Wastewater Treatment Plant Facility Plan Update

REVISED

City of North Liberty, Iowa

January 2014

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January 2014

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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

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My license renewal date is December 31, 2014.

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Executive Summary

Background and Scope

The City of North Liberty, Iowa currently operates a Membrane Bioreactor (MBR) wastewater treatment facility (WWTF). The system was originally constructed at its present location in 1998, with major expansion projects occurring in 2004 and 2007. The 2004 expansion added a flow equalization basin and pumping station. The 2007 expansion converted the sequencing batch reactor (SBR) process to the currently utilized MBR, which has been operating since August 2008.

Due to North Liberty's geographical location between Iowa City and Cedar Rapids, the community has experienced extremely rapid growth. The population of North Liberty increased from 5,367 in 2000 to 13,374 people in 2010. This is an increase of nearly 150% in 10 years, or an average annual increase of 9.56%. The current estimated population is around 15,500.

Planning for and assisting this rapid growth has been a priority for community leaders and City staff. To help keep pace with rapid growth and plan for future wastewater treatment needs, FOX Engineering has been retained by the City of North Liberty to update the *Wastewater Treatment Facility Plan* completed in March 2006. The 2006 plan identified two phases for expanding the plant. Phase I, completed in 2008, was designed to handle a population of 14,000, which is less than the current estimated population of 15,500. Phase II was intended to serve a population of 22,000. Population growth has been more rapid than anticipated, necessitating a facility plan update. This facility plan update includes updating the existing and projected wastewater flows and loadings, a review of the capacity and performance of the wastewater treatment facility, and updating the plan for expansion of the facility.

Basis of Evaluation and Design

North Liberty's 2012 population is estimated to be approximately 15,500. Projections provided by the City show that the population is anticipated to grow to around 22,200 by 2020 and 30,600 by 2030. This high rate of growth will accelerate the need for wastewater infrastructure improvements.

Current wastewater flows and loads average around 1.4 million gallons per day (MGD) and 1950 lbs/day BOD_5 (five day biochemical oxygen demand). Per capita flows range from 80 to 109 gallon per capita per day (gpcd), and per capita BOD_5 loading averages around 0.15 lbs/capita/day. In order to project future wastewater treatment needs based on population growth, flows were projected assuming 120 gcpd and BOD_5 loading was projected assuming 0.17 lbs/capita/day. These values are somewhat higher than the existing data shows, but using these more conservative values does provide some factor of safety and flexibility in meeting future needs. Existing data was used to develop peaking factors for peak flow and loads relative to average. Projected flows and loadings are presented in Table 1.

Because of the rapid rate of growth, wastewater treatment plant flows and loads were prepared based on target populations rather than a specific year, and divided into two phases. Phase IA would be designed for a population of about 20,400 (approximately year 2018). Phase II would be designed for a population of 27,800 (approximately year 2026). The projected flows and loads for Phase IA and II, along with the current flows and loads, are presented in Table 1.

Table 1. Current and Projected Wastewater Flows and Loads

Parameter	Current	Phase IA	Phase II
Average Daily Flow (ADF), MGD	1.37	2.45	3.33
$CBOD_5$ (lbs/day) (max. month)	2566	3,470	4,730
TSS (lbs/day) (max. month)	2,847	4,080	5,560
TKN (lbs/day) (max. month)	462	670	920

The plant is nearing its design capacity in terms of flow and loading. In order to keep pace with population growth, expanding the wastewater facility in the near future will be necessary.

Existing Facilities

The existing facilities were evaluated in terms of capacity, physical condition, and performance relative to projected wastewater flows and loads. Several needs were identified in order to meet the projected Phase IA and Phase II wastewater treatment demands. These are summarized in Table 2.

Table 2. Summary of Deficiencies.

Flow Equalization

- Increase EQ pumping capacity when the pumps wear out.
- Provide VFD's for the EQ pumps.
- Install new overflow pipe and structure in EQ basin.

Preliminary Treatment

- Replace the screen with a higher capacity unit in Phase IA.
- Replace the manually cleaned screen with a grinder.
- Increase the raw wastewater pumping capacity.
- Install a mixing system in the raw wet well to minimize grease build-up.
- Consideration should be given to installing an odor control system at preliminary treatment.
- Construct a new sewer influent structure.

Secondary Treatment

Fine Screens

- Provide additional fine screening capacity for Phase IA and Phase II.
- Provide hot water spray wash system.

Aeration Basins

- Provide additional aeration basin capacity for Phase II.
- Provide valved opening(s) between the two tanks to allow the water levels in the tanks to equalize.

Aeration System

- Increase the blower capacity for Phase IA.
- Expand the aeration system for Phase II.

Waste Sludge System

- No deficiencies noted.

Mixed Liquor Recirculation Pumps

- Increase the capacity for Phase II.

Membrane Trains

- Provide additional membrane capacity for Phase IA and Phase II flows.
- Replace the membranes prior to April 2018.
- Replace the coating on the membrane tanks when the membranes are replaced.
- Cover the membrane tanks with a solid surface.
- Add a small concrete tank to facilitate membrane cleaning.

Permeate Pumps

- Increase the capacity for Phase IA and Phase II.

Backpulse Tank

- Modify piping to allow increased permeate flow.

