence of Badger Mill Creek and Sugar River.	No	No	Yes	No
Sugar River Headwaters Force Main	Construction of a new force main for the new effluent pumping station to the Sugar River headwaters near CTH PD.	No	No	No	Yes
High Quality Effluent Treatment facility at the NSWTP	Construction of a new high quality effluent treatment facility at the NSWTP with capacities of 4.3 mgd (DAF) and 13.7 mgd (DMF). The facility would include processes for effluent polishing to meet the 5 mg/L limit for BOD ₅ and TSS. The facility would also be designed to meet a potential 0.075 mg/L TP limit and a 3 mg/L Total N limit.	No	Yes	Yes	Yes

The Alternative MP-2 is based on pumping all of the wastewater flows generated within the service area of PS 17 to a new satellite treatment plant in the Sugar River watershed for treatment. This alternative includes the following two variations:

- **Alternative MP-2A** – Construction of a new advanced secondary wastewater treatment plant by 2020 with discharge to the main branch of the Sugar River downstream of the confluence with Badger Mill Creek. Average day flows in 2060 will be 4.3 mgd.
- **Alternative MP-2B** – Construction of a new advanced secondary wastewater treatment plant by 2020 with discharges to the main branch of the Sugar River downstream of the confluence with Badger Mill Creek and to the headwaters of Sugar River near CTH PD

northwest of Verona. Average daily flows in 2060 will be 2.5 mgd and 1.8 mgd, respectively, at these two locations.

For both of these planning alternative variations, 3.6 mgd of treated effluent would continue to be pumped from the NSWTP to Badger Mill Creek. Layouts for each of these alternatives are shown in Figure 7-5 and 7-6. The major component projects for these two alternatives are listed in Table 7-2.

Table 7-2 Component Projects of Master Planning Alternative MP-2

Facility Name	Component Project	MP-2A	MP-2B
Sugar River WWTP	Construction of a new Sugar River WWTP with capacities of 4.3 mgd (DAF), and 13.7 mgd (DMF). Facility would include processes for effluent polishing to meet the 5 mg/L limit for BOD ₅ and TSS. Facility would also be designed to meet a potential 0.075 mg/L TP limit and a 3 mg/L Total N limit.	Yes	Yes
PS17	Firm pumping capacity expansion to average daily flow of 4.37 mgd and peak flow of 13.6 mgd.	Yes	Yes
PS17	Force main from PS 17 to Sugar River WWTP	Yes	Yes
Effluent Pumping Station	Construction of a effluent pumping station to pump flow to the headwaters of the Sugar River near CTH PD	No	Yes
Effluent Force Main	Construction of an effluent force main to convey flow to the headwaters of the Sugar River near CTH PD	No	Yes
PS11	Pumping station condition improvement. The cost for this improvement is already budgeted and included in the scheduled PS 11 condition improvement project.	Yes	Yes
PS12	Pumping station condition improvement. The cost for this improvement is already budgeted and included in the scheduled PS 12 condition improvement project.	Yes	Yes
NSVI	Relining the entire length of the NSVI	Yes	Yes

For Alternatives MP-2A and MP-2B, two options are available for biosolids disposal. First, the waste biosolids can be hauled to the NSWTP for anaerobic digestion and then used for land application or other utilization. Second, onsite anaerobic digestion and 180 days of biosolids storage can be constructed at the new Sugar River plant. The biosolids can be used for land application in the vicinity of the plant site.

Long-Term Planning Alternatives

Long-term alternatives are those planning alternatives that cannot be implemented soon enough to provide relief in the conveyance system; however, they remain potentially viable options beyond the year 2030 for mitigating inter-basin transfers of water, or providing high quality effluent for reuse options. Due to growing demands on available groundwater supplies and the long-term goal of stabilizing the groundwater aquifer operating level in the Dane County area, high quality effluent utilization could be a promising way to solve these issues in the future, especially if population growth occurs as expected. The following two long-term alternatives emphasizing effluent reuse were selected for further evaluation. These two alternatives have

potential to be implemented after 2030 and provide high quality effluent to various locations for reuse options and to mitigate inter-basin transfer of water.

- **Alternative MP-3 – Centralized High Quality Effluent Treatment & Distribution:**

This alternative would include construction of facilities at the NSWTP that would produce a high quality effluent for use in various applications, including stream flow augmentation, infiltration, industrial reuse, or turf irrigation. It also includes a new effluent pumping station and effluent force main to convey the effluent from Nine Springs to a point of use near PS 13.

