Appendix J

Executive Summary on Wastewater Treatment Mod Study

Table of Contents

Tables

EXECUTIVE SUMMARY

1.0 INTRODUCTION

The Grand Rapids Public Utilities Commission (GRPUC) contracted with HDR to assess the capacity and condition of the Grand Rapids Wastewater Treatment Facilities (WWTF) in preparation for the implementation of Project Thunderhawk by the UPM/Blandin Paper Mill (Mill). UPM/Blandin currently produces approximately 86 percent of the total WWTF flow and plans to add Paper Machine No. 7 (PM7) and groundwood and thermomechanical pulping lines to their existing facilities.

This Modifications Study includes a review of the GRPUC's wastewater treatment 1998 Comprehensive Plan, an assessment of current conditions, develops flows and loadings for current and future conditions, provides a preliminary evaluation of alternatives to address treatment needs, and presents initial results of BioWin™ modeling. The study concludes with estimated costs and a discussion of the preliminary findings, recommended alternative and recommended construction phasing to complete the work while maintaining interim treatment. This Modifications Study builds upon prior work, where relevant, and provides input for the Environmental Impact Statement (EIS) required for the implementation of the Thunderhawk Project.

It is noted that this Modifications Study presents treatment alternatives and a recommended alternative based upon preliminary findings. During the design phase of the Project, additional modeling, pilot study work and evaluation will be done to establish the actual design parameters for treatment unit sizing and proposed process equipment as well as verify assumptions and initial criteria presented in the Modifications Study. The final recommended design will be subject to the MPCA NPDES Permit process. As a result, the WWTF improvements will be in compliance with MPCA requirements under the GRPUC NPDES Permit, Solid Waste Permit, Ten States Standards and other applicable requirements.

2.0 EXISTING CONDITIONS

Industrial wastewater generated at the Mill is treated at the WWTF, owned and operated by the GRPUC. The WWTF are distributed between two site locations. Wastewater from the Mill is initially pumped to the Primary Plant. Treatment by clarification results in primary solids removal. Septage, domestic wastewater, and nutrients are then added to the primary effluent before it is pumped to the Secondary Plant, which is located approximately a mile away. Biological treatment by an activated sludge process occurs at the Secondary Plant. Unit processes include aeration, clarification, and disinfection. The solids produced by the Secondary Plant are referred to as Waste Activated Sludge (WAS). Treated effluent is discharged from the Secondary Plant into the Mississippi River at an outfall structure located approximately two miles downstream of the Blandin Dam.

2.1 CURRENT EFFLUENT DISCHARGE

Effluent is discharged to the Upper Portion of the Upper Mississippi River Basin (Grand Rapids Dam to Prairie River segment), in accordance with Minn. R. 7050.0470, Subp. 4. This segment of the Mississippi River is Class 2B, 3B, 4A, 4B, 5, 6 water. The GRPUC WWTF operates according to national and state regulations including National Pollutant Discharge Elimination System (NPDES) and State Disposal System (SDS) Permit MN 0022080 for discharge into the Mississippi River. The current NPDES Permit discharge limits are listed in Table J-1. In addition to the parameters listed in Table J-1, priority pollutant total metals including cadmium, chromium, copper, lead, zinc, and nickel must be monitored. The NPDES Permit also requires the monitoring of mercury, dissolved oxygen (DO), and temperature.

Class 2B requirements state that wastewater discharges cannot increase the temperature of the receiving stream more than 5º F above natural based on monthly average of the maximum daily temperature and in no case shall the discharge exceed the daily average temperature of 86º F. The average maximum final wastewater effluent temperature was 59º F for the period 2003 to present. During this time period, there were only two days when the maximum wastewater temperature reading exceeded 86º F (by 1º F).

Table J-1
Current NPDES Permit Limits for GRPUC Mississippi River Wastewater Discharge

Parameter	Effective Period		
	Jan-Dec	Apr-Oct	June-Sept
BOD_5: Monthly Average (kg/d, mg/L)	1436, 25		
BOD_5: Max Week Average (kg/d, mg/L)	2298, 40		
BOD: Percent Removal (%)	85		
Chlorine Residual: Monthly Maximum (mg/L)		0.038	
Fecal Coliform: Monthly Geometric Mean (No./100 mL)		200	
Total Ammonia Nitrogen: Monthly Average (kg/d, mg/L)			460, 8
pH Range: Monthly Min & Max	6.0 – 9.0		
TSS: Monthly Average (kg/d, mg/L)	1724, 30		
TSS: Max Weekly Average (kg/d, mg/L)	2586, 45		
TSS: Percent Removal (%)	85		

2.2 CURRENT INFLUENT FLOWS AND LOADS

The WWTF currently treat wastewater from the Mill, the cities of Grand Rapids, La Prairie and Cohasset, and septage from the counties of Itasca, Cass, and Aitkin. Wastewater from the Mill is currently generated by PM5 and PM6 and two pressurized ground wood pulping lines. Existing flows and loads are detailed in Table J-2 for the period from February 2003 through April 2005. Prior to February 2003, wastewater from the Mill included the contributions of PM3 and PM4, which are no longer in operation.