Secondary Treatment (continued)

Membrane Aeration System

- For Phase IA, convert the existing membrane trains to GE/Zenon's LEAPmbr system.

Chemical Feed Systems

- No deficiencies noted at this time.

Compressed Air System

- No deficiencies noted at this time.

Ultraviolet Disinfection System

- No deficiencies noted at this time.

Solids Handling Facilities

Aerobic Digesters

- Replace the existing blowers and provide additional blower capacity for Phase II.
- Install magnetic flow meters for the sludge transfer pumps.
- Replace piping supports for the aeration piping in the digesters.

Sludge Storage

- Provide additional sludge storage capacity for Phase IA and Phase II.

Control Building

- Expand the control building to provide additional office space and support facilities.

Biological Nutrient Removal

- Consider adding biological phosphorous removal as part of Phase II.

Separation Requirements & Land Acquisition

- Obtain separation waivers from any individuals that wish to build inhabitable structures within 1,000 ft of the property lines of the existing facilities.
- Consider acquiring the property directly to the east of the existing treatment plant site.

Proposed Improvements

To address the identified needs, proposed improvements for Phase IA and Phase II were developed. These proposed improvements, along with the associated opinion of probable cost, are shown in Table 3 and 4. An opinion of probable cost was also developed for implementing biological phosphorous removal as part of Phase II. This is presented in Table 5.

Table 3. Phase IA Improvements – Opinion of Probable Cost

Item	Cost Opinion
Flow EQ & Preliminary Treatment Improvements	$1,315,000
Secondary Treatment Improvements	$1,305,000
Solid Handling Facility Improvements (Alt. 2 – Dewatering)	$1,431,000
Control Building Addition	$53,000
Electrical & Controls	$647,000
SUBTOTAL	$4,751,000
Contingency	$710,000
Engineering/Legal/Administrative	$820,000
TOTAL	**$6,281,000**

Table 4. Phase II Improvements – Opinion of Probable Cost

Item	Cost Opinion
Preliminary Treatment Improvements	$72,000
Secondary Treatment Improvements	$3,192,000
Solid Handling Facility Improvements (Alt. 2 – Dewatering)	$821,000
Control Building Renovations	$93,000
Electrical & Controls & HVAC	$658,000
SUBTOTAL	$4,836,000
Contingency	$725,000
Engineering/Legal/Administrative	$834,000
TOTAL	**$6,395,000**

Table 5 Adding Biological Phosphorous Removal – Opinion of Probable Cost

Item	Cost Opinion
Site Work and Site Piping	$156,000
Splitter Structure and Channel Modifications	$135,000
Anaerobic Tanks & Equipment	$578,000
Anoxic Mixed Liquor Return Pumping	$165,000
Electrical & Controls	$163,000
SUBTOTAL	$1,197,000
Contingency	$180,000
Engineering/Legal/Administrative	$210,000
TOTAL	**$1,587,000**

Impact on User Rates

Based on the proposed improvements, the City Administrator and financial advisors performed a rate analysis to determine the impact on user rates. Refer to Appendix F for details of the rate analysis and proposed increases. The rate projections were prepared based on projected revenues and expenditures through fiscal year 2025. The projections were based on estimated revenue increase of 2% per year. This is a relatively conservation growth projection, given that the projected wastewater needs are based on a higher population growth. The projections show that rate increases will be necessary through fiscal year 2020 to fund the needed improvements. Rate increases will vary from year to year, but will range between 2% to 15%.

Summary and Recommendations

The wastewater treatment facility is nearing its capacity. As North Liberty continues to grow, expansion of the wastewater treatment plant should commence in the near future to prevent the plant from becoming overloaded. In order to meet the ever increasing wastewater needs of the community, Phase IA and Phase II are proposed to increase the design population to 27,800.

Based on the evaluations presented in this report, the following recommendations are offered:

1. Expansion of the wastewater treatment facility should proceed in the near future, per the recommended schedule shown below.

2. Due to the anticipated rapid growth in North Liberty, Phase II expansion would likely need to be implemented shortly after completion of Phase IA. Therefore, it’s recommended that the city proceed with both the Phase IA and Phase II expansions at the same time.

3. In order to meet newly implemented nutrient reduction requirements, it's recommended that the plant expansion include biological phosphorous removal.

4. The concepts presented in this Facility Plan should be reviewed and discussed and decisions made regarding the specific features and components to be included in the selected plan.

5. Part of the decision process will include deciding how quickly to expand the facilities to meet the growing needs of the community. The City should concur with the proposed components as presented or direct that revised analyses be made.

6. Following acceptance by the City, the facility plan should be submitted to IDNR for review and approval.

7. Following comment by the IDNR, the preliminary design phase of the selected project should be initiated, as appropriate.

Once a decision is reached, then discussions can proceed on various preliminary design aspects associated with the selected plan. Some of the recommendations and analyses discussed in this report may merit more detailed examination. During the design development stage, numerous decision points will arise regarding specific features of the proposed project. It can then be decided which of the recommendations to include in the selected plan and which deviations to make from the concepts proposed by this analysis.

