MWMC Eugene-Springfield WPCF Facility Plan—Preliminary Screening

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Executive Summary

This technical memorandum has been prepared as part of the Metropolitan Wastewater Management Commission (MWMC) Facility Plan Update (MWMC Project No. 80010) and presents the preliminary screening of alternatives. The methodology used to conduct this screening included 1) identifying project drivers, 2) identifying potential alternatives by unit process, 3) developing evaluation criteria and a scoring system, 4) conducting the screening process, and 5) recommending alternatives for further consideration. Alternatives recommended for further evaluation are summarized in Table 7 at the end of this technical memorandum.

Introduction

The purpose of this memorandum is to identify project needs and to conduct a preliminary screening that will advance certain unit process alternatives for inclusion into subsequent unit process analyses and/or system-wide alternatives. The methodology used to identify those alternatives is as follows:

- Identify project drivers
- Identify unit process alternatives
- Develop Evaluation Criteria
- Conduct Screening of Alternatives
- Recommend Alternatives for Further Consideration

Existing Facilities

Existing liquids treatment facilities at the Eugene-Springfield Water Pollution Control Facility (WPCF) consist of influent pumping, coarse bar screening, aerated grit removal, pre-

aeration, primary clarification, bioreactor basins, secondary clarification, chlorine disinfection, and sulfur dioxide dechlorination.

Preliminary treatment at the WPCF consists of influent pumping, coarse screening, aerated grit removal, and preaeration. The influent pump station uses four open screw pumps to lift the wastewater to a common influent channel upstream of the coarse bar screens. Six screening channels, each 4.5 feet wide and approximately 10 feet deep house ½-inch coarse mechanically cleaned bar screens. Screenings are discharged to a common sluice trough and conveyed into the headworks facility where they are compacted, then loaded out to a truck for ultimate disposal. Grit removal is provided by four aerated grit chambers, each 13 feet wide and 85 feet long. Grit chambers use coarse bubble air diffusers. Four pre-aeration basins provide aeration for the wastewater using coarse bubble air diffusers. Each pre-aeration basin is 13 feet wide, 130 feet long, and approximately 13 feet deep.

Primary treatment is accomplished with four primary clarifiers that operate to thicken primary sludge in the clarifiers. Each clarifier is 135 feet in diameter, has a 12-foot side water depth, outboard launders, and a standard scraper mechanism. The effective peak primary treatment capacity is estimated at 90 million gallons per day (mgd) with all four primary clarifiers in service. During the wet weather season the facility has pushed in excess of 200 mgd through the primary clarifiers. This resulted in poor performance and washout of the primary sludge blanket.

Secondary treatment facilities consist of two aeration basins for biological treatment, each having four equal-sized cells, and eight secondary clarifiers. Each cell of an aeration basin holds approximately 2.2 million gallons, and the total aeration volume available for treatment is 17.8 million gallons. The aeration basins are currently operated in a plug flow mode with all the return sludge entering the first cell of each basin. Secondary clarifiers are 130 feet in diameter, have a 14-foot side water depth, inboard launders, and each contains a rapid sludge withdrawal mechanism. A return sludge pump station with a total capacity of 72 mgd returns sludge from the secondary clarifiers to the aeration basins. The current peak flow secondary treatment capacity is estimated at 103 mgd and is limited by secondary clarification. During peak wet weather flows, primary effluent in excess of 103 mgd is diverted around secondary treatment through a diversion conduit and recombined with the secondary effluent prior to disinfection.

Disinfection facilities consist of gaseous chlorine with four chlorine contact basins and gaseous sulfur dioxide for dechlorination. Five chlorinators, each rated at 2,000 lb/day, provide chlorine feed. However, the system can only deliver a total of 5,000 lb/day because of piping restrictions. Each chlorine contact basin is 10 feet wide, 250 feet long, and 8 feet deep and has adequate detention time to treat peak flows. However, the influent Parshall flumes limit the hydraulic capacity of the contact basins. Sulfonators feed sulfur dioxide to the chlorinated effluent for dechlorination. There are two sulfonators, one with a capacity of 450 lb/day and the other with a capacity of 2,000 lb/day. Sulfur dioxide is fed to the chlorinated effluent at orifices downstream of the chlorine contact basins, which provide the required mixing. The peak disinfection capacity is estimated at 215 mgd, limited by the chlorinators and hydraulic capacity of the chlorine contact basins.

The WPCF peak hydraulic capacity is estimated at 175 mgd with all units in service and no submergence at any unit process. The plant has pushed in excess of 200 mgd through the

plant during certain winter storm events; however, at these flow rates the plant experiences submergences at a number of weirs, including the secondary clarifiers and primary clarifiers, and occasional motor submergences at the influent climber screens.

