



Technical Memorandum No.5

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To: Madison Metropolitan Sewerage District
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1.01 TECHNICAL MEMO OVERVIEW

This Technical Memo reviews existing and foreseeable future regulatory issues potentially affecting Madison Metropolitan Sewerage District's (MMSD's) planning and operations in the next 50 years. This review is conducted for various potential alternatives, such as continued treatment at a single Nine Springs Wastewater Treatment Plant (NSWTP), or potential new facilities north of Lake Mendota (Mendota Plant) and/or on the Sugar River near Verona. Potential treatment at NSWTP with discharge to Lake Waubesa or an increased discharge to Badger Mill Creek and treatment of some MMSD wastewater flows at the Sun Prairie or Stoughton Wastewater Treatment Plants (WWTPs) are also reviewed. A meeting to discuss relevant water quality and regulatory issues was held with the Wisconsin Department of Natural Resources (DNR), Capital Area Regional Planning Commission (CARPC), Dane County, and others on December 7, 2007. Information from that meeting forms the basis for much of this memo.

1.02 SURFACE WATER REGULATIONS POTENTIALLY IMPACTING ALL ALTERNATIVES

Current rules affecting effluent limitations for a discharge to surface waters are contained in Wisconsin Administrative Code Chapters NR 102, NR 104, NR 105, NR 106, NR 207, NR 210, and NR 217. Additional regulatory or quasi-regulatory initiatives at the local, state, or federal levels (e.g., DNR listing of impaired waters) could impact surface water discharge. Issues of particular importance relative to alternatives being considered in the Master Planning process are summarized below.

1. Phosphorus (P) criteria: The District's Wisconsin Pollutant Discharge Elimination System (WPDES) permit currently contains an effluent limit of 1.5 mg/L to comply with requirements specified in NR 217. The DNR is undertaking a new regulatory initiative that could lead to the establishment of P water quality criteria through revisions to NR 102 and 106. Proposed limits for rivers and streams range from 0.075 to 0.105 mg/L. Proposed limits for reservoirs and lakes (excluding the Great Lakes) range from 0.015 to 0.04 mg/L. These requirements could result in MMSD needing to further reduce effluent P levels and/or offset P loads through a watershed-based trading program. MMSD is a

member of the DNR's technical advisory committee developing the P criteria and companion implementation language. The DNR currently anticipates that revisions to NR 102 and 106 will be complete by mid-2009.

2. Total nitrogen (TN) criteria: The DNR does not currently have a schedule for TN criteria development. However, the United States Environmental Protection Agency (EPA) is interested in states developing these criteria soon. It is anticipated that these criteria may be developed by around 2010 or 2011. If developed, TN criteria would likely be promulgated under NR 102 and 106 and may result in MMSD needing to provide an additional level of treatment and/or offset TN loads through a watershed-based trading program.
3. P and TN effluent standards: The Natural Resources Defense Council (NRDC) has petitioned the EPA to revise the definition of secondary treatment to include nutrient removal. The NRDC has recommended effluent standards on the order of 0.3 mg/L for total P and 3 mg/L for TN. The future of this initiative is unclear.
4. Chlorides: Chlorides are currently addressed in NR 106: Chloride concentrations in MMSD effluent continue to increase primarily because of the use of in-home water softeners. MMSD does not yet have a numeric effluent limit for chloride in its WPDES discharge permit, although future requirements are likely. These requirements could take multiple forms, including the establishment of an interim limit, a target value, and the requirement to establish a source reduction program. MMSD currently provides public education regarding optimizing water softener salt usage.
5. Mercury and other metals: Mercury and other toxics are currently addressed in NR 105, with additional requirements for mercury in NR 106. MMSD does not currently have a mercury limit in its WPDES permit. However, consistent with the mercury variance language in NR 106, MMSD has developed a mercury minimization program. In addition, mercury sampling of effluent is required. A 1.3 mg/L limit for mercury may be included in a future WPDES permit, pending EPA requirements. MMSD's WPDES permit does not include limits for other metals, and none are anticipated in the near future. However, effluent monitoring is required for several metals, including cadmium, chromium, copper, lead, nickel, and zinc.
6. Thermal standards: The DNR has issued draft revisions to NR 102 and NR 106 regarding temperature impacts from certain point source dischargers including WWTPs. The DNR accepted public comments on the draft rules in February 2008 and is now developing its response to the comments. These rules may become final in late 2008. As currently written, the draft rules allow an existing WWTP to apply for a variance if they have a continued or increased discharge to an existing outfall. Therefore, the rules should not affect the NSWTP Badfish Creek or Badger Mill Creek outfalls as long as MMSD applies for the variance. New discharge locations may need to comply with the standards, however, and this could require installation of heat exchangers, cooling towers, or other facilities.

7. **Microconstituents:** Microconstituents are gaining attention across the country because of their potential negative impact on aquatic and other communities. This may eventually result in promulgation of new or more restrictive effluent limits requiring additional monitoring and perhaps additional treatment. There is no Wisconsin rulemaking process underway yet, but NR 105 secondary value language could be used to regulate pollutants that are demonstrated to cause harm.
8. **Water quality assessment and impaired waters listing:** Impaired waters are those waters that are not meeting state water quality standards as defined by Section 303(d) of the federal Clean Water Act. Every two years, the DNR is required to submit a list of impaired waters to EPA for approval. Waters on the 303(d) list are given high priority for regulatory action, which could include development and implementation of total maximum daily loads (TMDLs) to address the cause of impairment. Information from the DNR's 2006 and draft 2008 assessment document and list of impaired waters (303(d)) for Badfish Creek is included in Table 1.03-1. As additional water quality criteria (WQC) are developed, the pollutants of concern for which local water bodies are listed may increase; for example, P may be added to the list of potential causes of impairment for additional water bodies in the 2010 303(d) list. In this case, additional TMDLs could eventually be developed by the DNR, or other DNR-approved studies and measures could be taken to address the impairments.
9. **Water balance issues:** Water balance issues will receive increased attention, with the expected drivers occurring at the local or regional level. For example, water balance and the impacts of groundwater pumping are discussed in the *Dane County Groundwater Protection Plan*, prepared by the Dane County Regional Planning Commission (DCRPC; 1999). An increased discharge to Badfish Creek will exacerbate existing issues related to groundwater table decline and surface water base flows in the greater Madison area, unless other measures are taken to offset the increased discharge. The groundwater table decline and effluent diversion currently reduce base flows in some area rivers and streams. It also impacts area springs and wetlands. Impacts are becoming apparent in the Rock River and Sugar River Basins. Some City of Middleton officials have expressed concern that groundwater pumping will begin to impact base flows in Black Earth Creek in the Wisconsin River Basin if current trends continue. Offset measures could include discharge of effluent to appropriate locations in the affected watersheds, water conservation, reduced groundwater pumping, increased stormwater infiltration, or other means to replace water discharged to Badfish Creek via the NSWTP. These latter measures would traditionally be led by area municipal water supply and stormwater agencies; however, a cooperative approach among multiple agencies including MMSD has been suggested by the DNR and Dane County. Additional detailed information about this issue can be found in various publications including the *Dane County Groundwater Protection Plan*, 1999, and the MGE publication titled *MGE-UW West Campus Cogeneration Facility—Final Environmental Impact Statement*, June 2003.