The following schedule is proposed for completing the selected improvements as outlined in this report:

Item	Begin Date	End Date
Submit Facility Plan to IDNR for review	Jan. 2014	Feb. 2014
Preliminary and Final Design	Feb. 2014	Dec. 2014
Bidding	Jan. 2015	Feb. 2015
Construction	Apr. 2015	Apr. 2017

1 - Introduction

1.01 Background and Scope

The City of North Liberty, Iowa currently operates a Membrane Bioreactor (MBR) wastewater treatment facility (WWTF). The system was originally constructed at its present location in 1998, with major expansion projects occurring in 2004 and 2007. The 2004 expansion added a flow equalization basin and pumping station. The 2007 expansion converted the sequencing batch reactor (SBR) process to the currently utilized MBR, which has been operating since August 2008.

Due to North Liberty's geographical location between Iowa City and Cedar Rapids, the community has experienced extremely rapid growth. The population of North Liberty increased from 5,367 in 2000 to 13,374 people in 2010. This is an increase of nearly 150% in 10 years, or an average annual increase of 9.56%. The 2012 estimated population is around 15,500.

Planning for and assisting this rapid growth has been a priority for community leaders and City staff. To help keep pace with rapid growth and plan for future wastewater treatment needs, FOX Engineering has been retained by the City of North Liberty to update the *Wastewater Treatment Facility Plan* completed in March 2006. The 2006 plan identified two phases for expanding the plant. Phase I, completed in 2008, was designed to handle a population of 14,000, which is less than the current estimated population of 15,500. Phase II was intended to serve a population of 22,000. Population growth has been more rapid than anticipated, necessitating a facility plan update. This facility plan update includes updating the existing and projected wastewater flows and loadings, a review of the capacity and performance of the wastewater treatment facility, and updating the plan for expansion of the facility.

1.02 General Description of the Facilities

The existing WWTF is a MBR facility consisting of the following items: preliminary treatment including flow monitoring, screening, grit removal, and raw wastewater pumping; flow equalization basin and pumping station; the MBR facility including two aeration basins and 4 membrane tanks (3 currently in service; 1 for future expansion); disinfection facilities utilizing ultraviolet light technology (currently not in operation); two aerobic sludge digesters with mixing and aeration; and a sludge stored tank also with mixing and aeration.

2 – Basis of Evaluation and Design

2.01 Planning Period and Population Projections

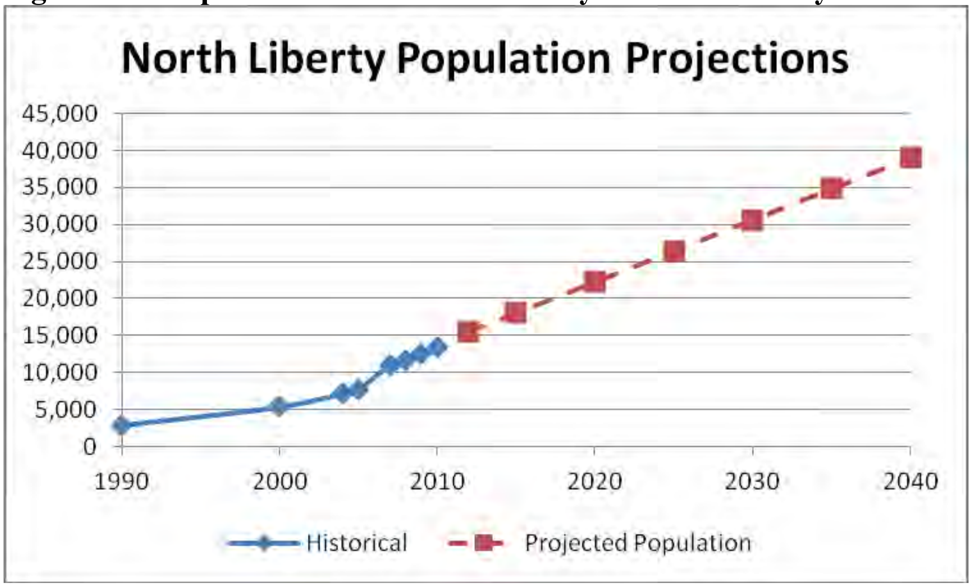
The size and operation of wastewater treatment facilities are heavily dependent upon residential, commercial, and industrial wastewater contributions, as well as inflow of storm water and infiltration of groundwater to the system. Because wastewater treatment facilities are capital intensive and not easily expandable, it has become necessary to develop a long-term plan regarding expansion of the existing WWTF to deal with future community growth.

Most typically, a planning period of 20-years is utilized when planning improvements to wastewater treatment facilities. However, the population of North Liberty is expanding at an exceptional rate. The population grew from 2,926 in 1990 to 5,367 in 2000, which is an average annual rate of 6.25%. From 2000 to 2004, the population increased from 5,367 to 7,224, or an average annual rate of 7.7%. The average annual growth rate from 2004 to 2007 was nearly 15%, and from 2007 to 2010 was about 6.8%. With such an exceptional growth rate, developing accurate population projections for the next 20-years and beyond becomes difficult. Projected population data through the year 2040 was based on an estimated population growth of 840 persons per year in accordance with information provided by the City of North Liberty. This results in a modest population growth rate of 2 to 5% per year through the year 2040. Table 2.1 and Figure 2.1 show the historical and projected population data.

Table 2.1. Historical and Projected Population.

