MWMC Eugene-Springfield WPCF Facility Plan—Thermal Load Evaluation

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Project File – Task 4.2

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DATE: November 15, 2003

Introduction

The purpose of this technical memorandum is to identify alternatives that may assist the Metropolitan Wastewater Management Commission (MWMC) in meeting the current thermal load limits in the National Pollutant Discharge Elimination System (NPDES) permit and/or assist MWMC with implementing the action items in the Temperature Management Plan.

Existing Temperature Management Plan

Under the 1996 Oregon Temperature Standard (Oregon Administrative Rule 340-41-0026), the Eugene-Springfield Water Pollution Control Facility (E-S WPCF) was required to prepare and implement an approved Temperature Management Plan for the following reasons:

- Discharge from the facility is to a stream 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 the Oregon Department of Environmental Quality (DEQ) prior to permit renewal.

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, the U.S. Environmental Protection Agency (EPA) approved Oregon's new water quality standards for temperature. The DEQ is developing a temperature total maximum daily limit (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.

Historical Thermal Load Analysis

A detailed thermal load analysis was performed to estimate historical thermal load discharges to the Willamette River. The analysis evaluated 7 years of historical flow and temperature data to develop average and peak week dry season thermal loads. Thermal loads discharged are a function of both the wastewater flow and temperature. Average thermal loads are the product of the average daily flow and the maximum daily temperature. Maximum week thermal loads are the product of the 7-day average flow and corresponding 7-day average of the maximum daily temperatures. From these data a peak week thermal load peaking factor was calculated for each year evaluated. The historical data are summarized in Table 1.

TABLE 1
Historical Average and Peak Week Thermal Loads Discharged by the Eugene-Springfield WPCF
MWMC Facility Plan, Eugene-Springfield

Year	DWA Temperature (Degrees F)	DWA Thermal Loading (Billion Btus/day)	DWMW Thermal Loading (Billion Btus/day)	DWMW Thermal Load Peaking Factor
1996	63.5	15.8	31.8	2.01
1997	66.6	15.9	20.7	1.30
1998	66.6	16.9	29.1	1.73
1999	65.2	14.8	19.4	1.31
2000	66.5	15.4	23.0	1.49
2001	68.6	13.8	17.6	1.27
2002	68.1	13.9	16.6	1.20
Average	**66.4**	**15.2**	**22.6**	**1.47**
Maximum	**68.6**	**16.9**	**31.8**	**2.10**

Projected Thermal Loads

In the absence of the new TMDL standards, the E-S WPCF will continue planning for facilities using the current thermal load limitation and will continue to implement the approved Temperature Management Plan. Therefore, projections of future thermal loads anticipated from the Eugene-Springfield WPCF as outlined in this section are based upon the method described in the current NPDES permit for calculating the excess thermal load.

Data from Table 1 can be used to project future thermal loads assuming no provisions for thermal load mitigation practices or strategies are introduced. The criteria used to project the thermal loads are based on the average of the maximum daily dry season temperatures calculated from 1996 through 2002. The maximum week thermal load peaking factor selector to convert the projected average thermal loads to maximum week thermal loads is the maximum peaking factor for all years evaluated. The design criteria are shown in Table 2.

TABLE 2
Design Criteria Used To Project Future Thermal Loads Through 2025
MWMC Facility Plan, Eugene-Springfield

Design Criteria	
DWA Temperature, Degrees F	66.4
DWMW Thermal Load Peaking Factor	2.01

Applying the design criteria shown in Table 2 to the projected average dry season flow results in the projected dry season average and peak week thermal loads through the design year 2025. These projections are shown in Table 3.