1.03 SURFACE WATER REGULATIONS IMPACTING NSWTP ALTERNATIVES

A. NSWTP Continued Discharge to Badfish Creek

A summary of the DNR's listing and assessment information is shown in Table 1.03-1, and potential effluent limits related to a continued discharge to Badfish Creek are summarized in Table 1.03-2. Potential future issues besides those noted previously are summarized below.

1. Rock River Basin P and sediment TMDL: The TMDL is being developed by consultants under contract with the EPA. The draft TMDL report is scheduled to be issued for public comment late 2008 or early 2009. It appears MMSD will have a waste load allocation (WLA) for total P as a result of this TMDL. The magnitude of the WLA will be dependent upon other sources of P loading in Badfish Creek, lower Yahara River, and Rock River and will also depend on the method(s) used by the EPA to allocate the TMDL between point and nonpoint sources. At this time, since Badfish Creek itself is not listed as impaired because of P, we expect that MMSD's WLA will be set assuming a NSWTP design average flow of 50 million gallons per day (mgd) and a target P concentration in the Yahara River around 0.1 to 0.125 mg/L. The EPA will also look at other sources of P in the Yahara and Rock Rivers when determining the WLA. It is anticipated that the DNR will develop a companion Implementation Plan after the TMDL report becomes final, and it appears likely the DNR will involve MMSD and other stakeholders in its preparation. Among other things, the Implementation Plan may be used to further refine allocations [WLAs and load allocations (LAs)], schedules, and methods for incorporating WLA-related effluent limits into permits.
2. P criteria: The proposed P criteria for Badfish Creek is currently 0.075 mg/L. It appears the Yahara River P WQC downstream of the confluence of Badfish Creek will be around 0.1 mg/L. Depending on the background concentration of P in Badfish Creek (i.e., from groundwater or other sources of dilution water), some dilution may be allowed when determining the associated water quality-based effluent limit (WQBEL) for P.

B. NSWTP with Increased Discharge to Badger Mill Creek

The MMSD is presently permitted to discharge up to 3.6 mgd to Badger Mill Creek and may consider alternatives that increase this discharge. Badger Mill Creek is a tributary to the Sugar River. The Sugar River has been designated an exceptional resource water (ERW). Water quality assessment and listing information for Badger Mill Creek and downstream Sugar River are shown in Table 1.03-1. Current WPDES permit limits for MMSD's discharge to Badger Mill Creek are summarized in Table 1.03-2; however, for an increased discharge, the effluent limits could be impacted by the more stringent rules related to the Sugar River. The initiatives listed for surface water discharges (Section 1.02 A) would apply to an increased discharge to Badger Mill Creek, as would the following.

1. P criteria: The current draft administrative code language for P criteria would result in a P WQC around 0.075 mg/L for Badger Mill Creek. Depending on background concentrations, some dilution may be allowed when determining the WQBEL for P.

However, the P concentration for an increased discharge at this location may be limited further because of the downstream Sugar River ERW designation.

2. DNR interpretation of antidegradation requirements: Antidegradation rules are contained in NR 207. Since the Sugar River is an ERW, it is subject to more stringent antidegradation requirements. In general, a new discharge to an ERW needs to meet upstream water quality. Regulations are not as stringent for an increased existing discharge; however, the permittee would still need to demonstrate there will either be no significant lowering of water quality or that the project has sociological and economic benefits. Because of this, MMSD may need to perform modeling, stream studies, or other analysis to demonstrate that an increased discharge to Badger Mill Creek will not result in significant lowering of water quality in the Sugar River or that the project is otherwise justified. Such demonstration may be particularly important for effluent parameters like ammonia, chloride, and P.
3. Water balance issues: This discharge location would help offset some of the water balance issues caused by the pumping of water supply wells located in west Madison and Verona. It will help maintain base flows in Badger Mill Creek and the Sugar River.

C. NSWTP with Discharge to Lake Waubesa via Nine Springs Creek

One alternative that MMSD may consider is discharge of highly treated effluent to Nine Springs Creek or wetlands tributary to Mud Lake and Lake Waubesa. MMSD is presently allowed to discharge to Nine Springs Creek on an emergency basis only and has only done so on rare occasions when the capacity of effluent pumps and on-site storage structures is exceeded. Water quality assessment and listing information for Nine Springs Creek and Lake Waubesa are shown in Table 1.03-1. Current potential effluent limitations for a discharge to Nine Springs Creek are also summarized in Table 1.03-2; however, the effluent limits would likely be most impacted by the more stringent statutes related to Lake Waubesa. In addition to those noted in Section 1.02, a discharge to Lake Waubesa would be affected by the issues summarized below.

1. Thermal standards: If this discharge location is construed as an existing outfall for MMSD, it is possible that it would be eligible for a variance to the proposed thermal standards outlined in draft revisions to NR 102 and NR 106. Otherwise, some mitigation of effluent temperature may need to be included for a discharge at this location.
2. P criteria: The current draft administrative code language for P criteria would result in a P WQC around 0.040 mg/L for shallow lakes like Lake Waubesa. Depending on the background concentration of P in the lake, some dilution may be allowed when determining the WQBEL for P.
3. DNR interpretation of requirements in Wisconsin State Statute 281.47: This statute was the driver for MMSD diverting effluent around the Madison lakes beginning in the late 1950s. The statute does not explicitly prohibit direct discharge of effluent to the chain of lakes including Lake Waubesa, but it does place conditions that must be met for direct discharges to occur. The DNR is given authority to determine whether these conditions

are met. Based on DNR discussions during Madison Gas and Electric's (MGE's) cogeneration facility planning, it appears the effluent quality would need to be close to background surface water quality for P prior to approval of a Lake Waubesa discharge. Background concentrations may be close to the 0.040 mg/L proposed shallow lake criteria.

4. Water balance issues: This discharge location would help offset some of the water balance impacts of the discharge to Badfish Creek. Specifically, it would increase dry weather base flows in the Yahara River south of Lake Waubesa.

In summary, implementation of a potential discharge at this general location will depend on addressing the following issues:

1. Public acceptance of a discharge to Lake Waubesa, Lake Kegonsa, and the Yahara River upstream of Stoughton.
2. DNR approval of the discharge based on requirements in the Wisconsin State Statutes.
3. Technical and economic feasibility of constructing additional facilities that will meet proposed P and N standards for a lake discharge.