Project Drivers

In addition to capacity needs resulting from the projected flow and load analysis, additional project drivers establish a need for further analysis and planning. Three categories of project drivers have been identified, including:

- Regulatory drivers
- Existing WPCF drivers
- Technology drivers
- Each of these project drivers is discussed in detail below.

Regulatory Drivers

Regulatory drivers include existing conditions contained in the National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit [e.g., carbonaceous 5-day biochemical oxygen demand ($CBOD_5$) and total suspended solids (TSS) mass and concentration limitations], and new regulations or changes in regulatory policy that affect the overall treatment capacity rating, treatment strategy, or effluent requirements. Regulations that were newly included in the 2002 reissuance by the Oregon Department of Environmental Quality (DEQ) of the WPCF discharge permit include the requirement for a dry season effluent ammonia limitation, and a thermal load limit. Changes in regulatory policy or evolving regulatory policy for the WPCF include the elimination of sanitary sewer overflows (SSOs) for certain wet season storm events, and effluent blending practices. New requirements, expected beginning in 2004 or 2005, include total maximum daily loads (TMDLs) for effluent constituents such as temperature, arsenic, and mercury. Regulatory drivers are discussed below.

Ammonia

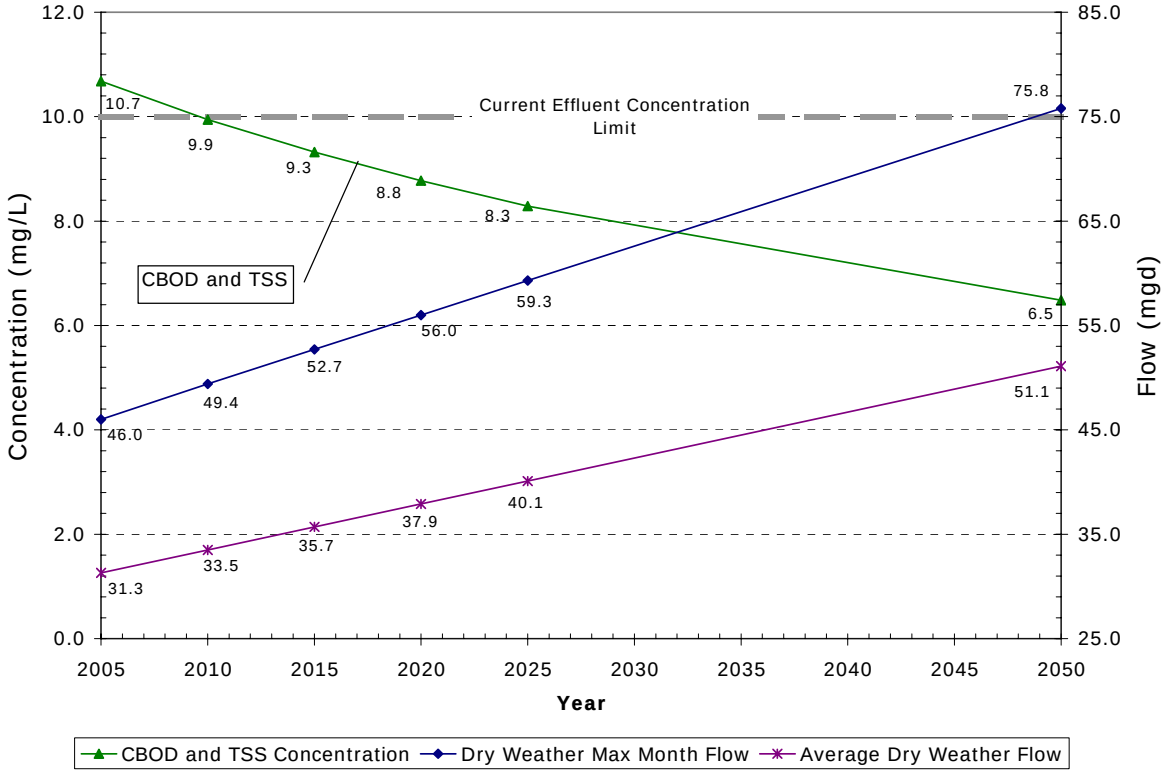
The current NPDES permit (issued in 2002) includes a requirement for dry weather nitrification. Current Oregon water quality criteria drove previous reasonable potential findings and the justification for a dry weather average month and maximum day effluent ammonia concentration limit of 12 milligrams per liter (mg/L) and 22 mg/L, respectively. Wet season nitrification is not required. Historical influent ammonia concentrations have ranged from 14 to 24 mg/L in the dry season. However, plant staff believe this to be the absolute minimum because the filtrate return flow from the Biosolids Management Facility (BMF) has not been consistent in the past and future return flows are anticipated to increase influent ammonia concentrations. The treatment facility must partially or completely nitrify on a peak month basis in the dry season to meet its permit. Because the month of May is typically the month having the coldest wastewater temperatures and highest wastewater flow rates, it will dictate the required solids retention time (SRT) for nitrification and pose the highest risk for meeting the effluent ammonia requirement. Partial nitrification would result in meeting the dry weather maximum day effluent limit and will be less of a concern relative to the dry weather average month effluent limit, which will be more difficult to