Table J-2
Existing Influent Flows and Loads for the GRPUC WWTF

Units	Flow	TSS		$CBOD_5$	
	mgd	mg/L	t/d	mg/L	t/d
Annual Average					
Domestic	0.8	330	1.1	204	0.7
Industrial	5.8	1,335	32.0	425	10.2
Total	6.6	1,212	33.1	398	10.9
Maximum Month					
Domestic	1.1	403	1.8	229	1.0
Industrial	7.6	1,893	59.0	480	15.2
Total	8.7	1,684	61.0	449	16.2
Maximum Day					
Domestic	1.7	416	2.9	292	2.0
Industrial	9.2	5,237	200.0	519	19.8
Total	10.8	4,496	203.0	483	21.8

The WWTF have demonstrated excellent performance based on testing of the NPDES permit parameters since February 2003 (see Table J-3). In excess of 99 percent of influent Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) were removed, compared to the 85 percent requirement. Only 3 percent of the permitted BOD and total ammonia nitrogen and 12 percent of the permitted TSS mass loads were discharged into the Mississippi River.

Table J-3
Testing Results for NPDES Permit Limit Parameters

Parameter	Effective Period		
	Jan-Dec	Apr-Oct	June-Sept
BOD_5: Monthly Average (kg/d, mg/L)	44, 1.9		
BOD_5: Max Week Average (kg/d, mg/L)	59, 2.4		
BOD_5: Percent Removal (%)	99.6		
Chlorine Residual: Monthly Maximum (mg/L)		0	
Fecal Coliform: Monthly Geometric Mean (No./100 mL)		38	
Total Ammonia Nitrogen: Monthly Average (kg/d, mg/L)			15, 0.6
pH Range: Monthly Min & Max	7.1 – 7.7		
TSS: Monthly Average (kg/d, mg/L)	219, 9		
TSS: Max Weekly Average (kg/d, mg/L)	321, 12		
TSS: Percent Removal (%)	99.1		

2.3 CURRENT SIGNIFICANT INDUSTRIAL USER AGREEMENTS

The Mill is classified as a "Significant Industrial User" (SIU) of the WWTF by the NPDES Permit. Table J-4 summarizes the two current SIU Agreements between the GRPUC and the Mill, one for the Primary Plant and one for the Secondary Plant.

Table J-4
Current SIU Agreements between GRPUC and UPM/Blandin Paper

Parameter	Primary	Secondary
Flow, average (mgd)	13.25	13.25
Flow, peak (mgd)	14.25	14.25
TSS, average (lb/d; t/d)	324,000; 162	28,000; 14
TSS, peak (lb/d; t/d)	567,000; 283.5	33,000; 16.5
BOD, average (lb/d; t/d)	N/A	41,300; 20.7
BOD, peak (lb/d; t/d)	N/A	57,350; 28.7
Maximum Temperature, (F;C)	150; 65	104; 40

There were five exceedances of the Secondary Plant SIU TSS peak load limit during the time period evaluated. These occurred on April 27, May 21, August 10, and October 6 of 2003 and September 26, 2004. The reported TSS quantities for these dates ranged from 35,251 to 338,911 pounds. There was one exceedance of the Primary Plant SIU temperature peak on September 12, 2004 of 152º F. There was one instance of the Secondary Plant SIU temperature peak of 104º F being reached on July 20, 2004.

2.4 CURRENT SOLIDS PRODUCED BY THE WWTF

Residual solids produced by the WWTF include domestic screenings, industrial screenings, primary sludge, and WAS. Municipal screenings are those produced from the barscreens at the Primary Plant. This material consists of rags, plastics, paper, and other large items removed from the domestic wastewater. The domestic screenings are disposed of by Waste Management in the Elk River Sanitary Landfill. Approximately 150 cubic yards of domestic screenings are landfilled annually.

Industrial screenings are those produced from the barscreens in the Industrial Screen House just downstream of the Mill. This material consists of wood, bark and pulp from the industrial wastewater. The mechanical barscreens remove the screenings from the wastewater, which are loaded into GRPUC sludge trucks. The industrial screenings are transported and disposed of by GRPUC staff in the GRPUC Landfill near the Secondary Plant. Approximately 300 cubic yards of industrial screenings are landfilled annually.