1.04 SURFACE WATER REGULATIONS IMPACTING SATELLITE WWTP ALTERNATIVES

The satellite wastewater treatment plant (WWTP) concept could include one of the following approaches:

1. Full treatment of all flows generated in a particular area at a satellite WWTP: This could include expansion of an existing WWTP or construction of new WWTPs.
2. Full treatment of dry weather flows generated in a particular area at a satellite WWTP: Peak wet weather flows could be diverted from smaller treatment plants and treated at the NSWTP.
3. Use of "cluster" WWTP systems providing full treatment of wastewater from smaller or remote subdivisions: Examples would include a community mound-type septic system or small package aeration system. Such systems could potentially be owned and/or operated by MMSD.

For any of these approaches, administration, laboratory, and biosolids management services could continue to take place at MMSD's main NSWTP, assuming this is most cost-effective. Surface water regulations affecting such WWTPs are described below. Satellite WWTPs could also have a discharge to the groundwater; the associated regulations are discussed in Section 1.05.

A. Mendota Plant (Upper Lake Mendota Watershed Discharge)

MMSD may consider constructing a satellite WWTP with discharge of highly treated effluent to the upper Yahara River or wetlands tributary to Lake Mendota. Water quality assessment and listing

information for this segment of the Yahara River and Lake Mendota are shown in Table 1.03-1. Anticipated effluent limitations for a discharge in this location are also summarized in Table 1.03-2; however, the effluent limits would likely be subject to the more stringent state statutes related to Lake Mendota.

Many of the initiatives listed in Section 1.02, as well as those listed for a Lake Waubesa discharge (1.03 C) would apply to a discharge to Lake Mendota. According to the current draft rules, a new discharge at this location would probably not be eligible for a variance according to NR 102 and NR 106 thermal standards. In addition, a discharge to Lake Mendota would be affected by the issues summarized below.

1. P criteria: The current draft administrative code language for P criteria would result in a P WQC around 0.015 mg/L for Lake Mendota. Depending on the background concentration of P in the lake, some dilution may be allowed when determining the WQBEL for P. The DNR has noted that a TMDL-like approach could be required before setting WLAs, LAs, and WQBELs for a Lake Mendota discharge so that load and wasteload allocations can be assigned to all the sources of P to the lake.
2. Water balance issues: This discharge location would help offset some of the water balance impacts of the existing NSWTP discharge to Badfish Creek. Specifically, it would increase dry weather base flows through the Madison Lakes and in the Yahara River.

In summary, implementation of a potential Mendota plant will depend on addressing the following issues:

1. Public acceptance of a discharge to Lake Mendota and other lakes and Yahara River segments upstream of Stoughton.
2. DNR approval of the facility based on requirements in the Wisconsin State Statutes.
3. Technical and economic feasibility of constructing a facility that will meet proposed P and N standards for a lake discharge.
4. Technical and economic feasibility of constructing a facility that will meet proposed thermal discharge standards.

B. Sugar River Plant (Sugar River Watershed Discharge)

MMSD is considering construction of a satellite WWTP with discharge of highly treated effluent to the Sugar River or its tributaries.

Water quality assessment and listing information for the Sugar River are shown in Table 1.03-1. Anticipated effluent limitations for a discharge directly to or impacting the Sugar River are summarized in Table 1.03-2. The initiatives listed in Section 1.02 would apply to a discharge to the Sugar River. An increased discharge to one of the Sugar River tributaries, Badger Mill Creek, was discussed in Section 1.03 B, and the requirements would be similar for other Sugar River tributaries with the exception that any new discharge (as opposed to an increased Badger Mill Creek discharge) would be subject to

additional requirements. For example, it is likely that it would not be eligible for a variance according to the draft revisions to NR 102 and NR 106 for thermal standards. In addition, a discharge to the Sugar River would be affected by the issues summarized below.

1. P criteria: The current draft administrative code language for P criteria would result in a P WQC around 0.075 mg/L for the Sugar River; however, antidegradation requirements contained in NR 207 would also apply. For an Exceptional Resource Water (ERW), this essentially means the new discharge would need to meet background water quality. For example, if the background P concentration in the Sugar River is 0.050 mg/L, the effluent limit could be 0.05 mg/L.
2. Chlorides: Since the Sugar River is designated an ERW, it is possible the chloride concentrations in the discharge would need to meet background concentrations in accordance with NR 207. The DNR has expressed some willingness to discuss this issue further with the MMSD, particularly if there is a net environmental benefit associated with the discharge such as restoration of water balance or other benefits.
3. Ammonia, biochemical oxygen demand (BOD), and other limits: It is possible that the effluent limit for ammonia, BOD, total suspended solids (TSS), and other parameters may need to be equal to background concentrations of these parameters because of the ERW designation for the Sugar River. The DNR Guidance on the "13 pound rule" contains calculations related to assimilative capacity and may impact BOD limits for non-variance streams; this guideline may apply if the background concentration does not.
4. Water balance issues: This discharge location would be used to offset groundwater withdrawals from the Sugar River Basin, as is currently being done with the Badger Mill Creek discharge.

In summary, implementation of a potential Sugar River plant will depend on addressing the following issues:

1. Public acceptance of a new or increased Sugar River discharge.
2. Technical and economic feasibility of constructing a facility that will meet proposed P and N standards for a discharge to the Sugar River, which is an ERW.
3. Technical and economic feasibility of constructing a facility that will meet proposed thermal discharge standards for a Class II trout stream that is an ERW.
4. Technical and economic feasibility of constructing a facility that will meet potential effluent chloride and other limitations based on a new or increased discharge to an ERW.

C. Sun Prairie WWTP (Koshkonong Creek Discharge)

Another alternative MMSD may consider is a cooperative agreement with Sun Prairie to treat a portion of MMSD's wastewater flow. This would result in an increased discharge to Koshkonong Creek. Water quality assessment and impairment listings for Koshkonong Creek and downstream Lake Koshkonong

are shown in Table 1.03-1. Sun Prairie is presently permitted to discharge. Current WPDES permit limits for Sun Prairie's discharge are also summarized in Table 1.03-2. The initiatives listed in Section 1.02 would generally apply to an increased discharge to Koshkonong Creek. Since this discharge location is an existing outfall for Sun Prairie, it is likely that it would be eligible for a variance to the proposed thermal standards outlined in draft revisions to NR 102 and NR 106. In addition, an increased discharge to Koshkonong Creek may be affected by the issues summarized below.

1. P criteria: The current draft administrative code language for P criteria would result in a P WQC around 0.075 mg/L for Koshkonong Creek and 0.040 mg/L for Lake Koshkonong. Depending on background P concentrations, some dilution may be allowed when determining the WQBEL for P.
2. Water balance issues: Currently, flow is being diverted from the Yahara River Basin to the Koshkonong Creek Basin because of discharges from the Sun Prairie treatment plant. If future growth in MMSD in the Koshkonong Creek Basin results in the net diversion going to the Yahara River Basin, this discharge location would help offset some of the water balance impacts. Specifically, it would increase dry weather base flows in Koshkonong Creek.

A potential option for the Sun Prairie WWTP would be the return of highly treated effluent from the Sun Prairie WWTP to Token Creek to provide base flows lost in Token Creek because of areas in the Sun Prairie urban service area (USA) that are located in this watershed. This return could be done either directly or through wetlands as a method of restoring the wetlands base flow lost through groundwater depletion as a result of water supply withdrawals for Sun Prairie.