Year	Population	
1990	2,926	
2000	5,367	
2004	7,224	(special census)
2007	10,982	(Census Bureau estimate)
2010	13,374	
2012	15,500	(estimate by provided City)
2015	18,020	
2020	22,220	
2025	26,420	
2030	30,620	
2035	34,820	
2040	39,020	

Figure 2.1. Population Growth for the City of North Liberty.



Because of the rapid growth rate, this report will present recommendations for improvements based upon selected target populations. The year in which the actual population targets occur will ultimately be dependent upon the rate of population growth. To help distribute some of the capital cost over a larger population base, it is anticipated that the necessary improvements will be constructed in phases. The previous facility plan utilized two phases to expand the plant for a population of 22,000. Phase I was designed for a population of about 14,000 and Phase II was intended to be designed for a population of 22,000. This facility plan will look at re-evaluating the design capacities of Phase I and Phase II, look at an intermediate Phase IA, and take a preliminary look at phases beyond Phase II.

2.02 Wastewater Treatment Standards

The North Liberty WWTF is subject to the provisions of the Clean Water Act and to regulations issued by the Iowa Department of Natural Resources (IDNR) and the U.S. Environmental Protection Agency (EPA). The WWTF was issued an NPDES permit (National Pollutant Discharge Elimination System) on November 12, 2002. These permits are typically issued for five years, and the current permit expired November 11, 2007. Since IDNR is behind on issuing new permits, North Liberty, like many communities in Iowa, is operating on an expired permit. When a new permit is issued, it is anticipated that it will have more stringent limits for ammonia. It may also include limits and monitoring requirements for certain metals. The indicator organism for disinfection will also change from Fecal Coliform to *E. Coli*.

Further impacting the water quality standards of the receiving stream (Muddy Creek) for the North Liberty WWTF discharge are downstream uses of Muddy Creek and the Iowa River, including the Iowa City and University of Iowa water supply. Muddy Creek also flows through residential neighborhoods and is in close proximity to an elementary school. Concerns with student contact with Muddy Creek have lead to disinfection limits being imposed. In the past, North Liberty's wastewater discharges into Muddy Creek have come under public scrutiny. However, since the implementation of the MBR, the plant has put out exceptionally high quality water, with no effluent permit violations. Reports indicate that the water quality in Muddy Creek has improved substantially.

A summary of permitted discharge limitations is included in Table 2.2. A copy of the NPDES permit is included in Appendix A.

Table 2.2 Summary Permitted Discharge Limitations.

Parameter	*30 Day Average Concentration*	*30 day Average Mass Loading*
AWW Flow*	1.160 MGD	-
MWW Flow**	2.270 MGD	-
CBOD	25 mg/L	242 lbs/day
TSS	30 mg/L	290 lbs/day
Ammonia – Jan	36 mg/L	300
Ammonia – Feb	42 mg/L	350
Ammonia – Mar	30 mg/L	256
Ammonia – Apr	22 mg/L	186
Ammonia – May	22 mg/L	186
Ammonia – June	22 mg/L	186
Ammonia – July	23 mg/L	192
Ammonia – Aug	19 mg/L	165
Ammonia – Sept	26 mg/L	218
Ammonia – Oct	26 mg/L	218
Ammonia – Nov	22 mg/L	186
Ammonia – Dec	26 mg/L	218
PH	Min 6, Max 9	
Fecal Coliform	200/100 mL (Daily Max)	

* Average daily flow in the wettest month of the year.
** Maximum daily flow

In addition to the effluent parameters shown in Table 2.2, the City must monitor various influent and aeration basin parameters and must meet other effluent criteria including:

- A seven-day average effluent limitation for $CBOD_5$ and TSS.
- A daily maximum effluent limitation for ammonia.
- A daily maximum effluent limitation for fecal coliform (April through October).
- A “non-toxic” effluent limitation for Ceriodaphnia and Pimephales acute toxicity.

New and modified treatment facilities must also meet the latest design standards established by the IDNR. The design standards establish flow and loading requirements for unit processes, reliability criteria for redundancy, and various other requirements established to avoid operational problems.

Water quality standards continue to increase, requiring more stringent effluent limits for municipal wastewater treatment plants. These potential new, more stringent limits should be considered and planned for when undertaking a major WWTP expansion. IDNR is in the process of implementing new water quality standards that will most likely result in more stringent effluent limits for the North Liberty WWTP, particularly for ammonia. Total dissolved solids (TDS), particularly chloride, are also becoming more of a concern in wastewater. Initial testing at North Liberty has found chloride concentrations more than 500 mg/L. Water quality standards establish criteria for chloride levels in streams. Both acute and chronic values are established, and depend on background hardness, sulfate, and chloride. Assuming statewide background values, the chronic criteria (which will most likely govern for North Liberty) is 389 mg/L chloride. Additional testing on background hardness and sulfate may increase the chloride limit, but probably not above the existing concentration. Removal of chlorides is typically not economically feasible at a WWTP. Source reduction is most often the preferred solution.

Potential future nutrient limits and antidegradation requirements are discussed in the following sections.