The sludge from the three primary clarifiers at the Primary Plant and the three secondary clarifiers at the Secondary Plant are combined in the Solids Dewatering Building at the Primary Plant. The three belt filter presses remove a majority of the water from the sludge prior to being loaded into GRPUC sludge trucks. The dewatered primary sludge/WAS is transported and disposed of by GRPUC staff in the GRPUC Landfill. Table J-5 lists the quantities of solids transferred to the GRPUC Landfill, an average of approximately 120 tons/day. High peak daily loads are the result of process changes or upsets at the Mill. There are no apparent seasonal or other patterns to the peaks.

Table J-5
Dewatered Solids Transferred to GRPUC Landfill

Year	Parameter	Loads /Day	Tons/Day	Cubic Yards/Day
2003	Average daily	14	123	165
	Average, max month	18	156	210
	Peak daily	35	312	420
2004	Average daily	12	109	147
	Average, max month	16	145	195
	Peak daily	43	383	516
2005	Average daily	14	122	164
	Average, max month	15	136	184
	Peak daily	30	267	360

2.5 CURRENT GRPUC LANDFILL CAPACITY

The GRPUC Landfill is operated according to MPCA approved Solid Waste Management Facility Permit No. SW-210 issued on August 23, 2001 and effective through August 23, 2006. The 43-acre site has a permitted area of 15 acres with a permitted capacity of 1,350,722 cubic yards. The design capacity of the entire site is 4,218,022 cubic yards. Without consideration of remaining permitted capacity and using just the difference between design and permitted capacity and the current sludge production rates results in a landfill-life of 49 years.

The GRPUC has processed an application to renew permit SW-210 through August 23, 2011. The application is based upon future anticipated sludge production and future operating conditions. The GRPUC's application is currently under review by MPCA staff.

2.6 EXISTING WWTF CONSTRAINTS WITHOUT PM7

There are several constraints on operation at the current WWTF. In the event of an upset at the Mill, such as when a paper machine shuts down, the WWTF is inundated with high solids loading. Primary treatment cannot occur after the primary clarifiers are filled with solids. Solids that pass through the clarifiers are sent to the Secondary Plant. The dewatering capacity of the three existing belt filter presses is inadequate for this peak condition and requires the continuous operation of this dewatering equipment over a period of several days following the upset incident. The biological systems at the Secondary Plant also lack the capacity to treat the BOD loads present during peak loading conditions. Additional areas of concern include the useful life of some process equipment and buildings and the lack of redundancy.

3.0 FUTURE CONDITIONS WITH PM7

The addition of PM7 will result in increased flow and pollutant loads to the WWTF. The influent flow is expected to increase approximately 3.4 mgd to an annual average daily flow of 10.0 mgd. Since PM3 and PM4 have been decommissioned, the flow from PM6 and increase in flow from PM7 will not exceed the current Primary Plant SIU limit or the overall limit in the NPDES permit. Influent flow characteristics will also change with PM7 as the BOD and TSS quantities will increase from current conditions. Due to the proposed addition of heat recovery and dissipation technologies at the Mill, WWTF industrial influent flow temperatures will decrease significantly. Without taking into account remaining useful life, the existing facilities have adequate capacity for future average loading conditions. However, the existing facilities do not have adequate capacity to treat future peak loading conditions.

3.1 Projected Influent Flows and Loads After PM7

Both the quality and quantity of the wastewater is expected to change with the addition of PM7 and a thermomechanical pulping line as shown in Table J-6. Average annual flows are expected to increase 52 percent to 10.0 mgd, TSS is expected to increase 90 percent to 62.9 tons/day and BOD is expected to increase 212 percent to 34.0 tons/day. Maximum monthly flows are expected to increase 53 percent to 13.3 mgd, TSS is expected to increase 92 percent to 117.3 tons/day and BOD is expected to increase 213 percent to 50.7 tons/day. Maximum daily flows are expected to increase 59 percent to 17.2 mgd, TSS is expected to increase 92 percent to 390.0 tons/day and BOD is expected to increase 211 percent to 67.8 tons/day.

Table J-6
Projected Flows and Loads for the GRPUC WWTF after PM7

Units	Flow	TSS		$CBOD_5$	
	mgd	mg/L	t/d	mg/L	t/d
Annual Average					
Domestic	1.0	330	1.4	204	0.9
Industrial	9.0	1,632	61.5	879	33.1
Total	10.0	1,501	62.9	811	34.0
Maximum Month					
Domestic	1.4	403	2.3	229	1.3
Industrial	11.9	2,315	115.0	992	49.4
Total	13.3	2,121	117.3	915	50.7
Maximum Day					
Domestic	2.8	416	4.9	292	3.4
Industrial	14.4	6,422	385.0	1,075	64.4
Total	17.2	5,443	390.0	947	67.8

3.2 Potential Impact of PM7 on Current Significant Industrial User Agreements

The existing Primary Plant SIU agreement limitation of 283.5 tons/day of peak TSS would be exceeded with PM7 if the TSS load were not equalized. The current plans for PM7 include a non-contact water cooling loop system at the Mill that will be designed to reduce Mill wastewater temperature to a maximum of 115° F. Additionally, the proposed cooling towers at the Mill for vacuum pump cooling water heat dissipation will reduce the temperature to a maximum of 110º F. Maximum temperatures averaged 131º F for the period of January 2003 to present, so PM7 actually results in a reduction of 16º F to 21º F respectively, in maximum temperature currently entering the WWTF. It is unlikely that the 150º F Primary Plant agreement limitation could be exceeded after PM7.