- **Alternative MP-4 – Decentralized High Quality Effluent Treatment Facilities:**

This alternative would include construction of facilities northeast of the Dane County Regional Airport. The new treatment plant would receive wastewater flows tributary to PS13 or both PS13 and PS14. Effluent from this facility could be used for stream flow augmentation to Starkweather Creek, wetland restoration at Cherokee Marsh, groundwater infiltration, industrial reuse water or turf irrigation.

Due to the long planning horizon, specific effluent reuse projects cannot be clearly defined at this stage. However, the MMSD would like to take a proactive approach to study the potential economic, technical and environmental factors that may impact implementation of future effluent reuse programs. To facilitate the study, high quality effluent facilities with capacities of 4 mgd and 10 mgd, representing both small and medium sized effluent reuse programs, were chosen for this evaluation. The PS13 service area was selected as the location for the reuse facility. Potential reuse applications could include industrial reuse, stream flow augmentation, turf irrigation, and groundwater infiltration. Layouts for the reuse facilities are shown in Figure 7-7 and 7-8.

Alternative MP-3 would include construction of high quality effluent treatment facilities with a capacity of either 4 mgd (Alternative MP-3A) or 10 mgd (Alternative MP-3B). Alternative MP-3A is directly comparable to Alternative MP-4A, and Alternative MP-3B is directly comparable to Alternative MP-4B.

Planning alternatives MP-3A and MP-3B would include the additional treatment facilities at the NSWTP to produce high quality effluent as well as the pumping facilities to return the high quality effluent to the PS 13 site northeast of the Dane County Regional Airport. Actual implementation of effluent reuse may not require water quality as stringent as would be produced by a high quality effluent facility if the end use water quality requirements are lower, or if the end user provides additional treatment that would meet their specific needs and comply with Wisconsin Administrative Code requirements. The component projects included in this alternative are listed in Table 7-3.

Table 7-3 Component Projects of Master Planning Alternative MP-3

Facility Name	Component Project
High Quality Effluent Treatment Facilities at NSWTP	Construction of new high quality effluent facilities with capacity of either 4 mgd (Alternative MP-3A) or 10 mgd (Alternative MP-3B) at the NSWTP. Facilities would include processes for effluent polishing to meet the 5 mg/L limit for BOD ₅ and TSS. Facility would also be designed to meet a potential 0.075 mg/L TP limit and a 3 mg/L Total N. The level of treatment will be further determined after the treated effluent utilizations become better defined in the future.
Effluent Return Pumping Station	Construction of a new pumping station at the NSWTP to return high quality effluent to PS 13 area.
Effluent Return Force Main	Construction of a new force main to return high quality effluent to PS 13 area.

Alternative MP-4 includes construction of stand-alone high quality effluent treatment plant with a capacity of either 4 mgd (Alternative MP-4A) or 10 mgd (Alternative MP-4B). Alternative MP-4A is directly comparable to Alternative MP-3A, and Alternative MP-4B is directly comparable to Alternative MP-3B. Actual implementation of effluent reuse may not require water quality as stringent as would be produced by a high quality effluent facility if the end use would not require such a high quality or if the end user would provide additional treatment that would meet their specific needs and comply with Wisconsin Administrative Code requirements. The component projects included in this alternative are listed in Table 7-4.

Table 7-4 Component Projects of Master Planning Alternative MP-4

Facility Name	Component Project
Starkweather Creek WWTP	Construction of a new high quality effluent treatment plant with a capacity of 4 mgd. The plant would include processes for effluent polishing to meet the 5 mg/L limit for BOD ₅ and TSS. Facility would also be designed to meet a potential 0.075 mg/L TP limit and a 3 mg/L Total N limit.
PS13 and PS14 Service Area WWTP	Construction of a new high quality effluent treatment plant with a capacity of 10 mgd. The plant would include processes for effluent polishing to meet the 5 mg/L limit for BOD ₅ and TSS. Facility would also be designed to meet a potential 0.075 mg/L TP limit and a 3 mg/L Total N limit.

To determine the optimum near-term and long-term planning alternative(s) to be implemented during the 50 year planning period, these alternatives were evaluated and ranked with the ranking criteria developed in the following chapter.