2.03 Nutrient Reduction Strategy

Over the past several years there has been a good deal of speculation about the possibility of nutrient limits (nitrogen and phosphorous) being imposed on municipal wastewater discharges. IDNR has recently adopted a “Nutrient Reduction Strategy” for municipal dischargers. The strategy is based on the concept that most large (>1 MGD average design flow) activated sludge treatment plants could economically meet technology-based total nitrogen (TN) limits of 10 mg/L and total phosphorous (TP) limits of 1 mg/L on an *annual average* basis with biological nutrient removal (BNR) technology. For facilities that do not have BNR installed and are planning for increased capacity, an evaluation of nutrient removal through the construction permitting process and anti-degradation procedures will be required. Nutrient removal will be encouraged as part of the Nutrient Reduction Strategy. If nutrient removal is not included as part of the expansion, then the next renewed NPDES permit will include requirements to study the feasibility and cost of adding BNR within two years. A schedule would then be negotiated for implementing BNR. After completion of construction, a process optimization and performance evaluation would be completed to determine N and P limits. For the next major expansion, the City will likely be required to evaluate the feasibility and cost of implementing biological nutrient removal.

2.04 Antidegradation

Antidegradation refers to federal regulations designed to maintain and protect high quality waters and existing water quality in other waters from unnecessary pollution. IDNR has adopted an antidegradation policy and implementation procedure to ensure Iowa's waters are protected from activities which have the potential to lower water quality. The antidegradation policy and implementation procedure applies to all new or expanded discharges.

An applicant proposing any regulated activity that would degrade water quality is required to prepare an evaluation of alternatives to the proposed activity. The purpose of this evaluation is to determine whether or not the proposed degradation is "necessary," that is, no reasonable alternative(s) exist to prevent degradation. These alternatives are compared (in terms of practicability, economic efficiency and affordability) to the controls required to protect existing uses and to achieve the highest statutory and regulatory requirements (i.e., the more stringent between the water quality-based effluent limits to protect an existing use and the applicable technology-based effluent limits). Following the evaluation of pollution control alternatives, the least degrading alternative that is practicable, economically efficient, and affordable should be considered the preferred pollution control alternative. If this alternative results in degradation, the applicant must then document the social and economic importance (SEI) of the activity.

Due the growth in North Liberty, an antidegradation alternatives analysis will be required for an expansion of the treatment facility.

2.05 Wastewater Effluent Quality

The City's NPDES permit requires that the wastewater effluent quality be monitored on a regular basis. Since the MBR started operation in August 2008, the facility has be producing exceptionally high quality effluent. For example, the permit requires that CBOD5 and total suspended solids (TSS) concentrations average 25 mg/L and 30 mg/L respectively. For the past three plus years, the plant has been consistently producing effluent with less than 2 mg/L CBOD5 and less than 1 mg/L TSS. In addition, effluent turbidity is consistently less than 0.04 NTU. While not a permit requirement, this is an indication of very high quality effluent (drinking water standard is 0.3 NTU). Table 2.3 shows the effluent wastewater characteristics compared to NPDES permit requirements.

Table 2.3 Wastewater Effluent Quality

Parameter	Avg. Effluent Quality	NPDES Permit Limits
CBOD5	<2 mg/L	25.0 mg/L
TSS	<1 mg/L	30.0 mg/L
Ammonia	<1 mg/L	42.0 – 19.0 mg/L
pH	7.3 – 7.7	6.0 – 9.0
Fecal Coliform	<10 #/100 mL	200 #/100 mL
Turbidity	<0.04 NTU	NA

2.06 Biosolids Management Rules

Land application and disposal of wastewater biosolids (primarily organic solids produced by wastewater treatment processes) are governed by federal and state regulations. Current federal regulations for the utilization or disposal of biosolids and biosolids products are found in 40 CFR Part 503: *Standards for the Use or Disposal of Sewage Sludge.* Part 503 regulates land application, surface disposal, and incineration of biosolids.

Iowa Administrative Code (IAC) Chapter 67 establishes standards for the land application of biosolids. IAC Chapter 67 provides for three classes of sludge based on pollutant levels, pathogen requirements and vector attraction reduction requirements. Class I sludge criteria include more limiting pollutant levels and a higher level of pathogen reduction. However, Class I sludge has less management practice restrictions for disposal due to its excellent quality. Class I biosolids may be applied to lawns and home gardens in addition to agricultural land.

Class II sludge criteria provide for sludge of normal quality that may not meet one of the more stringent requirements for Class I. Class II biosolids may be land applied to agricultural land, but cannot be applied to lawns or home gardens. In addition, more stringent management practice limits are imposed in the regulations for Class II sludge to further protect the public.

Class III sewage sludge is any sewage sludge that does not meet the criteria for either Class I or Class II sludge. Class III sludge cannot be land applied for beneficial use and must be disposed of according to the surface disposal or incineration requirements contained in the Federal Part 503 regulations.

In Iowa, very few municipal wastewater treatment facilities produce Class I or Class III biosolids. Class I biosolids are generally not produced due to the relatively high cost of treatment required to generate such a high-quality sludge. Because Class III biosolids cannot be land applied, they are generally avoided due to their high disposal costs. Given these factors and the ample agricultural ground available for land application, Class II biosolids are produced by the vast majority of municipal wastewater treatment facilities in Iowa. Due the factors discussed above, alternatives associated with producing Class I or Class III biosolids were not developed for the purposes of this report.