attain. Based on the premise that it will be difficult to relax the current effluent ammonia requirements, it is assumed that the current ammonia effluent limitations will be implemented in future permits. The result is that the biological process at the WPCF will need to be modified to accommodate more sustainable nitrification, and thus de-nitrification may be required to address the alkalinity deficit currently experienced during nitrification.

Effluent CBOD and TSS Concentrations, Mass Limitations, and Percent Removal Requirements

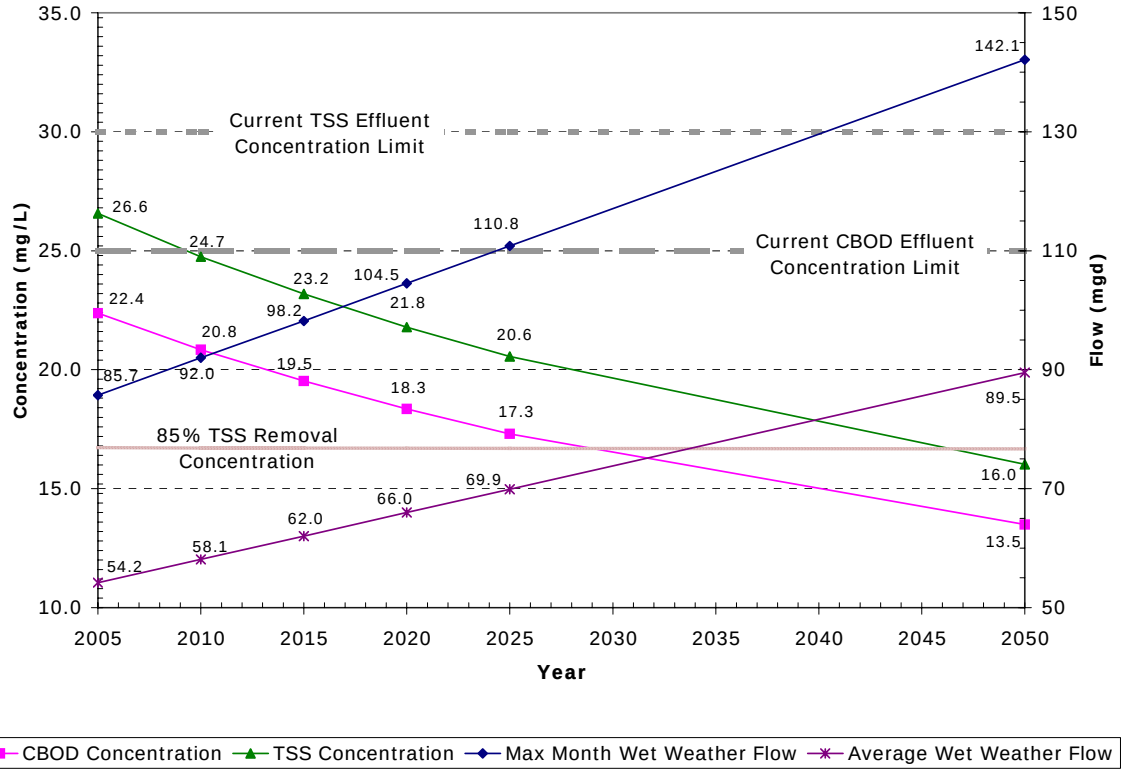
Dry season mass limitations for both CBOD and TSS as outlined in the NPDES permit are based on the current average dry season flow of 49 mgd. Concentration limits as well as percent removal requirements are also specified in the NPDES permit. The current maximum month concentration limits for CBOD and TSS are 10 mg/L. The mass limit requirements must also be met for the highest 30-day flow period in the dry season (maximum month basis). Even if the constant concentration limits for CBOD and TSS are met, the mass limits imply a lower concentration requirement if the wastewater flows exceed the current dry weather design capacity or if the future dry weather design capacity of the facility is increased. **Figure 1** illustrates the anticipated maximum month CBOD and TSS concentrations that result from projected flows and unchanged mass limitations as specified in the existing NPDES permit. These are shown relative to the anticipated concentration limits. The data shown in Figure 1 indicate that additional tertiary treatment (i.e., filtration) would be required to meet permit requirements within the study period if the mass limits in the permit remain the same. To consistently meet an 8.3 mg/L 30-day monthly average level, the planning criteria would have to be in the 6 mg/L range to provide some level of safety factor or margin of error to account for weather variability, plant upsets, influent spikes/slugs, and other unknowns. Percent removal limits apply; however, they are not a factor during the dry season because the mass and concentration limits are significantly more stringent.