Use of a portion of the capacity of the Sun Prairie WWTP or the implementation of construction of a high quality effluent facility at the Sun Prairie WWTP will depend on addressing the following issues:

1. Intergovernmental cooperation between the City of Sun Prairie and MMSD.
2. Public acceptance of an increased Koshkonong discharge.
3. Technical and economic feasibility of constructing a facility that will meet proposed P and N standards for a discharge to Koshkonong Creek or Token Creek.
4. Technical and economic feasibility of constructing a facility that will meet proposed thermal discharge standards for Koshkonong Creek or Token Creek, which is an ERW of the State of Wisconsin.
5. Technical and economic feasibility of constructing a facility that will meet potential effluent chlorides limitations based on a new discharge to Token Creek, an ERW, or increased discharge to Koshkonong Creek.

D. Stoughton WWTP (Lower Yahara River Discharge)

Another alternative MMSD may consider is a cooperative agreement with Stoughton to treat a portion of MMSD's wastewater flow. This would result in an increased discharge to the Yahara River at

Stoughton. Stoughton is presently permitted to discharge up to 1.65 mgd design average flow at this location and may soon begin facilities planning to increase the design average flow to about 2.35 mgd. Water quality assessment and impairment listings for the Yahara River are shown in Table 1.03-1. Current WPDES permit limits for Stoughton's discharge to the Yahara River are summarized in Table 1.03-2. If the WWTP is expanded, it is anticipated that Stoughton will have more stringent limits for weekly average summer BOD and TSS and more stringent ammonia limits. The initiatives listed in Section 1.02 would apply to an increased discharge to the Yahara River. Since this discharge location is an existing outfall for Stoughton, it is likely that it would be eligible for a variance to the proposed thermal standards outlined in draft revisions to NR 102 and NR 106.

An increased discharge at this location would provide less relief from the water balance issues in the Yahara River, since the water balance concerns in the Yahara River system are greater upstream of Stoughton's discharge point.

Constructing new capacity at the Stoughton WWTP or construction of a new facility to treat both MMSD and Stoughton wastewater near Stoughton will depend on addressing the following issues:

1. Intergovernmental cooperation between the City of Stoughton and MMSD.
2. Public acceptance of an interceptor corridor near Door Creek, if wastewater flows are conveyed from the Cottage Grove area.

E. Oregon WWTP (Badfish Creek Discharge)

MMSD has considered a possible cooperative agreement with the Village of Oregon to treat a portion of MMSD's wastewater flow. Oregon discharges to the Oregon Branch of Badfish Creek, with limits as described in Table 1.03-2. This alternative would be subject to regulations and have similar impacts as those described for an NSWTP discharge to Badfish Creek (Section 1.03 A.). This alternative would provide a minimal water balance benefit.

F. Other Surface Water Discharge Locations Including Stream Base Flow Augmentation

Other surface water discharge locations may be considered, such as a new discharge to the Yahara River just downstream of Lake Waubesa. A discharge at this location would likely have similar issues and benefits as those discussed above for a discharge to Nine Springs Creek and Lake Waubesa.

Base flow augmentation using highly treated WWTP effluent may also be considered in the future, particularly for urban streams. For example, relatively small volumes of effluent could be further treated at the Sun Prairie or a future north MMSD WWTP and discharged to streams in the northeast portion of the Lake Mendota or north Lake Monona watersheds. Starkweather Creek has experienced a reduction in dry weather base flows over the years, possibly caused by the high percentage of impervious surfaces in the watershed and pumping of groundwater in Madison, and could be a good candidate to receive flow augmentation in this manner. A discharge of treated effluent at this location would have similar issues and benefits as those discussed above for a discharge to the upper Yahara River and Lake Mendota.

1.05 WATER REGULATIONS IMPACTING A GROUNDWATER DISCHARGE OR EFFLUENT REUSE

A. Groundwater Recharge

Groundwater recharge using effluent is being practiced in several locations around the state, particularly in the Wisconsin River Valley and other locations where soils are sandy and thus conducive to infiltration. A typical method of effluent groundwater recharge is to use seepage cells (also called absorption ponds), which are regulated under NR 206. Current effluent limitations for discharge to absorption ponds include:

BOD	50 mg/L
TN	10 mg/L
TDS	500 mg/L
Chloride	250 mg/L

Groundwater monitoring is usually required for absorption ponds and the relevant groundwater standards at the design management zone boundary (250 feet from the seepage cell boundary) or at the property line would apply. These are contained in NR 140. The groundwater preventive action limit (PAL) for chloride is 125 mg/L and the enforcement standard (ES) is 250 mg/L.

Groundwater recharge using stormwater infiltration galleries is being practiced at the Odana Hills Golf Course in southwestern Madison. Since the discharge is to the subsurface and therefore cannot rely as much on aerobic and facultative bacteria, plant uptake, and other processes for treatment, the effluent limits for this type of discharge are more stringent. Typically, effluent limits are set equal to groundwater standards or upgradient groundwater quality. For the system in Madison, this has required pretreatment of the stormwater using membrane filtration prior to discharge to the infiltration galleries.

For this type of discharge, it appears the largest hurdles for MMSD to overcome would be TN and chloride effluent concentrations. Biological nitrogen removal can be used to reduce TN to below 10 mg/L. If a variance could not be obtained, chloride concentrations would need to be reduced through source reduction or reverse osmosis treatment prior to discharge to an infiltration gallery and may also need to be reduced prior to a discharge to absorption ponds.

Favorable groundwater infiltration locations were explored as part of the MGE West Campus Cogeneration facility environmental impact review. Four sites were identified in west and south Madison with the projected ability to recharge 120-million gallons per year of stormwater. A discussion can be found in the *MGE-UW West Campus Cogeneration Facility Final Environmental Impact Statement* (MGE, 2003). These sites would need to be reviewed from the perspective of wastewater quality to determine if they would be effective for effluent infiltration. Assuming they were suitable, these sites would be able to accept only a small fraction of MMSD's total effluent flow. A large, potentially favorable infiltration site has also been identified in Fitchburg.

The use of injection wells is another method of groundwater infiltration. Federal drinking water regulations include five types of injection well permits. Effluent would need to meet NR 140 standards

before injection, unless it could be shown that the aquifer receiving the effluent was nonpotable and isolated from water supply aquifers.

Depending on the location of groundwater absorption ponds, infiltration galleries, or injection wells, it may be necessary to provide additional treatment to remove additional pathogens (such as viruses) or microconstituents from the effluent prior to recharge. The upper sandstone aquifer in the Madison area is no longer used for human consumption, and recharge of this aquifer could help provide restoration of local springs and wetlands. However, the lower water supply aquifer is not protected everywhere in Dane County because the shale layer below the sandstone aquifer is discontinuous in some locations. Therefore, infiltration sites would need to be carefully selected if higher levels of treatment are not provided.