3.3 PROJECTED RESIDUAL SOLIDS AFTER PM7

Residual solids produced by the WWTF include domestic screenings, industrial screenings, primary sludge and WAS. Approximately 150 cubic yards of domestic screenings are landfilled annually in the Elk River Sanitary Landfill and this quantity will not change with PM7. The current plans for PM7 include a new screen house/pump station at the Mill to replace the existing structure near the Mill. Currently, approximately 300 cubic yards of industrial screenings are landfilled annually in the GRPUC Landfill near the Secondary Plant. The quantity to be discharged annually after PM7 is dependant on the efficiency of PM7 and the removal efficiency of the new screens, which is assumed to be approximately 450 cubic yards. The quantity of WAS produced is dependent on the improvements recommended for implementation and will be discussed with the WWTF improvements recommended.

4.0 WWTF IMPROVEMENTS EVALUATED FOR PM7

Four alternatives were evaluated that will allow the WWTF to accommodate the addition of PM7 as well as eliminating the existing WWTF constraints. These alternatives all include a new non-contact water cooling loop and new screen house/pump station at the Mill. Other common components include flow equalization, aeration system improvements selected to provide additional oxygen as well as maximizing temperature reduction, and increased sludge dewatering capacity. The alternatives are summarized below:

- Option 1 – Alternative 1: Relocate all sludge dewatering facilities to the Secondary Plant. This alternative includes relocating all sludge dewatering facilities from the Primary Plant to the Secondary Plant. WAS dewatering would be separated from primary sludge dewatering to optimize dewatering and minimize odor generation, but the sludges would be combined prior to landfilling. The existing primary clarifiers and Combined Flow Pump Station would continue to be used under this alternative, but rehabilitation of equipment would be required.
- Option 1 – Alternative 2: Relocate WAS Sludge Dewatering Facilities to the Secondary Plant, while maintaining primary sludge dewatering at the Primary Plant: This alternative includes relocating WAS dewatering facilities from the Primary Plant to the Secondary Plant to optimize dewatering and minimize odor generation, but the sludges would be combined prior to landfilling. The existing primary clarifiers and Combined Flow Pump Station would continue to be used under this alternative, but rehabilitation of equipment would be required.
- Option 2 – Alternative 1: Relocate primary clarifiers and all sludge dewatering facilities to the Secondary Plant. This alternative includes relocating all primary clarification facilities from the Primary Plant to the Secondary Plant. In order to accomplish this, the Domestic Lift Station would have to be upgraded to allow it to directly discharge into the force main to the Secondary

Plant. This would allow the Combined Flow Pump Station to be removed from service. All sludge dewatering facilities would be relocated from the Primary Plant to the Secondary Plant. WAS dewatering would be kept separate from primary sludge dewatering to optimize dewatering and minimize odor generation, but the sludges would be combined prior to landfilling.

- Option 2 – Alternative 2: Convert secondary clarifiers into primary clarifiers and relocate all sludge dewatering facilities to the Secondary Plant. This alternative includes relocating all primary clarification facilities from the Primary Plant to the Secondary Plant. In order to accomplish this, the existing secondary clarifiers would be converted into primary clarifiers at the Secondary Plant, and new secondary clarifiers and a new primary sludge pumping station would be constructed at the Secondary Plant. The newest RAS/WAS Pumping Station would continue to be used. The Domestic Lift Station would have to be upgraded to allow it to directly discharge into the force main to the Secondary Plant. This would allow the Combined Flow Pump Station to be removed from service. All sludge dewatering facilities would be relocated from the Primary Plant to the Secondary Plant. WAS dewatering would be kept separate from primary sludge dewatering to optimize dewatering and minimize odor generation, but the sludges would be combined prior to landfilling.

4.1 Alternative Costs

Capital costs, salvage values, operation and maintenance costs, and present worth for each of the four alternatives evaluated are summarized in Table J-7. These costs do not include the new non-contact water cooling loop or the new screen house/pump station at the Mill.