FIGURE 1
Dry Weather Maximum Month Effluent Concentration Requirements
Based on Existing Mass Load Limitations and Projected Flows
MWMC Facility Plan, Eugene-Springfield



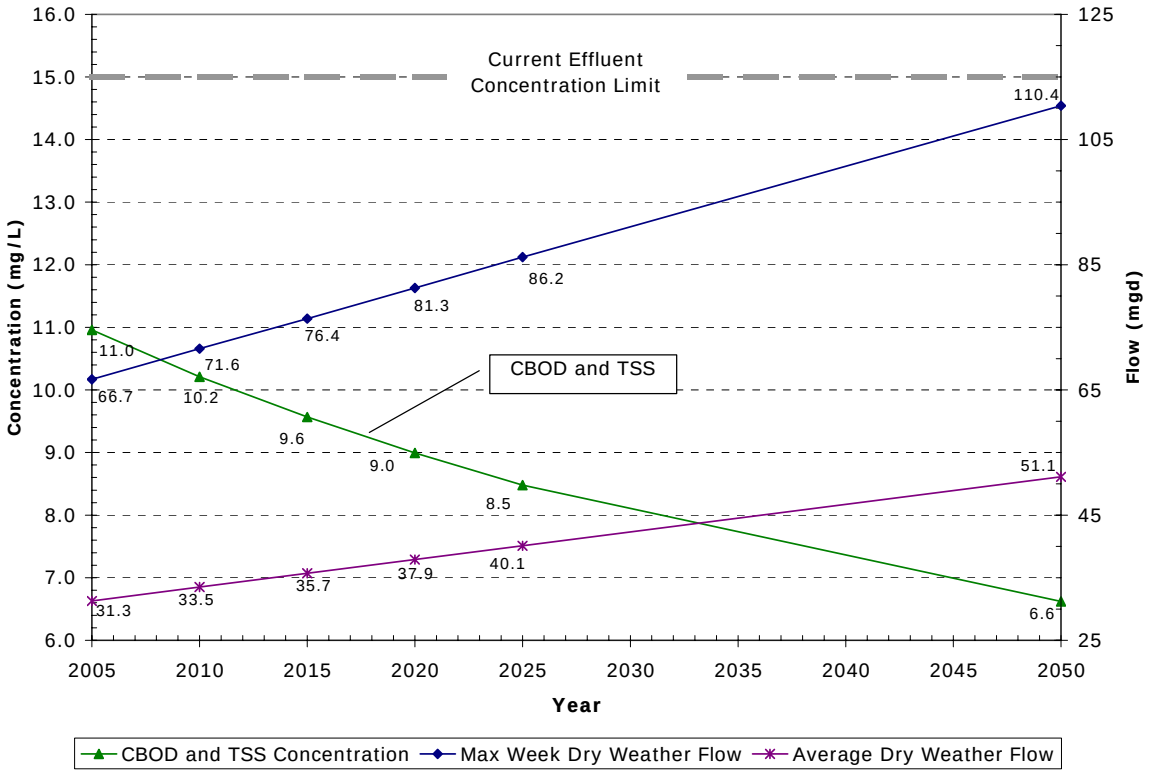
Similarly, wet season maximum month mass limitations for both CBOD and TSS as outlined in the NPDES permit are based on the average wet season flow of 75 mgd. Although significantly higher, concentration limits are also specified in the NPDES permit for wet weather. Maximum month concentration limits are 25 mg/L for CBOD and 30 mg/L for TSS. Percent removal requirements also apply. **Figure 2** illustrates the anticipated maximum month CBOD and TSS concentrations that result from projected flows and unchanged mass limitations as specified in the existing NPDES permit. These are shown relative to the anticipated concentration and percent removal requirement. However, because peak wet weather flows are very dilute, it is the percent removal requirement that is the most difficult to achieve.