TABLE 3
Projected Dry Season Average and Peak Week Thermal Loads Through 2025
MWMC Facility Plan, Eugene-Springfield

Year	Projected DWA Flow	Projected DWA Temperature	Projected DWA Thermal Loading (Billion Btu/day)	DWMW Thermal Load Peaking Factor	Projected DWMW Thermal Loading (Billion Btu/day)
2005	31.3	66.4	17.3	2.01	34.9
2010	33.5	66.4	18.6	2.01	37.3
2015	35.7	66.4	19.8	2.01	39.8
2020	37.9	66.4	21.0	2.01	42.2
2025	40.1	66.4	22.2	2.01	44.7

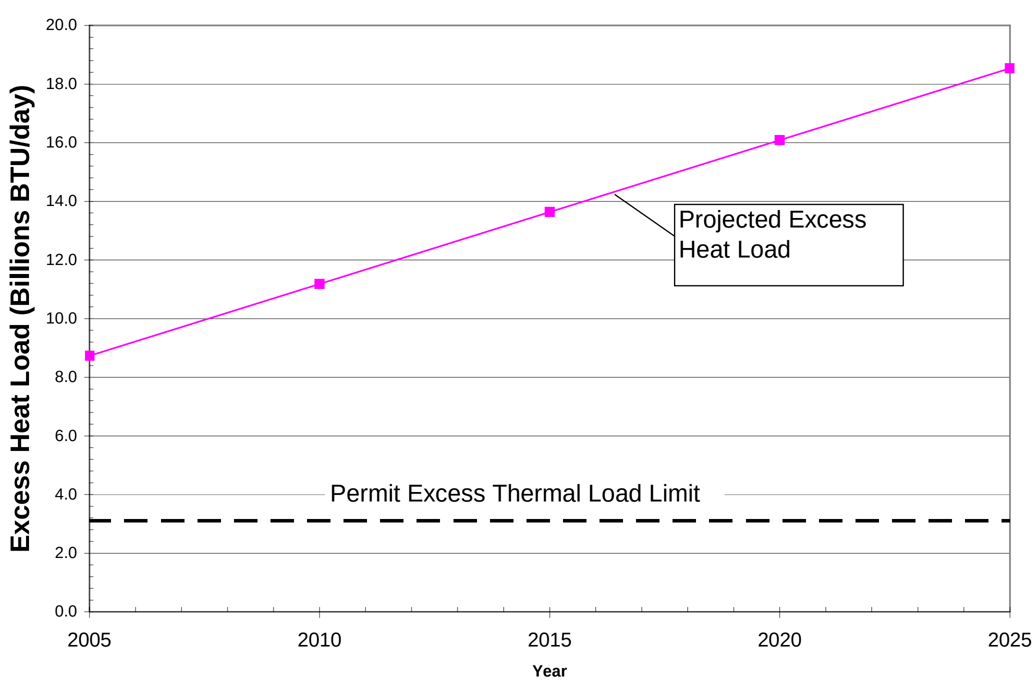
The current NPDES permit was issued with a thermal load limitation that was based on the dry weather design average flow of 49 mgd and the 7-day moving average effluent temperature of 71.6 degrees Fahrenheit. The excess thermal load limit is calculated based on the dry weather design flow and the degrees Fahrenheit that the maximum 7-day moving average effluent temperature exceeds the applicable stream temperature standard of 64 degrees Fahrenheit. However, the NPDES permit specifies that the facility must meet this thermal load limit for the maximum week flow during the dry season. Because of the way that 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. Using the projected DWMW thermal loading and the current NPDES maximum thermal loading based on the allowable stream temperature standard of 64 degrees Fahrenheit, the projected DWMW excess thermal load was calculated and is shown in Table 4.

TABLE 4
Projected DWMW Excess Thermal Load vs. Current NPDES Excess Thermal Load
MWMC Facility Plan, Eugene-Springfield

Year	NPDES Allowable Excess Dry Weather Heat Load Limit (Billion Btu/day)	Projected DWMW Thermal Loading (Billion Btu/day)	Current NPDES Maximum Heat Load	Projected DWMW Excess Thermal Loading (Billion Btu/day)
2005	3.1	34.9	26.2	8.7
2010	3.1	37.3	26.2	11.2
2015	3.1	39.8	26.2	13.6
2020	3.1	42.2	26.2	16.1
2025	3.1	44.7	26.2	18.5

Figure 1 illustrates the data in Table 4 graphically and shows that the facility has the potential to exceed the current excess thermal load standard prior to 2005.