B. Nonresidential Irrigation

The current MMSD permit contains provisions related to use of effluent on the Nine Springs Golf Course in Fitchburg as a demonstration project. This type of discharge would be regulated under NR 206. Current regulations include a BOD effluent limitation of 50 mg/L. Hydraulic loading rates and load and rest cycles are determined on a case-by-case basis and generally depend on the soil type. Likewise, TN and fecal coliform limits are determined on a case-by-case basis. Groundwater monitoring is often required for these systems, particularly when significant pretreatment is not provided. Groundwater standards for chloride (125 mg/L PAL and 250 mg/L ES) may be of greatest concern for MMSD's effluent.

Nonresidential irrigation would generally involve spray or drip irrigation of treated wastewater onto agricultural fields, grass lands, golf courses, or similar areas. Spray irrigation onto agricultural land has been practiced in Wisconsin for many years, primarily for industrial or small (less than 1 mgd) municipal wastewater treatment systems. Muskegon County, Michigan, has a large effluent irrigation and rapid infiltration facility near the shores of Lake Michigan that has been operating successfully for many years. Generally TN applications are limited to crop uptake rates, which are on the order of 165 lb/acre-year for corn and 300 lb/acre-year for certain grasses like reed canarygrass. Groundwater monitoring is often required for determining compliance with groundwater standards.

Crops from a spray irrigation field are typically harvested to remove nutrients. Crops may be used for cattle feed or bedding. More recently, crops like switchgrass are being explored as a potential biofuel for energy generation. The crops are not typically used for human consumption if domestic wastewater is used for irrigation, unless the effluent meets very stringent reuse standards such as California Title 22. Title 22 standards include a turbidity of 2.0 nephelometric turbidity units (NTU) and two total coliforms per 100 mL. In general, this requires advanced filtration and may require a chlorine residual.

Golf course irrigation using WWTP effluent is particularly attractive in areas where fresh water is scarce, such as the Southwest United States. However, it is gaining popularity in Illinois and elsewhere in the Midwest as a way to reduce discharges to receiving streams and reduce the use of fresh groundwater or surface water on golf courses. High salts can be a concern for land application because of the reduced-permeability impact on clayey soils from sodium (particularly if the sodium is high in proportion to other cations in the wastewater) and because of the concern about chloride applications resulting in an exceedance of groundwater quality standards. High salt concentrations can also result in

“burning” of foliage or stunted growth; however, this is not typically a concern for domestic wastewater irrigation in temperate climates. After four years of operation, MMSD’s Nine Springs Golf Course test plot has not shown adverse effects from salts, according to the greens keeper.

Irrigation using treated wastewater may be beneficial for the water balance issues in Dane County. First, irrigation of cropland may result in increased groundwater recharge. This is less likely for irrigation on golf courses because of high turfgrass evapotranspiration rates. Second, if golf course irrigation using effluent reduces the use of fresh water from rivers, lakes, or the ground, then it will also help improve water balance.

Implementation of any facilities for effluent reuse for irrigation, particularly onto food crops, or athletic fields or parks, will depend on addressing the following issues:

1. Public acceptance of the use of effluent for irrigation.
2. DNR approval.
3. Potential Wisconsin Department of Health and Family Services (DHFS) approval related to any public health concerns (total coliform limitations).
4. Availability and quantity of potential irrigation sites.
5. Proximity of irrigation sites to facilities that could provide highly treated effluent.
6. Available corridors to convey the treated effluent to the irrigation sites.

C. Industrial or Commercial Reuse

Wastewater effluent is being used for industrial noncontact cooling and other noncontact uses. An example in Wisconsin is the Heart of the Valley wastewater treatment plant in Kaukauna where highly treated effluent is being used by a nearby power plant for cooling. Wisconsin currently has no standards for the treatment of effluent for use in an industrial facility.

In 2002, MGE briefly explored the use of MMSD effluent for cooling at its new West Campus Cogeneration facility. A discussion is contained in *MGE-UW West Campus Cogeneration Facility Final Environmental Impact Statement* (MGE, 2003). The use of effluent would have offset MGE’s 2.75 mgd proposed full build-out water withdrawal from Lake Mendota. The cost for additional disinfection and filtration to remove protozoans, and a pipeline to convey effluent to the Cogeneration facility, was determined to be approximately \$9.5 million at that time. Annual operational costs were projected to be \$135,000. There were also concerns from the UW regarding use of the effluent in a residential and campus setting for a facility of the size being considered, so the concept was not pursued further.

It may also be possible for effluent to be reused for noncontact industrial cooling water. Several individuals responding to the MMSD interest survey indicated that commercial car wash use may be another viable alternative; however, the locations of such facilities may be too diffuse for cost-effective conveyance of the treated effluent. The concept should be initially explored with the largest water users

in Dane County who are believed to use fresh water for nonpotable uses. Potential users are listed here:

- Oscar Mayer.
- Golf courses, particularly in or just north of Madison.
- MGE Blount Street or other location.
- UW Physical Plant.
- Lycon Corporation.
- Wingra Stone.

Ethanol production consumes approximately five gallons of water per gallon of ethanol produced, and consideration could be given to colocating an ethanol production plant so that it can cost-effectively use WWTP effluent. This would still result in a net loss of water from the basin, but from a water resources standpoint, this would be preferable to an ethanol plant using fresh water. CARPC has indicated that it may be difficult to site an ethanol production plant in Dane County if they want to use groundwater or surface water. In Wisconsin, outside of Dane County, the communities of Cambria, Milton, Jefferson, and Monroe all have ethanol production plants being planned.

Other potential uses identified at the MMSD regulatory review meeting include sod farms and large agricultural operations that currently use fresh water for flushing systems in barns and other purposes.

D. Residential Reuse

It has been proposed by several individuals that treated effluent could be reused for toilet flushing, residential lawn irrigation, and other residential nonpotable water uses. Such a concept would require effluent treatment to a very high level (potentially California Title 22 standards as noted above for food crop irrigation), require force mains to convey the treated effluent to the residential developments, and require a new infrastructure similar to the “purple pipe” reuse water distribution systems used in the Southwest and elsewhere. This concept may be worth considering for new developments where installation costs would be lower compared to existing developments. However, it is likely that costs of such systems would outweigh the benefits, at least in the short term in the Madison area. For the short term, it appears that residential water conservation measures may provide similar benefits at a significantly lower cost.

Implementation of any facilities for effluent reuse for residential irrigation or reuse will depend on addressing the following issues:

1. Public acceptance of the use of effluent for residential purposes.
2. DNR approval.
3. Potential DHFS approval related to public health concerns (total coliform limitations).
4. Availability and quantity of potential reuse sites.
5. Proximity of residential reuse sites to facilities that could provide highly treated effluent.
6. Available corridors and distribution systems to convey the treated effluent to the reuse sites.