FIGURE 2
Wet Weather Maximum Month Effluent Concentration Requirements
Based on Existing Mass Load Limitations and Projected Flows
MWMC Facility Plan, Eugene-Springfield



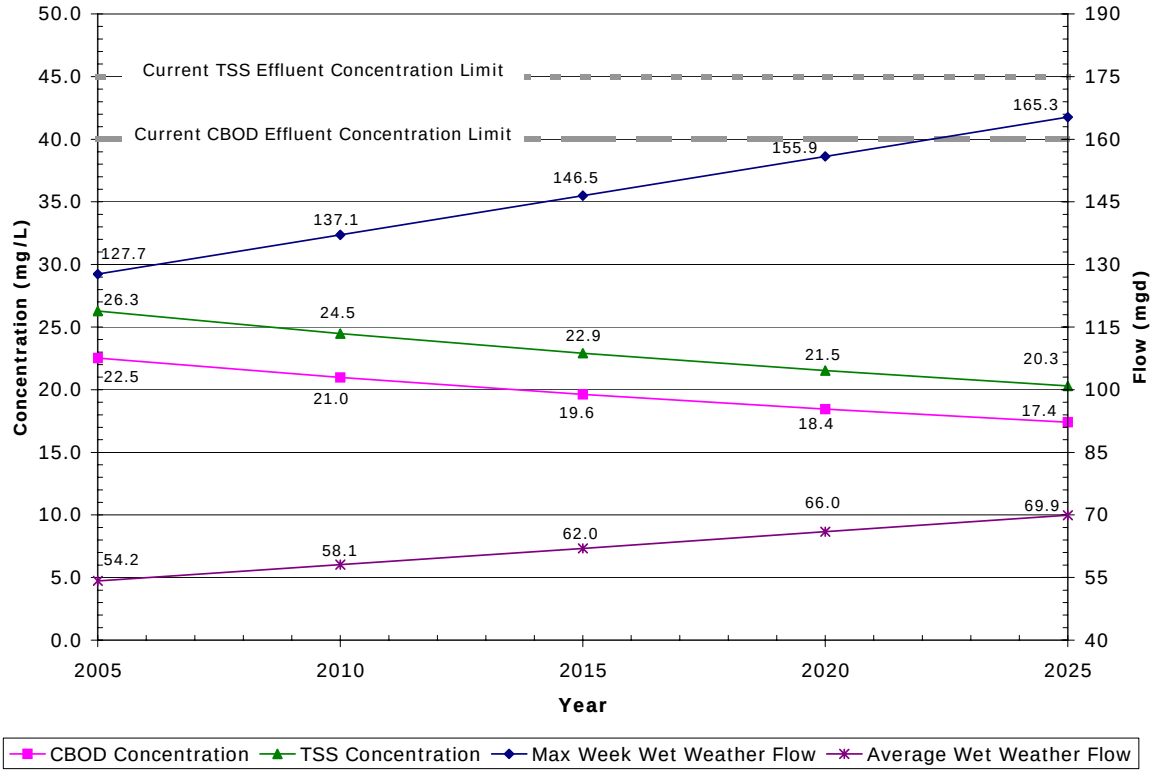
Dry weather maximum week mass limitations for both CBOD and TSS as outlined in the NPDES permit are based on the average dry season flow of 49 mgd. Concentration limits are also specified in the NPDES permit. **Figure 3** illustrates the anticipated maximum week CBOD and TSS concentrations that result from projected flows and unchanged mass limitations as specified in the existing NPDES permit. These are shown relative to the anticipated concentration limits. Percent removal limits do not apply on a maximum week basis.

FIGURE 3
Dry Weather Maximum Week Effluent Concentration Requirements
Based on Existing Mass Load Limitations and Projected Flows
MWMC Facility Plan, Eugene-Springfield



Wet season maximum week mass limitations for both CBOD and TSS as outlined in the NPDES permit are based on the average wet season flow of 75 mgd. Concentration limits are also specified in the NPDES permit. **Figure 4** illustrates the anticipated maximum week CBOD and TSS concentrations that result from projected flows and unchanged mass limitations as specified in the existing NPDES permit. These are shown relative to the anticipated concentration limits. Daily maximum mass limits also apply but are suspended when the average flow exceeds twice the dry weather capacity rating of the facility (currently 98 mgd).

FIGURE 4
Wet Weather Maximum Week Effluent Concentration Requirements
Based on Existing Mass Load Limitations and Projected Flows
MWMC Facility Plan, Eugene-Springfield



Currently the WPCF struggles to meet the dry season effluent requirements for TSS and ammonia during the critical dry weather months of May and October. The plant also struggles to meet the percent removal requirements in the wet season because the influent flows are so dilute and a portion of the primary effluent must be diverted around secondary treatment and blended with secondary effluent. MWMC may want to consider pursuing a permit modification for TSS in the months of May and October, which are critical flow months in the summertime. TSS limitations can be achieved reliably in other summertime months as the average dry weather flow (ADWF) is significantly less than the maximum month dry weather flow (MMDWF). MWMC may want to consider pursuing a permit revision to reduce the wintertime 85 percent removal requirement. MWMC team members noted that this has been tried at other facilities with limited success.