FIGURE 1
Graph of Projected DWMW Excess Thermal Load vs. Current NPDES Excess Thermal Load
MWMC Facility Plan, Eugene-Springfield



Preliminary Screening of Alternatives

A preliminary screening of strategies available for reducing effluent temperature /thermal loads discharged to the Willamette River produced the following ideas:

- Modifications to Processes at the WPCF
- Source Control
- Evaporative Cooling
- Mechanical Cooling
- Effluent Trading/Riparian Shading
- Hyporheic Cooling
- Shore Side Diffuser
- Effluent Reuse

These candidate processes were evaluated in the Preliminary Screening Alternatives technical memorandum and the following conclusions were reached with respect to each alternative.

Modifications to Processes at the WPCF

The Temperature Management Plan submitted to DEQ in January 2004 concluded that no plant practices cause a measurable increase in effluent temperature beyond those caused by necessary biological treatment activities. Staff will continue to monitor new process technologies and techniques as they are introduced. This alternative was eliminated from further consideration.

Source Control

The Temperature Management Plan submitted to DEQ in January 2004 concluded there are no significant industrial or commercial dischargers to the wastewater treatment system that have a measurable effect on influent temperature. Reducing their existing maximum allowable discharge temperature would have little or no effect on the temperature of the wastewater at the WPCF. This alternative was eliminated from further consideration.

Evaporative Cooling

Cooling towers and cooling ponds could be used to cool the wastewater effluent. A common limitation to all evaporative cooling systems is that the lower limit of achievable temperature is represented by the wet-bulb temperature, which depends primarily on air temperature and relative humidity. This technology will only cool water to some temperature above the wet bulb temperature, which in critical summer months is not very effective in reducing wastewater treatment plant temperatures. In addition, cooling ponds require a large surface area. This alternative was eliminated from further consideration because of limited effectiveness during critical summer months, and anticipated large footprint.

Mechanical Cooling

Mechanical cooling using refrigeration technology is a reliable means of consistently cooling the effluent below ambient temperatures. It is also one of the most expensive and energy-intensive options. This alternative was eliminated from further consideration because of energy-intensive processes that do not meet sustainability evaluation criteria.

Effluent Trading/Riparian Shading

MWMC is in the early stages of exploring water quality effluent trading. Opportunities may exist over the long term to perform riparian area restoration and shading and/or hyporheic flow augmentation to cool sections of the watershed in exchange for a relaxed temperature standard at the WPCF outfall.

Over the past 200 years, much of the shade canopy that existed along stream banks has been removed through anthropogenic activities. This shade canopy had long provided insulation against solar gain, particularly on smaller channels. Restoring this riparian shade canopy in the smaller, shallower channels can provide significant positive temperature impacts over the entire watershed.

MWMC staff will continue to pursue opportunities in these areas as they arise, but no further analysis of these alternatives will be discussed in this technical memorandum.

Willamette River Hyporheic Cooling of the Hyporheic Zone – MWMC and WPCF management staff are exploring opportunities to discharge some effluent into hyporheic zones to take advantage of the unique hydrological cooling process. MWMC staff will continue to pursue opportunities and track research progress in this area, but no further analysis of this alternative will be discussed in this technical memorandum.

Shore Side Diffuser

A perforated pipe could be buried along the Willamette River that would diffuse effluent into the ground. This effluent would then migrate into the Willamette River in a much more diffused manner than currently occurs with the existing instream diffuser. However, no net heat would be “removed” from the Willamette River via this process. Also, this approach would not effectively address the need for additional outfall capacity during peak flow events in the winter season. This alternative was eliminated from further consideration.