Table J-7
Alternative Costs

Alternative	Capital	20-yr Salvage Value	Yearly Operation and Maintenance	Present Worth
Option 1 – Alternative 1	$30,684,000	$5,644,000	$3,350,000	$31,906,000
Option 1 – Alternative 2	$31,257,000	$6,083,000	$3,430,000	$32,394,000
Option 2 – Alternative 1	$33,725,000	$5,841,000	$2,943,000	$34,467,000
Option 2 – Alternative 2	$33,215,000	$6,685,000	$2,943,000	$33,635,000

4.2 Recommended Alternative

Option 1 – Alternative 2 is the recommended alternative based on low present worth (within 1.5 percent of lowest present worth alternative) and ease of phased implementation. This alternative includes components required for PM7 as well as components to address existing WWTF deficiencies. These components include: flow equalization by converting the old A-2 cell, an aerobic selector with coarse-bubble diffusion, fine bubble diffusers in Aeration Basin A-2, supplemental surface aeration in A-2 for temperature reduction, rehabilitated surface aeration in Aeration Basin A-1, and additional sludge dewatering capacity to replace aged equipment and accommodate PM7. Dewatering of the primary solids will be done by new screw presses in a new building at the Primary Plant. A new WAS day tank and sludge dewatering building with gravity belt thickeners and belt filter presses is planned for the Secondary Plant. One belt filter press will be relocated from the Primary Plant. The new non-contact water cooling loop system and new screen house/pump station at the Mill are also required components of the recommended alternative. All process units will be designed to meet the MPCA and Ten States Standards for redundancy and reliability.

The first phase of the recommended alternative should be operational by early 2008 to accommodate the proposed March 31, 2008 PM7 start-up date. Interim treatment must be maintained through project construction. Effluent quality cannot lapse because of construction activities nor will construction be an excuse for interrupting treatment, bypassing, or contaminating a water supply.

5.0 RECOMMENDED WWTF IMPROVEMENTS FOR PM7

Several modifications to the WWTF are planned as part of the process improvements associated with the addition of PM7. The existing facilities have adequate capacity for future average loading conditions, but lack adequate capacity to treat future peak loading conditions. To mitigate future peak TSS loads, the addition of flow equalization and increased sludge dewatering capacity is proposed. To mitigate future peak BOD loads, an aerobic selector and additional oxygen for the aeration basins is proposed. To mitigate future peak temperature loads, non-contact cooling at the Mill and supplemental surface aeration at the Secondary Plant is proposed. Additional improvements are also required due to the age and condition of the existing facilities.

5.1 PROJECTED INFLUENT FLOWS AND LOADS AFTER EQUALIZATION

Flow equalization is required to cost-effectively treat the peak TSS loads shown in Table J-6. Flow equalization will also allow PM7 to be accommodated within the limitations of the existing Primary Plant SIU agreement. The Old A-2 cell at the Secondary Plant will be converted into a flow equalization basin. This will prevent flow and solids from overloading the Primary Plant and additionally protect the activated sludge from peak events. Although the equalization basin will have to be cleaned after use, it will provide the rest of the WWTF with a more consistent wastewater for treatment. Table J-8 shows the projected design loadings on the WWTF after PM7 with proposed flow equalization.

5.2 AERATION BASINS

Due to the loadings expected with PM7, additional biological treatment capacity is needed as well as flow equalization. An aerobic selector with coarse-bubble diffusion is proposed to ensure growth of appropriate microorganisms. Modifications to the existing aeration basins include installing a liner and fine bubble diffusers in the New A-2 cell. Supplemental surface aeration will be added for temperature reduction. Surface mechanical aerators in the New A-1 cell will be rehabilitated to provide better aeration, enhanced biological treatment, and will also provide supplemental temperature reduction.

Table J-8
Design Loadings after Equalization

Units	Flow	TSS		$CBOD_5$	
	mgd	mg/L	t/d	mg/L	t/d
Annual Average (A-A)					
Domestic	1.0	330	1.4	204	0.9
Industrial	9.0	1,632	62.0	879	33.1
Total	10.0	1,501	63.0	811	34.0
Maximum Month (MM)					
Domestic	1.4	403	2.3	229	1.3
Industrial	11.9	2,315	115.0	992	49.4
Total	13.3	2,121	117.3	915	50.7
Maximum Day (MD)					
Domestic	2.8	416	4.9	292	3.4
Industrial	12.7	3,711	196	1,066	56
Total	15.5	3,112	201	925	60

Utilizing the full surface area of both aeration basins is more important for heat reduction than the type of aeration process utilized. The aerobic selector is proposed to be a concrete basin to minimize its footprint, but it is aerated with coarse-bubble diffusers which reduces wastewater temperature. As with the aeration basins, the equalization basin will be a lined earthen basin with a large surface area for its possible role in heat reduction. The lining of the two basins will eliminate future leakage concerns.