E. Wetlands Restoration

The DNR has indicated that a discharge to wetlands may be subject to less stringent requirements than a discharge to an ERW stream or the Madison lakes, particularly for restored wetlands. A potential option for the Mendota Plant would be to discharge effluent to wetlands to provide the base flow for the wetland system that has been lost because of groundwater table lowering from water supply withdrawals in Madison, Waunakee, DeForest, Windsor, and Sun Prairie. This option may also be useful in lieu of a direct stream or lake discharge in the vicinity of the Sugar River or Nine Springs Creek/Lake Waubesa.

Wetland discharges are regulated under NR 103. NR 103 applies to natural and restored wetlands but not to constructed wetlands for wastewater treatment or polishing; the latter systems are typically constructed with liners separating them from natural waters and are considered a wastewater treatment unit process.

NR 103 addresses water quality and functional use of a wetland. Discharge of treated effluent to a natural wetland would require high levels of treatment, possibly similar to a Madison lakes discharge. Otherwise, the functional use of the natural wetland could change over time as oxygen demanding substances, nutrients, and other effluent constituents could eventually affect the types of plants and the water quality in the wetland.

Because of the concern over changed functional use of natural wetlands, an effluent discharge to a restored wetland may be more cost-effective, assuming conveyance costs are not too high. The DNR has indicated that they provide greater flexibility regarding functional use in the case of a restored wetland. Restoration of wetlands provides many other environmental benefits and could result in P trading or other credits for MMSD. Wetland restoration also tends to be viewed favorably by the public and environmental advocacy groups. CARPC and the DNR have mapped potentially restorable wetlands and have indicated that some of these areas are quite large and may provide good benefit for the cost.

1.06 OTHER KEY REGULATIONS ISSUES

A. Biosolids Management

The following biosolids regulations have been identified as possibly being applicable to MMSD's future operations. Within the next 20 years, these regulations along with increased development in the Madison area may result in the requirement for more land and increased hauling distances in the Metrogro program. These regulations may also place additional restrictions on the MetroMix program. In the longer term, MMSD may need to consider additional alternatives for at least a portion of its biosolids such as landfilling. Landfilling may still be considered a beneficial reuse option if biosolids are used as cover material, are used to facilitate decomposition, are part of a landfill bioreactor, or if biosolids additions promote the formation of landfill gas that is then recovered and used to generate electricity.

1. State (NR 204) and federal (40 CFR Part 503) biosolids regulations: These regulations may come under triennial or other review. New requirements (lower limits for existing parameters, new limits for microconstituents, development of risk-based pathogen

requirements, or different pathogen indicator organisms) could be promulgated. If so, these requirements could impact MMSD's ability to beneficially reuse biosolids through the Metrogro and MetroMix programs or through other beneficial reuse initiatives.

2. Runoff management rule (NR 151), Soil and Water Resource Management Rule (ATCP 50), and Wisconsin NRCS 590 Nutrient Management Standards: These rules could place restrictions on MMSD's Metrogro applications to agricultural land by limiting phosphorus loadings. The rules are presently being rewritten and are expected to require agricultural fields to meet a phosphorus index of 6 (an average of approximately 6 pounds P runoff per acre per year). Potentially lower indexes would be applied where needed to meet a TMDL. Eventually the state could impose additional restrictions on fertilizer P applications to agricultural land unless soil testing indicates P is needed. These types of regulations could lead to future competitions between applications of manure and biosolids.
3. Impaired waters (303(d)) listings and TMDLs: Commonly thought of in terms of impacts on effluent quality, a TMDL could also impact Metrogro applications because it would place restrictions on both point and nonpoint (e.g., agricultural runoff) loads to an impacted waterbody or stream segment. In the short term, nutrient and/or sediment-related TMDLs are most likely to cause impacts.
4. Local ordinances relating to the use of lawn fertilizers containing phosphorus: As currently written, Dane County and City of Madison ordinances would have little or no impact on MMSD's ability to use MetroMix. However, revisions to these ordinances and/or adoption of new ordinances developed by the state or other communities could have a negative impact on the ability to use MetroMix.
5. State regulations covering fertilizers and related products (ATCP 40): Current regulations reference sewage sludge and sewage sludge products. Revisions could lead to the imposition of significant fees based on mass of material produced, which may influence future decisions regarding potential biosolids management options.

B. Pollutant Minimization

Pollutant minimization will be more important in the future, particularly for compounds that are difficult or costly to remove using current treatment methods. MMSD has a pretreatment program that requires regulated industries to meet local limits for metals and other parameters. In 2007 MMSD cosponsored a pharmaceutical take-back program to reduce the chance that these compounds will end up in the wastewater. They have also developed a mercury minimization plan and an ordinance requiring dental offices to recover mercury amalgam. They are investigating sources of chloride in the wastewater in efforts to reduce this compound in the NSWTP influent. Pollution prevention and source reduction is more proactive than wastewater treatment so is often viewed more favorably by the public. There are often economic benefits of pollution prevention.

Future potential opportunities for pollutant minimization include:

1. Additional sponsorship of pharmaceutical take-back programs.
2. Ordinances against discharge of microconstituents to municipal sewers.

3. Additional mercury reduction ordinances or strategies.
4. Additional local pretreatment limits to further reduce heavy metals or other compounds in the wastewater.
5. Coordination with Madison or other water utilities for significant changes in water softening practices (centralized reverse osmosis or lime softening) to reduce chlorides in the wastewater.

C. Pollutant Load Trading

Pollutant load trading is a likely future initiative because it can reduce the cost of compliance with new water quality or other regulations. The Rock River publicly owned treatment works (POTW) group explored pollutant load trading for a pilot P TMDL in the late 1990s and early 2000. At that time, the cost to remove P to 1.0 or 1.5 mg/L at WWTPs was found to be low enough that pollutant load trading was not worthwhile. There were other issues affecting pollutant load trading at the time, such as high trading ratios being suggested by the DNR (i.e., requiring the removal of two or three pounds of agricultural P in trade for one pound of WWTP P), that contributed to the decision to remove P at the WWTPs at the time. Since then, the DNR has collected additional performance data and more sophisticated models have been developed to better predict P reductions through agricultural best management practices (BMPs), and this should reduce trading ratios. The DNR has also indicated interest in working with WWTPs on many of the other trading issues such as the length of time a trade would be permitted. Pollutant load trades such as those listed below may be beneficial to MMSD in the future.

1. Installation of agricultural BMPs or restoration of wetlands in the Badfish Creek or Yahara River watersheds to allow for a higher effluent P limit at MMSD's NSWTP. It is possible that this would reduce or eliminate the need for effluent filtration. This could also be used for nitrogen load trading.
2. Potentially, participation in sediment removal, dam removal, or stream bank restoration projects in the watershed to reduce in-stream sources of sediment and P in exchange for higher effluent limits.
3. Treatment of its wastewater to levels below MMSD's permit limit. This option would then produce credits that could be sold to downstream P dischargers.
4. Assistance to or coordination with local communities for changes to deicing practices to allow an increased chloride discharge to the groundwater or Sugar River basin surface waters. This type of cooperative effort is underway in the DuPage River/Salt Creek Watershed in Illinois.