Temperature

Under the 1996 Oregon Temperature Standard (Oregon Administrative Rule 340-41-0026), the WPCF was required to prepare and implement an approved Temperature Management Plan for the following reasons:

- Discharge from the facility is to a river that is water quality-limited
- Heat is contributed to the stream above a water quality-limited stream segment

- Reasonable potential exists for the discharge to have a measurable impact outside of the assigned mixing zone
- Temperature-sensitive endangered fish may be present

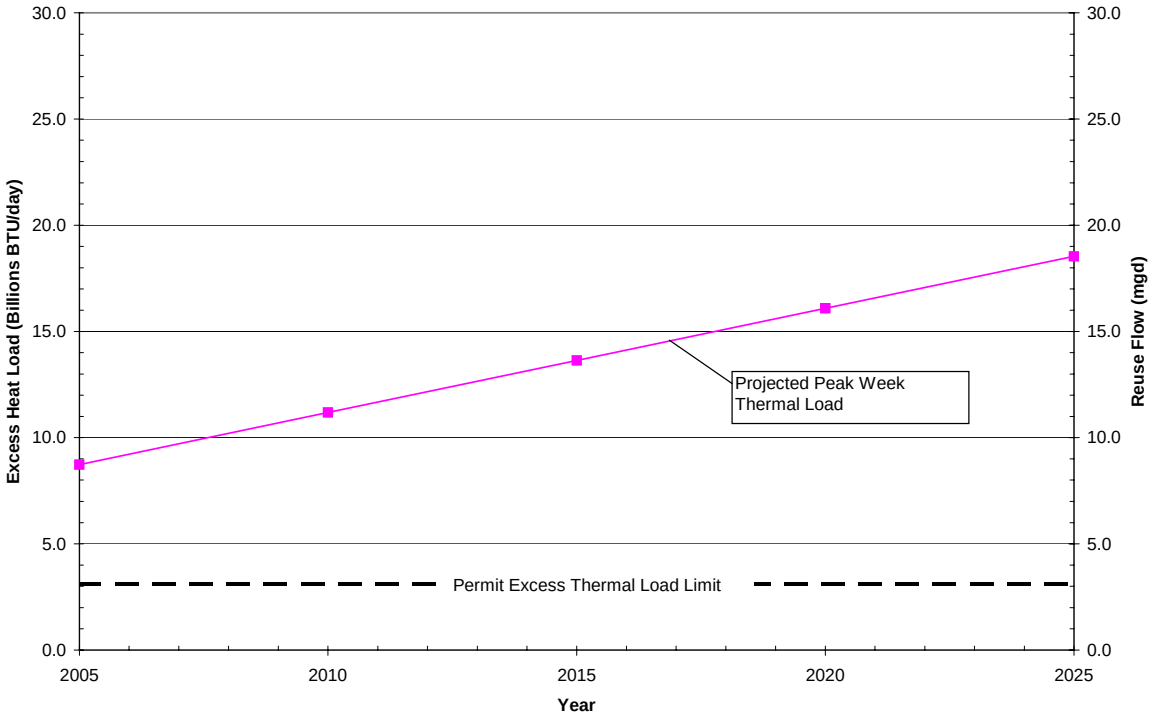
The Temperature Management Plan for the facility was developed and approved by DEQ prior to permit renewal and has been incorporated into the permit.

The current NPDES permit was issued with a thermal load limitation that was based on the dry weather design average flow. The NPDES permit specifies that the facility must meet this thermal load limit for the maximum week during the dry season. Because of the way the excess thermal load limit is calculated, the facility has the potential to surpass the permitted excess thermal load limit of 3.1 billion BTUs during peak week flows.

Since the Temperature Management Plan was approved by DEQ, Oregon's water quality standard for determining thermal load limitations has been somewhat in flux. After a period of uncertainty, the regulatory environment for temperature discharges has become clearer. In June 2003 DEQ published guidance that specifies that the maximum weekly design flow should be used to calculate the excess thermal load. In early March 2004, EPA approved Oregon's new water quality standards for temperature. The DEQ is developing a temperature TMDL for the Willamette River based on the new Oregon standard. The details of the TMDL are still to be worked out, but could result in a revised thermal load limitation for the facility once the permit is up for renewal. In the absence of the new TMDL standards, the WPCF will continue planning for facilities using the current thermal load limitation and will continue to implement the approved Temperature Management Plan.

A detailed thermal load analysis was completed to estimate the projected dry season thermal load through 2025. Thermal loads discharged to the river are the product of wastewater flows and their corresponding temperatures. The analysis evaluated 7 years of historical flow and temperature data to develop average and peak week dry season thermal loads. From these data, a peak week thermal load peaking factor was calculated and applied to future average thermal loads developed from projected flows and historical average temperatures. The resulting projected peak week thermal load is shown in **Figure 5**.