5.3 TEMPERATURE REDUCTION

As previously mentioned, temperature is regulated at three locations in the WWTF. The Primary Plant SIU limits peak temperature from the Mill to 150º F. The Secondary Plant SIU limits peak temperature from the aeration basins to 104º F. Finally, Class 2B receiving water requirements state that discharges cannot increase the temperature of the stream more than 5º F above natural based on monthly average of the maximum daily temperature and in no case shall the discharge exceed the daily average temperature of 86º F, both temperatures measured at the end of a mixing zone.

5.3.1 Primary Plant SIU

In the time period from January 2003 through April 2005, there was only one hourly reading where the Mill wastewater effluent exceeded 150º F; the maximum temperatures averaged only 131º F. Since the proposed non-contact cooling system at the Mill will limit Mill wastewater effluent to between 115º F and 110º F after the introduction of PM7, these improvements represent a 16º F to 21º F reduction in maximum temperature entering the WWTF. Therefore no additional improvements are recommended for Mill effluent temperature reduction.

5.3.2 Secondary Plant SIU

In the time period from January 2003 through April 2005, the Secondary Plant SIU temperature peak of 104º F was reached only once. The future non-contact water cooling system at the Mill will make it unlikely that the 104º F temperature limitation is exceeded. There is concern expressed that the Secondary Plant biology would be stressed by extended operation at 104º F. Therefore, the WWTF improvements recommended for PM7 were modeled to determine their respective impacts on temperature. These improvements include adding an aerobic selector with coarse-bubble diffusion and converting one aeration basin to fine-bubble diffusion with supplemental surface aeration for temperature reduction. The second aeration basin retains its existing surface aerators. The proposed improvements also include a flow equalization basin that could be used for temperature reduction, but this was not modeled as the primary function of this facility is to treat a Mill spill.

Table J-9 details the effect of the selected treatment processes on the wastewater temperature by applying a steady-state temperature model developed by Talati and Stenstrom for the worst-case condition. The worst-case condition was defined as peak industrial flow (Maximum day = Mill spill), average domestic flow with maximum domestic temperature (minimum cooling from domestic wastewater), utilizing existing surface aerators (designed for maximum oxygen transfer, not cooling effect), and the assumption that the peak flow and temperature are sustained (actual peak flow spill events are 5-6 hours duration, temperature varies constantly).

Table J-9
Predicted Wastewater Temperatures

Process	Q (mgd)	115º F Influent		110º F Influent	
		ºF	ºC	ºF	ºC
Industrial Wastewater Effluent	12.7	115.0	46.1	110.0	43.4
Industrial Primary Clarifier Effluent	12.7	112.6	44.8	107.9	42.2
Domestic Wastewater Influent	1.0	65.0	18.3	65.0	18.3
Combined Selector Influent	13.7	108.8	42.7	104.8	40.4
Aeration Basin Influent	13.7	107.8	42.1	103.9	39.9
Aeration Basin Temperature Under Various Operating Scenarios					
2 Aeration Basins, 8 Surface Aerators	13.7	97.5	36.4	95.0	35.0
1 Aeration Basin, 8 Surface Aerators	13.7	102.7	39.3	99.7	37.6
2 Aeration Basins, 0 Surface Aerators	13.7	99.3	37.4	96.6	35.9
1 Aeration Basin, 0 Surface Aerators	13.7	104.1	40.1	100.9	38.3
1 Aeration Basin, 8 Surface Aerators, No FB	6.9	97.7	36.5	95.2	35.1
1 Aeration Basin, 0 Surface Aerators, FB	6.9	98.8	37.1	96.1	35.6
Combined Aeration Basin Effluent	13.7	98.2	36.8	95.6	35.4

Table J-9, shows that the temperature reduction through the primary clarifiers for the 115° F Mill cooling alternative is 2.4° F. Mixing the Mill effluent with the cooler domestic influent results in a further temperature reduction of 3.8° F. After the aerobic selector, the aeration basin influent temperature is 107.8° F. The typical aeration operation scenario is to operate the aerobic selector in series with the A-2 basin with the fine bubble diffusers operational, but with surface aerators off. Under this operating condition, A-2 temperatures could reach 104.1° F. Just by activating the surface aerators in A-2 will reduce the temperature to 102.7° F. If the flow is then split equally between basins A-1 and A-2, temperatures would be further reduced to 98.2° F. The flow equalization basin could be used to further reduce temperature, but this was not modeled since its primary role is to contain a Mill spill.