D. Air Quality

The following air quality-related regulations or initiatives have been identified that may impact MMSD's operations.

1. State air regulations (NR 404, NR 405, NR 406, NR 407, NR 429, NR 438, NR 439, and NR 445): These regulations could impact multiple areas of MMSD's operations including emissions from unit processes, digester gas-fueled engines, biosolids processing, and

- biosolids land application. Typical focus is on parameters such as carbon monoxide, nitrogen and sulfur oxides, and volatile organic compounds. These regulations may require additional permitting, sampling, covering of tanks, collection and scrubbing of exhaust from engine generators, or other measures in the future.
2. Federal air regulations (Maximum Achievable Control Technology standards): These regulations would primarily apply to new WWTP projects, or major reconstruction projects, that are over a certain size. Currently, a major source is defined as one that emits more than 10 tons per year of a hazardous air pollutant (HAP) or more than 25 tons per year of a combination of HAPs. Currently, none of MMSD's operations result in a major source of HAPs.
 3. Greenhouse gas emissions and climate change: The global warming issue may not be far enough along to affect WWTPs for the next decade or so. In Wisconsin, the Governor's task force is presently focusing on larger sources. However, Wisconsin Focus on Energy and Energy Star programs are two that are actively assisting WWTPs with greenhouse gas emission reductions through grants and incentives and accounting tools. In the future there may be more opportunities for cooperative projects such as irrigation of wastewater onto "biomass" crops that are subsequently used for ethanol or direct energy production. This could reduce the need for chemical fertilizers to establish the crops, which has been one criticism of the current practice of growing corn for ethanol production, for example.

There may be regulations related to climate change and sizing of conveyance and treatment facilities in the future to address extreme weather events.

1.07 FINAL COMMENTS

On the surface, it appears that current or pending water quality regulations tend to point MMSD toward no change in its current practices. If the public approves of MMSD's current practices, and assuming it is more cost-effective to maintain the single-WWTP model, there may be little impetus for MMSD to build satellite plants or implement water reuse strategies. Water reuse and similar initiatives may require partnerships with other agencies under the direction of a state or county agency.

It is anticipated that the Great Lakes Compact and other water quantity initiatives may raise public awareness of the water quantity/balance issue in the Madison area. Also, if lawn watering or other restrictions become commonplace, the public will see more value in its water resources. This may shift trends toward mandated or voluntary, cooperative measures for interbasin water balance efforts.

Along with the MMSD, the public should continue to think about its water quality and quantity goals and how much they are willing to pay to realize those goals. For example, should MMSD operate at lowest cost possible or operate at a higher cost and be part of a holistic solution to water quantity issues in Dane County? What are the public's aquatic life and recreational use goals—is maintenance of our current fisheries a high enough goal? Are algae blooms in the Madison lakes infrequent enough that they do not cause too much of a recreational use nuisance?

Some of these questions will continue to be asked as part of future development approvals in Dane County, as well as during the DNR's triennial standards review process. As they relate to the 50-Year Master Planning process, MMSD has taken a proactive approach by asking some of these questions through its user questionnaire and public outreach process.

1.08 DEFINITIONS

Following are definitions for the acronyms and abbreviations used in this technical memo.

ATCP	Agriculture, Trade, and Consumer Protection (Wisconsin Department of)
BOD	biochemical oxygen demand
BMP	best management practice
CARPC	Capital Area Regional Planning Commission
DCRPC	Dane County Regional Planning Commission
DHFS	Wisconsin Department of Health and Family Services
DNR	Wisconsin Department of Natural Resources
EPA	United States Environmental Protection Agency
ERW	Exceptional Resource Water
ES	enforcement standard
HAP	hazardous air pollutant
LA	load allocation
LAL	limited aquatic life
LFF	limited forage fish
MGE	Madison Gas & Electric
mgd	million gallons per day
MMSD	Madison Metropolitan Sewerage District
N	nitrogen
ng/L	nanograms per liter
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NSWTP	Nine Springs Wastewater Treatment Plant
NTU	nephelometric turbidity unit
P	phosphorus
PAL	preventive action limit
POTW	publicly owned treatment works
TMDL	Total Maximum Daily Load
TN	total nitrogen
TSS	total suspended solids
USA	urban service area
WLA	waste Load Allocation
WPDES	Wisconsin Pollutant Discharge Elimination System
WQBEL	water quality based effluent limit
WQC	water quality criteria or criterion
WWSF	warm water sport fish
WWTP	wastewater treatment plant

TMDL: A TMDL is the maximum amount of pollutant loading that surface water can accept and still meet water quality standards including designated uses. The general TMDL equation is as follows:

$$\text{TMDL} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

Where $\sum \text{WLA}$ is the sum of the waste load allocations for the pollutant, assigned to all point sources (a point source is generally any discharger that has a WPDES permit); $\sum \text{LA}$ is the sum of the load allocations for the pollutant, assigned to all nonpoint sources (e.g., agricultural runoff, nonpermitted municipal runoff, and atmospheric deposition); and MOS is a margin of safety provided to account for uncertainties in the water quality monitoring, modeling, or science.

Microconstituents: Include but are not limited to pharmaceuticals, hormones, and other endocrine disrupting compounds and various bactericides.

Groundwater table: The groundwater table is the point where subsurface soils become saturated, and its surface is at atmospheric pressure. In this report, references to the decline in the groundwater table also encompass the decline in the piezometric surface of the partially confined aquifer below the water table aquifer.

Table 1.03-1
DNR Listing and Assessment Information for Possible Discharge Locations
MMSD 50-Year Master Plan