2.07 Current Wastewater Treatment Facility Flows and Loadings

To establish current wastewater flows and loadings, plant operational data was collected and evaluated for the time period of January 2009 to July 2013. Information from this data set was used in conjunction with other general design criteria to establish current and projected design flows and loadings for the established planning period. Current flows and loadings are addressed in this section, while projected flows and loadings and biosolids demands are addressed in the sections that follow.

Current flows were established based on the flow metering data included in the plant's records and as defined in the IDNR Design Standards. Table 2.4 shows a summary of current flow data. Plant flow and loading data is included in Appendix B.

It should be noted that during March and December of 2010, and March through May of 2011, the City was testing their new Aquifer Storage and Recovery Well. During those time periods, water from the well was discharged to the sanitary sewer at an average rate of 1200 gpm. This is not a normal occurrence, and is not expected to continue in the future, so this flow was subtracted from the raw wastewater flows shown in Table 2.4.

Current loadings were established for the average day, maximum month, and maximum day using the available data included in the plant's records for the time period of January 2009 to July 2013. Current loadings were established for five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), ammonia nitrogen, and total Kjeldahl nitrogen (TKN). Since only ammonia data was available for the raw wastewater, TKN was estimated assuming a ratio of TKN to Ammonia of 1.6 (typical value for domestic wastewater). Table 2.5 shows a summary of current loadings for BOD_5, TSS, Ammonia, and TKN.

Table 2.4 Current WWTP Flows.

Hydraulic Demands	Flow (MGD)	Peaking Factor
Average Daily Flow (ADF) (1)	1.373	1.0
Average Dry Weather Flow (ADW) (2)	1.300	0.88
Average Wet Weather Flow (AWW) (3)	2.218	1.33
Maximum Wet Weather Flow (MWW) (4)	7.915	3.57
Peak Hourly Wet Weather Flow (PHWW) (5)	12.960	1.64

(1) ADF (Average Daily Flow) is defined as the average daily flow for the year.
(2) ADW (Average Dry Weather) flow is defined as the daily average flow when groundwater is at or near normal. This is often assumed to be the average flow during January and February.
(3) AWW (Average Wet Weather) flow is defined as the daily average flow for the wettest 30 consecutive days on record. The maximum month flow occurred during April 2013.
(4) MWW (Maximum Wet Weather) flow is defined as the maximum flow received in a 24-hour period during wet conditions. The peak day flow occurred during April 2013. The peaking factor is a ratio of MWW:AWW.
(5) PHWW (Peak Hourly Wet Weather) flow is defined as the total maximum flow received in one hour during wet conditions. PHWW was determined from plant flow data, and occurred on April 17, 2013. The peaking factor is a ratio of PHWW:MWW.

Table 2.5 Current WWTP Loadings

Parameter	BOD_5 (lbs/day)	TSS (lbs/day)	Ammonia (lbs/day)	TKN (lbs/day)
Average Day	1,949	2,224	231	370
Maximum Month	2,566	2,847	288	462
Maximum Day	4,137	5,446	659	1,054

The IDNR has established guidelines for determining flow and wastewater strength on a per capita basis. Wastewater flows and loadings (BOD, TSS, and TKN) on a per capita basis are presented in Table 2.6, along with corresponding IDNR guidelines for comparison (TKN loading per capita is based on common practice). The flow is within IDNR guidelines, except for recent dry years. The TSS loading per capita is below or on the lower end of the IDNR guidelines. The BOD5 loading per capita is generally lower than IDNR guidelines. The TKN loading per capita is also on the low end the range of what one might expect in a typical domestic wastewater.

Table 2.6 Historical WWTP Flows and Loadings on per Capita Basis.

Parameter	Data from 2009 – 2013	IDNR Guidelines
Population (1)	12,524 – 16,300	---
ADF (gpcd)	79 – 109	100 – 120
BOD_5 (lbs/capita/day) (2)	0.146 – 0.162	0.17 – 0.20
TSS (lbs/capita/day) (2)	0.17 – 0.21	0.20 – 0.25
TKN (lbs/capita/day) (2),(3)	0.027 – 0.035	0.03 – 0.04 (4)

(1) 2010 census population; estimated for other years.
(2) BOD_5, TSS, and TKN loadings are maximum month.
(3) TKN values assumed to be 1.6 x ammonia.
(4) TKN loading per capita is based on common practice and has not been established by the IDNR.

2.08 Projected Wastewater Treatment Facility Flows and Loadings

Using past flow data, projections through Phase III of the planning period (population 55,500) have been established. While Phase III is many years in the future, and planning for that far into the future is tenuous at best, the intent of this facility plan is determine land area requirements for Phase III and beyond. This will help determine the feasibility of future expansion at the current site beyond Phase II. Future flow projections are heavily dependent upon population growth, and the rate at which the community grows will ultimately determine the rate at which wastewater flows and loads to the plant increase. However, there is direct correlation between population and wastewater flows. Projected flows will most likely occur at their correlating populations, rather than in a particular year.

Because of North Liberty's continued rapid growth, there is a desire to maximize the treatment capacity of the existing facilities while at the same time plan for expansion of the facilities as population growth dictates. To that end, expansion of the facilities has been divided into four Phases, as shown in Table 2.7. The flows and loads identified for each phase are largely dependent on the capacity of the secondary treatment process, the membrane bioreactor (MBR). This is discussed further in Section 3. Phase I construction has already been completed, but the Phase I projected flows and loads are those that the plant can handle without modification based on operational experience.