If the proposed cooling towers to cool the vacuum pumps are added at the Mill, further cooling of the industrial effluent to 110° F will be accomplished. Table J-9, shows that at 110° F the temperature reduction through the primary clarifiers is 2.1° F. Mixing the Mill effluent with the cooler domestic influent results in a further temperature reduction of 3.1° F. After the aerobic selector, the aeration basin influent temperature is 103.9° F. The typical aeration operation scenario will be to operate the aerobic selector in series with the A-2 basin with the fine bubble diffusers operational, but no surface aerators. Under this operating condition, A-2 temperatures could reach 100.9° F. Just by activating the surface aerators in A-2 the temperature is reduced to 99.7° F. If the flow is then split equally between basins A-1 and A-2 temperatures will be further reduced to 95.6° F. The flow equalization basin could be used to further reduce temperature, but this was not modeled since its primary role is to contain a Mill spill.

The temperature models verify the approach taken in the Modifications Study to balance aeration efficiency against the temperature reduction value of selected WWTF improvements. The improvements recommended for PM7 included converting one aeration basin to fine-bubble diffusion and retaining the current surface mechanical aerators for their thermal reduction value. The temperature models were much more sensitive to surface area than they were to the increased temperature of the compressed air used for fine-bubble diffusion. This is why the proposed improvements for PM7 utilize the full surface area of both aeration basins, rather than converting one or both to concrete basins.

The temperature models indicate that the aeration basin temperature will stay below the Secondary Plant SIU required 104º F under all conditions, except the one resulting in 104.1º F. This condition included the worst case conditions stated previously, a Mill wastewater effluent temperature of 115º F, use of only aeration A-2, with no surface aerators activated. Additional surface aerators that are more efficient at reducing heat (at the expense of aeration efficiency) could be added in the future for further cooling if required for process considerations. These will be evaluated during facility design if additional cooling is desired, being provided at a fraction of the cost of cooling towers at the Mill. Additional effluent cooling and dissolved oxygen enhancement could also be done by adding cascade aeration to the effluent pipeline.

This preliminary temperature modeling suggests that under the worst case scenario of 115º F mill wastewater that the temperature in the selector could reach 108.8º F degrees. During the design phase of the Project, additional modeling and pilot study work will be done at these temperatures to establish the actual design parameters for treatment unit sizing and proposed process equipment as well as verify assumptions and initial criteria developed in the modifications study.

5.3.3 Class 2B River Requirements

WWTF effluent temperature is measured at the Secondary Plant, prior to entering the underground effluent pipeline, which extends 1,050 feet horizontally and 44 feet vertically to its discharge into the river; physical features which result in further effluent cooling that is not measured. In the time period from January 2003 through April 2005, there were only two days when the maximum wastewater effluent temperature reading at the Secondary Plant exceeded 86ºF (by 1º F). It is not known what impact these maximum temperatures had on the river, since average river temperatures at both ends of the mixing zone and river flow is not known. The average maximum final wastewater effluent temperature was 59º F in the period from January 2003 through April 2005.

In order to assess whether the increased flows due to PM7 could increase the temperature of the river more than 5º F above natural based on a monthly average of the maximum daily temperatures, a simple analysis was performed. For summer conditions, the analysis included the following worst case assumptions: 1) the 87º F peak maximum effluent temperature (not average maximum as required by the Class 2B requirements) recorded in the past could be reached after PM7 with the new cooling system at the Mill and supplemental cooling systems at the Secondary Plant, 2) no further cooling occurs in the effluent pipeline, 3) the wastewater peak day flow of 13.7 mgd occurs for durations much longer than the typical 4-6 hour Mill spills of the past, and 4) the river is at 7Q10 minimum flow coincident with maximum recorded river temperature of 83.3º F. These assumptions produced a combined temperature of 84.9º F at the end of the mixing zone in the river, a temperature rise of only 1.6º F.

For winter conditions, the analysis included the following worst case assumptions: 1) the 39º F average monthly effluent temperature recorded in January 2004 could be reached after PM7 with the new cooling system at the Mill and supplemental cooling systems at the Secondary Plant, 2) no further cooling occurs in the effluent pipeline, 3) the wastewater peak day flow of 13.7 mgd occurs for durations much longer than the typical 4-6 hour Mill spills of the past, and 4) the river is at 7Q10 minimum flow coincident with a minimum river temperature of 32.1º F (just above freezing). These assumptions produced a combined temperature of 35.1º F at the end of the mixing zone in the river, a temperature rise of only 3º F. Using the same assumptions for February 2005, except for the 44º F average monthly effluent temperature recorded then, produced a combined temperature of 37.2° F at the end of the mixing zone in the river, a temperature rise of 5.1º F. While this marginally exceeds the 5º F limit, it is likely that the temperature would be reduced further due contact with frigid air temperatures.