Wastewater Treatment Plant	Discharge Location (Downstream Waterbody)	Basin (Watershed)	Designated Use	303(d) Listed Impairments and (Potential Causes)	Key Recommendations from DNR Water Quality Management Plan Reports (1)
Nine Springs	Effluent Ditch to Oregon Branch of Badfish Creek	Lower Rock (Badfish Creek - LR 07)	LAL	Not listed	MMSD should continue monitoring.
Nine Springs	(Badfish Creek to CTH A)	Lower Rock (Badfish Creek - LR 07)	LFF	FCA (PCBs)	Water quality has improved since the 1970s; better quality effluent.
Nine Springs	(Badfish Creek to Yahara River)	Lower Rock (Badfish Creek - LR 07)	WWSF	FCA (PCBs)	
Nine Springs	(Yahara River)	Lower Rock (Yahara River - Lake Kegonsa - LR 06)	WWSF	dhab; DO (phos; sed)	
Nine Springs	Badger Mill Creek	Sugar-Pecatonica (Upper Sugar River - SP 15)	LFF from former Verona STP to STH 69; being reclassified WWSF	Not listed	Water quality has improved since the 1970s. Control urban runoff from Verona and west Madison.
Nine Springs	Nine Springs Creek	Lower Rock (Yahara River - Lake Monona - LR 08)	WWFF	DO;temp (phos;sed)	Construction site runoff has contributed to sedimentation and lower water quality. Municipalities should enforce erosion control ordinances. Protect springs and wetlands. Boat traffic lowers water quality. Adopt and enforce no-wake ordinance.
Nine Springs	(Upper Mud Lake)	Lower Rock (Yahara River - Lake Monona - LR 08)	WWSF	Not listed	
Nine Springs	(Lake Waubesa)	Lower Rock (Yahara River - Lake Monona - LR 08)	WWSF	Not listed	Water quality has improved since MMSD effluent diversion. Additional monitoring. Control of aquatic plants.
Village of Oregon	Oregon Branch Badfish Creek	Lower Rock (Badfish Creek - LR 07)	LAL	Not listed	V. Oregon should upgrade and enforce erosion control ordinances.
Village of Oregon	(Oregon Branch Badfish Creek)	Lower Rock (Badfish Creek - LR 07)	LFF	Not listed	
Village of Oregon	(Badfish Creek to CTH A)	Lower Rock (Badfish Creek - LR 07)	LFF	FCA (PCBs)	Water quality is gradually improving.
City of Stoughton	Yahara River	Lower Rock (Yahara River-Lake Kegonsa - LR 06)	WWSF	dhab; DO (phos; sed)	Evaluate return of MMSD effluent to increase base flow. C. Stoughton and V. McFarland enforce erosion control ordinances.
City of Sun Prairie	Koshkonong Creek	Lower Rock (Upper Koshkonong Creek - LR 12)	LAL	DO; eutr;dhab; sed (phos; sed)	Acquire land for wetlands. Triennial water quality standards review. C. Sun Prairie enforce erosion control ordinance. Improve creek.
City of Sun Prairie	(Koshkonong Creek 2.5 miles from outfall)	Lower Rock (Upper Koshkonong Creek - LR 12)	WWSF	DO; eutr;dhab; sed (phos; sed)	
City of Sun Prairie	(Koshkonong Creek)	Lower Rock (Lower Koshkonong Creek - LR 11)	WWSF	DO; eutr;dhab; sed (phos; sed)	Acquire land for wetlands. High nutrient and sediment loads, poor water quality. Form lake district. Improve public access. Additional monitoring.
City of Sun Prairie	(Lake Koshkonong)	Lower Rock (Lower Koshkonong Creek - LR 11)	WWSF	DO; eutr;dhab; sed (phos; sed)	
Mendota (North Madison)	Yahara River	Lower Rock (Yahara River - Lake Mendota - LR 09)	WWSF	Not listed	Acquire lands for public access. Municipalities should enforce erosion control ordinances. Control of aquatic plants. Acquire land for wetlands and access.
Mendota (North Madison)	(Lake Mendota)	Lower Rock (Yahara River - Lake Mendota - LR 09)	WWSF	FCA (PCBs)	
Sugar River	Sugar River	Sugar-Pecatonica (Upper Sugar River - SP 15)	CW/ERW	Not listed	Water quality has improved since the 1970s and is good except for fecal coliform. Groundwater diversion poses a threat to base flow. Control urban and agricultural runoff.
Sugar River	(Lake Belle View)	Sugar-Pecatonica (Upper Sugar River - SP 15)	WWSF	Not listed	Shallow reservoir with poor water quality.

Notes: 1 Non-binding or Early Planning Recommendations from Wisconsin DNR, 2001 (Lower Rock Basin) and 2006 (Upper Sugar River Watershed)

Abbreviations: FCA = fish consumption advisory impairment
PCBs = polychlorinated biphenyls are a potential cause of the indicated impairment
DO = dissolved oxygen impairment
Temp = temperature impairment
phos = phosphorus is a potential cause of the indicated impairment
sed = sediment is a potential cause of the indicated impairment
eutr = eutrophication impairment
dhab = degraded habitat impairment

Table 1.03-2 Potential Effluent Limits for Possible Discharge Locations MMSD 50-Year Master Plan												
Wastewater Treatment Plant	Discharge Location (Downstream Waterbody)	Designated Use	Minimum Dissolved Oxygen (mg/L)	BOD (1)		TSS (1)		Ammonia Nitrogen Limits (mg/L)	Total Nitrogen Monthly Potential (2) (mg/L)	Fecal Coliform Monthly (No/ 100 mL)	Phosphorus Current Monthly (mg/L)	Phosphorus Potential Monthly (3) (mg/L)
				Monthly (mg/L)	Weekly (mg/L)	Monthly (mg/L)	Weekly (mg/L)					
Nine Springs	Effluent Ditch to Oregon Branch of Badfish Creek	LAL	5	19	20	20	23	Yes	8	400	1.5	0.075
Nine Springs	(Badfish Creek to CTH A)	LFF										0.075
Nine Springs	(Badfish Creek to Yahara River)	WWSF										0.075
Nine Springs	(Yahara River)	WWSF										0.105
Nine Springs	Badger Mill Creek	LFF from former Verona STP to STH 69; being reclassified WWSF	5	N/A	7/16	10/16	N/A	Yes	8	400	1.5	0.075
Nine Springs	Nine Springs Creek	WWFF	7	5	5	5	5	Yes	8	400	1.5	0.075
Nine Springs	(Lake Waubesa)	WWSF										0.040
Village of Oregon	Oregon Branch Badfish Creek	LAL	4	20	20	20	30	Yes	8	400	1.5	0.075
Village of Oregon	(Oregon Branch Badfish Creek)	LFF										0.075
Village of Oregon	(Badfish Creek to CTH A)	LFF										0.075
City of Stoughton(4)	Yahara River	WWSF	6	25	33/40	30	40	Possible (At Least Max Day)	8	400	1.5	0.105
City of Sun Prairie	Koshkonong Creek	LAL	7	5/10	5/10	10	N/A	Yes	8	400	1.4	0.075
City of Sun Prairie	(Koshkonong Creek 2.5 miles from outfall)	WWSF										0.075
City of Sun Prairie	(Koshkonong Creek)	WWSF										0.075
City of Sun Prairie	(Lake Koshkonong)	WWSF										0.040
Mendota (North Madison)	Yahara River	WWSF	7	5	5	5	5	Yes	3	400	N/A	0.075
Mendota (North Madison)	(Lake Mendota)	WWSF										0.015
Sugar River (5)	Sugar River	CW/ERW	7	5	5	5	5	Yes	3	400	N/A	0.075
Sugar River	(Lake Belle View)	WWSF										0.040
Notes:	<p>1 Lower limit applies during summer. Limits shown as 5 mg/L are estimates based on meeting "background" concentrations.</p> <p>2 Nitrogen limits shown are estimated technology-based limits; Mendota and Sugar River limits assume a higher level of TN removal will be required at these locations.</p> <p>3 Phosphorus potential limits are based on proposed P criteria in draft NR 102 with no allowance for mixing and dilution. Actual limits will likely be higher.</p> <p>4 Stoughton limits shown are based on current 1.65 mgf DAF; BOD limits shown are actually CBOD.</p> <p>5 A new Sugar River discharge would need to meet background water quality because of antidegradation requirements for ERW waters.</p>											