FIGURE 5
Dry Season Peak Week Excess Thermal Load
Based on Existing Thermal Load Limitations and Projected Flows
MWMC Facility Plan, Eugene-Springfield



Sanitary Sewer Overflows and Blending

Perhaps the most significant impact to potential future treatment technologies lies in the changing regulations for SSO requirements. Currently, untreated emergency SSOs have specific limits on the seasonal timing and storm event conditions that create circumstances such that these discharges are unavoidable and allowable under Oregon state law. Oregon's current SSO rules are embedded in the bacteria water quality standard, which prohibits overflows from less than a 5-year 24-hour winter storm, and from a less than 10-year 24-hour summer storm. Proposed federal rule changes for SSO requirements are currently on hold for further review. More restrictive future federal rules on SSOs will override the Oregon regulations. SSO requirements are a major driver for significant future wet weather improvements. Recommended future treatment technologies should include alternatives for various combinations of SSO possibilities and blending techniques.

Recent collection system modeling efforts have concluded that peak wet weather flows (PWWFs) resulting from the projected 2025 5-year 24-hour storm is estimated at 277 mgd (which equates to 3.9 inches of rain for the Eugene-Springfield area, derived from statistical evaluation of precipitation data recorded at Mahlon Sweet Airport). The current hydraulic capacity of the facility is 175 mgd. The facility can pass wastewater flows up to 200 mgd, although operational and effluent quality problems are experienced at these flows. The aggregate influent pumping systems are unable to handle more than 200 mgd when all units

are in service and wastewater flows over 200 mgd result in SSOs. In addition, the primary clarifiers have a total effective capacity of approximately 90 mgd and the current secondary treatment process is limited to 103 mgd. An increase in both peak flow conveyance and treatment capacity is necessary to comply with DEQ's January 1, 2010 requirement that the wet season flow associated with the 5-year, 24-hour rainfall event be accommodated by MWMC's facilities without resulting in SSOs.

Blending

Blending or split flow refers to the practice of diverting flow around a treatment component (usually secondary treatment) during high flows; specifically, PWWFs. The WPCF was designed to operate using blending when flow exceeds the secondary system capacity, currently estimated at 103 mgd. The practice is not acknowledged in the current NPDES permit and is currently under review by EPA. In late 2003 EPA issued for public comment a proposed policy on blending that if adopted would clarify that blending is a legal practice, subject to the six principles outlined in the proposal. The proposal requires that all re-routed flows be combined before discharge. It is anticipated that the practice of blending will continue to be an acceptable approach for treating PWWFs. For the purposes of evaluating treatment technologies, it is recommended that MWMC look at solutions that are flexible enough to implement either conventional primary effluent blending or equivalent secondary effluent blending.

With the elimination of SSOs, blending will provide the most cost-effective opportunity for the WPCF to provide a treated effluent that meets secondary treatment standards in the most cost-effective manner. Using blended treatment would eliminate large capital investments for facilities that would be used very infrequently. In addition, treatment alternatives should attempt to maximize the capacity of the existing facility's primary and secondary treatment facilities, minimizing the frequency of blended treatment and taking full advantage of MWMC's existing investment. Even under the best circumstances, significant investments and modifications to the facility will be required to convey and treat the projected PWWF.

Bacteria

It is anticipated that the current bacteria limitations specified in the NPDES permit, which require a monthly geometric mean of 126 *e. coli* per 100 milliliters (ml) and a maximum sample containing 406 *e. coli* per 100 mL, will continue to be implemented in future NPDES permits. Although not required to meet anticipated bacterial limitations, alternative disinfection technologies should be evaluated to address operator and community safety issues associated with the current disinfection practice that uses gaseous chlorine and sulfur dioxide.

Turbidity

The current turbidity standard is based on the Oregon State Water Quality Standard, which stipulates that the wastewater cannot increase the river turbidity by more than 10 percent at the edge of the mixing zone. This standard is currently under review by the state and it is possible that a more stringent numerical limit could be imposed in future NPDES permits. Treatment alternatives that include improved secondary treated effluent water quality and effluent filtration should be considered at that time if necessary.

Dissolved Oxygen

The Willamette River in the Eugene-Springfield area is not included in the 303(d) list for dissolved oxygen (DO). The current DO standard is based on the Oregon State Water Quality Standard; however, there is no current numerical limit in the NPDES permit. It is possible that a more stringent numerical limit could be imposed in future NPDES permits. The implementation of a future DO numerical limit may require future treatment facilities. However, for purposes of the facility plan, no facility accommodations for DO are being considered.

Mercury

A TMDL for mercury is currently being developed for the Willamette River. The requirements resulting from the TMDL are uncertain at this time.

Arsenic

The Willamette River was listed in the 2002 303(d) list for exceedances of the arsenic human health criterion for "water and fish ingestion." This listing could eventually lead to development of a TMDL for arsenic. Any numerical arsenic limit is unlikely to affect future recommended treatment technologies at the WPCF and will likely be implemented as source control reductions.