5.3.4 Summary

The future thermal loading from the WWTF into the Mississippi River will decrease with the implementation of the non-contact cooling system at the Mill and the auxiliary systems at the WWTF. The aerobic selector basin, the retention of the existing large surface area aeration basins, and the retention of the surface mechanical aerators and supplementary aerators will more than offset any heat gains resulting from converting one aeration basin to a fine-bubble system. Reducing the thermal load from the WWTF will eliminate Mississippi River impacts. Cooling the Mill effluent will primarily occur at the Mill. Additional cooling will be accomplished (in the order of implementation) by: 1) activating the supplemental surface aerators in the aeration basin with fine-bubble diffusers, 2) placing both aeration basins in service, and 3) cooling in the equalization basin (assuming it is not being used to contain a spill at the time). Additional aeration basin cooling could be done simply by adding more surface aerators. Additional effluent cooling and dissolved oxygen enhancement could also be done by adding cascade aeration to the effluent pipeline.

This preliminary temperature modeling suggests that under the worst case scenario of 115º F mill wastewater that the temperature in the selector could reach 108.8º F degrees. During the design phase of the Project, additional modeling and pilot study work will be done at these temperatures to establish the actual design parameters for treatment unit sizing and proposed process equipment as well as verify assumptions and initial criteria developed in the modifications study.

5.4 AFFECT ON SIGNIFICANT INDUSTRIAL USER AGREEMENTS

Due to the fact that the proposed WWTF improvements represent a significant change in conditions, it is anticipated that some modification to the SIU Agreements with the GRPUC will be necessary. The extent of modification required will be determined after the recommended facilities design parameters are established.

5.5 FUTURE SOLIDS PRODUCED BY THE WWTF

It is noted that the projected solids yield in the preliminary modeling is less than what is currently being identified at the WWTF. During the design phase pilot work will be done to verify the anticipate sludge yield rate. Once the yield rate is verified, the equipment sizing and/or hours of operation will be adjusted for the observed sludge yield rate. The quantity of sludge is expected to increase as shown in Table J-10.

It is recommended that the existing Solids Dewatering Building and the two oldest belt filter presses at the Primary Plant be replaced by screw presses in a new building for primary sludge dewatering. The newest belt filter press will be moved to the Secondary Plant, combined with a new belt filter press and two gravity belt thickeners, and used to dewater both WAS and equalization basin solids. This equipment will be housed in a new building. The primary sludge will be dewatered separately from the secondary sludge in the WWTF modifications recommended for PM7. The separate dewatering is to optimize the dewatering efficiency of the different types of sludge; after dewatering, they will be combined for continued disposal in the GRPUC Landfill. During the Project design phase, pilot work will be done with both the proposed screw and belt filter presses to verify performance and percent solids achieved on primary and waste activated sludge. In addition, demonstration work will be done to evaluate the proposed mixing of the primary and secondary biosolids prior to placing in the landfill. The equipment and biosolids processing alternative selected for design will meet the MPCA requirements for landfill disposal under permit SW-210.

Table J-10
Projected Sludge Production after PM7

Design Condition	Primary Plant (dtpd)	Secondary Plant (dtpd)			Total solids (dtpd)
		WAS	EQ solids	Total	
Average	53	15	-	-	68
Max Month	99	27	-	27	126
Peak Day w/o EQ	332	55	-	-	386
Peak Day w/ EQ	167	39	189	76 [1]	243 [1]

[1] *FEQ solids were distributed over a five day period.*

The conversion from the total solids shown in dry tons per day (dtpd) to cubic yards is approximately 3.4. It is anticipated that all solids, with the exception of municipal screenings, will continue to be disposed of in the GRPUC Landfill. Average solids production will increase by approximately 92 percent (230 cubic yards/day) over existing conditions. There is adequate capacity in the GRPUC Landfill for the increased quantities for approximately 34 years if just the difference between landfill design and permitted capacity is used.

5.6 FUTURE EFFLUENT DISCHARGE

It was assumed that future facilities constructed to mitigate PM7 will be designed to replicate existing WWTF performance. On an annual average basis, this would mean that future pollutant concentrations would stay approximately the same, but mass loadings would increase by 52 percent, the projected annual average flow increase. The total projected future mass loading for BOD would still be only 5 percent of what is allowable by the NPDES Permit and TSS would be only 19 percent. Based on this, revisions to the NPDES permit are not anticipated.

5.7 EXISTING WWTF CONSTRAINTS ELIMINATED FOR PM7

Due to the peak loadings expected with PM7, additional biological capacity is needed as well as flow equalization. Modifications to the aeration basins include a new liner and fine bubble diffusers in one basin to increase oxygen transfer and rehabilitated surface aerators in the other to maintain a temperature suitable for biological activity. Separate treatment of the WAS from the Secondary Plant and primary sludge from the Primary Plant will be implemented in stages. Additional dewatering capacity to replace aged equipment and accommodate PM7 is required and will be provided by new equipment. A new sludge dewatering building and associated pumping and piping will be needed to accommodate the new dewatering equipment.