Average daily flows (ADF) were projected assuming 120 gallons per capita per day (gpcd). This value includes all commercial and industrial contributions, as a function of population. It is higher than the average value for the data set, but does provide a fairly conservative estimate while taking into consideration the variability of the data, and provides some factor of safety. Table 2.7 below provides a summary of the projected flows. The projected ADW and AWW flows were estimated assuming a peaking factor relative to the ADF as indicated in Table 2.4.

Projected MWW and PHWW flows were determined using a different method. As population increases, the ratio of peak to average flows typically decreases. This is especially true for growing communities like North Liberty, where new sewer systems minimize the amount of I/I from new growth areas. Rather than using the existing peaking factors, which includes I/I from much older sewers and areas of town, a revised approach that accounts for reduced I/I in new sewers was used. Project MWW flows were determined by using the existing MWW flow plus 120 gpcpd times the population growth times a peaking factor of 1.5. For PHWW flow, Ten States Standards (11.243) states that peak flows for new systems should be based on 100 gallons/capita/day (gpcd) times a peaking factor based on population ($PF = (18 + \sqrt{P})/(4 + \sqrt{P})$ where P = population in 1000's). This method was used to project the *additional* peak flow for increases in population, except that 120 gpcd was used. The results are shown in Table 2.7

Phase I was originally designed for a population of 14,000 or an ADF design flow of 1.69 MGD and an AWW design flow of 2.53 MGD. Operational experience has shown that the design flow of the membrane system at average conditions can be increased by about 15%. This results in a revised average day design flow of 1.96 MGD and a design population of 16,300. Similarly, the design population for Phase II, with an average day design flow of 3.33 MGD, is about 27,800. An intermediate Phase IA, which is discussed further in Section 4, is based on a population of 20,400. Finally, Phase III was based on a design population of 55,500, which is double the Phase II capacity.

Table 2.7 Projected WWTP Flows.

Hydraulic Demands (MGD)	Phase I	Phase IA	Phase II	Phase III	Peaking Factor
Projected Population	16,300	20,400	27,800	55,500	---
Average Daily Flow (ADF)	1.958	2.448	3.330	6.660	1.00
Avg. Dry Weather Flow (ADW)	1.723	2.154	2.930	5.860	0.88
Avg. Wet Weather Flow (AWW)	2.604	3.256	4.429	8.858	1.33
Max. Wet Weather Flow (MWW)	7.915	8.678	10.054	15.206	---
Peak Hourly Flow (PHWW)	12.960	14.261	16.424	23.416	---

Maximum month BOD and TSS loadings were projected using 0.17 lb/capita/day and 0.20 lbs/capita/day respectively. These loadings are higher than the historical data indicates, which results in conservative loading estimates. TKN loadings were projected using 0.033 lb/capita/day. Table 2.8 below provides a summary of the projected maximum month and maximum day BOD, TSS, and TKN loadings. The projected maximum day loadings were estimated based on peaking factors relative to the maximum month loading.

Table 2.8 Projected WWTP Loadings

Parameter		Phase I	Phase IA	Phase II	Phase III
BOD_5 (lbs/day)	Avg. Day	2,103	2,635	3,592	7,168
	Max. Month	2,770	3,470	4,730	9,440
	Max. Day	4,466	5,594	7,626	15,219
TSS (lbs/day)	Avg. Day	2,547	3,187	4,343	8,671
	Max. Month	3,260	4,080	5,560	11,100
	Max. Day	6,237	7,806	10,638	21,238
TKN (lbs/day)	Avg. Day	433	537	738	1,468
	Max. Month	540	670	920	1,830
	Max. Day	1,234	1,531	2,102	4,181

2.09 Biosolids Demands

Biosolids quantities were also estimated based on operational data collected during the January 2009 to July 2013. A summary of the current and projected biosolids quantities is provided in Table 2.9.

In this table, “Waste Sludge from MBR” refers to the waste activated sludge from the MBR basins that is pumped into the digesters. “Digested Biosolids” refers to the quantity of sludge removed from the digesters after digestion. “Biosolids Hauled for Land Application” refers to the quantity of sludge removed from the sludge storage tank and hauled for land application.

Table 2.9 Current and Projected Biosolids Quantities

Parameter		Current	Projected			
			Phase I	Phase IA	Phase II	Phase III
Waste Sludge from MBR						
Average	lbs/d	1044	2,183	2,728	3,725	7,450
	gpd	10,732	32,719	40,887	55,830	111,661
Max. Month	lbs/d	2,129	2,820	3,525	4,812	9,624
	gpd	20,188	42,266	52,833	72,122	144,245
Digested Biosolids						
Average	lbs/d	621	1,484	1,855	2,533	5,066
	gpd	3,600	8,900	11,121	15,186	30,372
Biosolids Hauled for Land Application						
Average	lbs/yr	433,553	541,821	677,090	924,545	1,849,090
	MG/yr	2.049	3.248	4.059	5.543	11.086

For current biosolids production, waste sludge was assumed to have an average concentration equal to the mixed liquor concentration (averaged 1.17%), with an average of 82% of the total solids being volatile solids (based on operational data). Digested biosolids quantities showed an average volatile solids reduction of approximately 57%, with an average solids concentration of 2%. Land applied biosolids averaged about 2.5% solids, with an average of 67% volatile solids.