Reuse

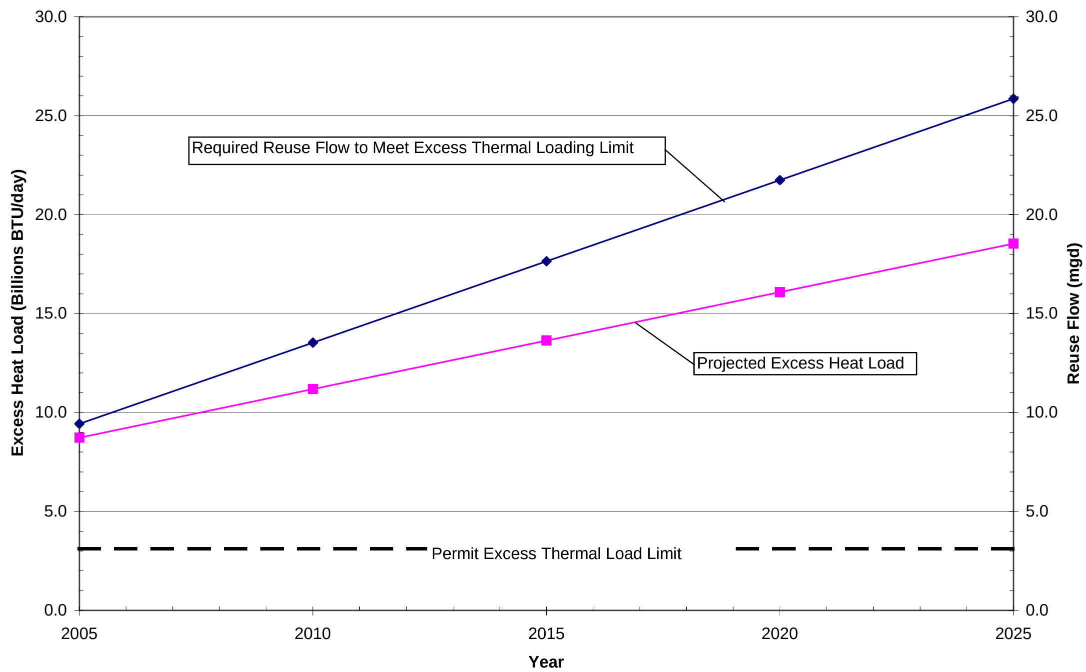
Beneficial reuse of effluent for irrigation reduces the amount of effluent and therefore heat that is discharged to the Willamette River. Reuse options should be considered further to reduce the excess thermal load discharge from the WPCF to the Willamette River.

Excess Thermal Load and Reuse

State regulations classify effluent reuse into four levels of end use. Moving from Level I to IV, more reuse options become available; however, the treatment and performance requirements also become more stringent. Regardless of the type of effluent reuse program implemented, the excess thermal load limitation, if mitigated strictly by reuse, would require the removal of approximately 30 mgd of wastewater from the Willamette River during periods of maximum week thermal load flow events at the 2025 design year. This assumes the worst case thermal load scenario from the WPCF and assumes that the thermal load restrictions in the current NPDES permit remain unchanged during the study period.

Figure 2 shows the amount of wastewater effluent required to be removed from the river to meet the current maximum week excess thermal load requirement of 3.1 billion Btus/day over the study period.

FIGURE 2
Wastewater Effluent Removal Requirements
MWMC Facility Plan, Eugene-Springfield



In the Lane County area, effluent reuse could potentially be conducted on poplar trees, grass for hay or seed, pasture or golf courses. Grass is grown in the region without irrigation, so a study would need to be conducted to determine if there is an interest from independent growers. A similar study would need to be conducted associated with golf courses, which currently use potable water from ground and/or surface water sources.

The *Preliminary Screening of Alternatives* technical memorandum provides an analysis of both large- and small-scale effluent reuse alternatives. The large-scale (approximately 30 mgd) reuse alternative discussed, or that are needed to mitigate the entire excess thermal load problem, appears to be cost-prohibitive. However, smaller-scale reuse alternatives, including the two-phase 10 mgd Level IV reuse program (included 2.5 mgd demonstration project and a 7.5 mgd full scale project) and the Level II reuse program at the Seasonal Industrial Waste Facility, can be implemented at a reasonable cost. These alternatives also have the added advantage of reducing the biochemical oxygen demand and total suspended solids loads to the river.

Although the recommended reuse program will not fully meet the projected, worst-case, long-term requirements for reducing the excess thermal load to the Willamette River, these programs will provide for a significant reduction in thermal loads discharged to the

Willamette River. These programs will also increase public awareness of the benefits of effluent reuse, and potentially increase the interest and the demand in the region for more effluent reuse.