Cyanide

Cyanide discharges into the treatment facility are currently below the calculated maximum headworks loading. Analytical laboratory results for final effluent indicate detectable levels of total cyanide, while analysis of secondary effluent before chlorination has consistently resulted in non-detectable amounts. The current disinfection process generates compounds that analyze as cyanide. These analytical results for total cyanide concentrations are not high enough to cause an exceedance of a water quality standard in the Willamette River and will not affect future recommended treatment technologies.

Metals

Current effluent and biosolids metals concentrations are well below any regulatory thresholds. Some changes to the Oregon criteria for metals are expected as a result of triennial review. New criteria are expected to be adopted by the Environmental Quality Commission (EQC) in April 2004, including metals criteria expressed as dissolved. This will reduce the likelihood of water quality-based effluent limitations for metals becoming a permit issue. Any numerical limits for metals are unlikely to affect future recommended treatment technologies at the WPCF and will likely be implemented as source control reductions.

Toxicity

There are no current problems complying with the acute and chronic toxicity requirements in the permit. If a situation were to arise whereby effluent toxicity was identified as a potential problem, a Toxicity Identification Process would be implemented that would likely result in a source control reduction program.

Phosphorus

Phosphorus has not been identified as an effluent quality issue for the Willamette River and there is currently no TMDL for phosphorus planned in the immediate future. However, phosphorus is quickly becoming targeted for biological nutrient removal in the wastewater treatment industry. Flexibility for phosphorus removal should be considered when evaluating alternative treatment technologies.

Total Dissolved Solids

The total dissolved solids (TDS) standard in the Willamette River is 100 mg/L. There are currently no compliance issues with respect to effluent quality and TDS. Any numerical limit is unlikely to affect future recommended treatment technologies at the WPCF. However, alternative disinfection practices such as the addition of sodium hypochlorite can significantly increase TDS discharges.

Dioxins and Furans

Currently, EPA's summary table of recommended criteria only contains criteria for one form of dioxin, 2,3,7,8-TCDD. Consequently, Oregon only has numeric criteria for this one form of dioxin. However, EPA has published a toxic equivalency factor (TEF) approach for states to voluntarily adopt criteria for a mixture of 2,3,7,8-TCDD and other dioxin-like compounds based on their relative toxicity to 2,3,7,8-TCDD. If adopted, sources of these compounds would be required to meet a single numeric concentration representing the mixture of dioxin-like compounds. At its May 20-21, 2004 meeting the EQC decided to not include the TEF approach in the Oregon water quality standards because DEQ staff indicated it would not be appropriate at this time to adopt the TEF approach because it would require increased resource requirements to implement.

Any future, more stringent limits for dioxins and furans could affect future recommended treatment technologies at the WPCF but will most likely be implemented as source control reductions through MWMC's existing industrial pretreatment program.

Existing WPCF Drivers

Existing treatment and operational issues at the WPCF further drive the need for analysis and planning. **Table 1** summarizes the current capacity, current unit process performance, limiting design factors, and deficiencies identified for each unit process at the WPCF. These issues must be addressed in the current planning process.

Technology Drivers

New technologies are emerging to address both existing and future wastewater treatment needs. New technologies may have the advantage of providing a better end product, providing more cost-effective treatment, lowering operational and maintenance requirements and costs, as well as other benefits. The WPCF staff would like to evaluate new technologies where it makes sense to address both existing and future needs.

Unit Process Alternatives

Regulatory drivers, existing WPCF drivers, and technology drivers can all be combined to form a matrix of treatment facility needs and potential solutions. **Table 2** summarizes the project matrix for the WPCF. This matrix identifies potential unit process solutions for various identified issues. Each of these unit process solutions must be screened to determine if a particular unit process may be combined with other unit processes to provide an overall system solution and recommended plan for the facility.

Evaluation Criteria

MWMC Evaluation Criteria

Each of the unit process solutions identified in the project matrix were screened to determine their suitability for further consideration. They were evaluated against criteria developed by MWMC and Eugene-Springfield staff at a chartering workshop. Developed criteria fall into three categories:

- Process Performance
- Process Operations and Maintenance (O&M)
- Process Implementation

Process performance criteria include the following:

- Reliability to meet current requirements
- Capability to meet future requirements
- Multiple applications or benefits
- Impact to other processes
- Sustainability (minimizing chemical, power, other resource use)
- Minimal odor, noise, and other impacts

O&M criteria include the following:

- O&M ease and simplicity
- O&M flexibility
- O&M environment and safety

Process implementation criteria include the following:

- Capital cost
- Annual O&M cost
- 20-year present worth
- Site impact
- Ease/impact of construction
- Flexibility for phased implementation