Projected biosolids quantities were based on the mass of solids wasted from the MBR as predicted by the activated sludge models (see Appendix C), and assuming 0.8% waste sludge concentration. This provides a more conservative estimate of biosolids production than utilizing historical data. Projected digested and hauled biosolids quantities were calculated assuming 40% volatile solids reduction, 80% volatile solids, and 2% total solids concentrations.

Biosolids quality is tested regularly to determine if regulatory pollutant limits are being met. Records show that the metal concentrations in North Liberty's biosolids are well below the pollutant limits of Class I biosolids. North Liberty's biosolids are therefore not limited by the Cumulative Pollutant Limits of Class II. The pathogen density of the sludge typically does not meet the Class I limit, so the biosolids are classified as Class II for management practices and record keeping.

3 – Existing Facilities

3.01 Collection System

A sanitary sewer service study was completed in April 2011, so analysis of the collection system was not included as part of the scope this study. However, it should be briefly discussed, as all sewage to the treatment facility does come from the collection system, and the performance of the collection system can impact the performance of the treatment facility. Most notably, the characteristic of the collection system that has the greatest impact on the treatment facility involves that of Inflow and Infiltration (I/I). Community growth also has an impact on the collection and ultimately the WWTP.

3.01.1 Inflow and Infiltration

Most sanitary sewer systems within Iowa are subject to flow contributions from I/I. I/I refers to clear (non-sewage) water that enters the sewer system. In the case of infiltration, clear water enters by way of leakage at pipe joints or cracks in the pipes. Inflow enters the sanitary sewer system directly through connections of drain tiles, storm sewers, foundation drains, floor drains, sump pump discharges, and roof drains.

Analyses of Peak Hourly Wet Weather flow (PHWW), Maximum Wet Weather flow (MWW), Average Wet Weather flow (AWW), and Average Dry Weather (ADW), provide some insight as to the amount of I/I entering the sanitary sewer system. If the sewer system were free of I/I, the flows would reflect only the amount of potable water supplied to system users. Typically, ADW flow is defined as the average flow that occurs when the groundwater is at normal levels, and I/I is not occurring.

I/I flow contributions can be difficult to eliminate. Causes of I/I are typically hidden underground, and their locations can only be determined through extensive field work and study. Oftentimes, communities spend large amounts of money to investigate I/I, and construct improvements to try to reduce the amount of flow contributed from I/I. However, considering the vast expanse of most sanitary sewer collection systems, service lines, and other connections, efforts to reduce I/I are often not cost effective.

Although the amount of I/I present in the collection system is significant, it does not appear excessive. When considering the characteristically high ground water table present in North Liberty, it is apparent that the amount of relatively new sewer lines throughout the community have been effective in minimizing the amount of I/I that enters the system. Peak flows due to I/I contributions appear to be within acceptable levels when compared to ADW flow. The flow equalization basin is designed to improve plant operation during periods of wet weather by storing the excess flow until flows decrease.

3.01.2 Parallel Interceptor Sewer

The Sanitary Sewer Service Study prepared in 2011 identified the need for a parallel interceptor sewer to alleviate overloading on the existing sewer. The new 33-inch interceptor sewer would parallel the existing 24-inch interceptor and enter the wastewater treatment plant from the west, and would be sized to handle the ultimate build-out for the existing service area. The two interceptor sewers together would handle an ultimate capacity of about 20.7 MGD. It will likely be many years until the build-out is complete and the ultimate flow is reached.

3.01.3 Southeast Growth Corridor

The 2011 Sanitary Sewer Service Study also identified several areas where growth is likely to occur in North Liberty, and how those areas would be served by sanitary sewer. One of the areas most likely to develop is the Southeast Growth Corridor, which ultimately includes 1275 acres. The 2011 study divided this area into three basins. Basin 1 is approximately 653 acres, which when fully developed will contribute an estimated 0.653 MGD average daily flow. Basin 2 is approximately 448 acres, which when fully developed will contribute an estimated 0.448 MGD average daily flow. Basin 3 is approximately 174 acres, which when fully developed will contribute an estimated 0.174 MGD average daily flow.

The city is currently planning to proceed with the sewer construction for Basins 1 & 2 next year. This will required construction of a new 27" interceptor sewer that will enter the WWTP on the north east corner. The 27" sewer will carry an ultimate capacity of about 6.0 MGD.

3.01.4 Impact of Sewer Improvements on WWTP

When the ultimate capacity of both the new 33-inch parallel interceptor and new 27-inch SE Growth Corridor sewer are realized, the projected peak flow to the WWTP will be about 26.7 MGD. This is very close to the projected Phase III peak flow. To handle this flow, major improvements will be needed at the plant, including a new preliminary treatment building. These are discussed further in Section 4.

In the interim period, the new sanitary sewers will need to be connected and routed to the existing preliminary treatment facility and EQ pumping station. This will require construction of some new structures and inter-connecting sewers. The existing facilities can handle the Phase II peak design flow of 16.4 MGD. Once this flow is reached, the wastewater will need to be re-routed to new preliminary treatment facility.

Section 4 discusses options routing the new sewers at the WWTP site, keeping in mind future considerations. Careful monitoring of growth and development will be necessary to ensure the WWTP expansion keeps pace.

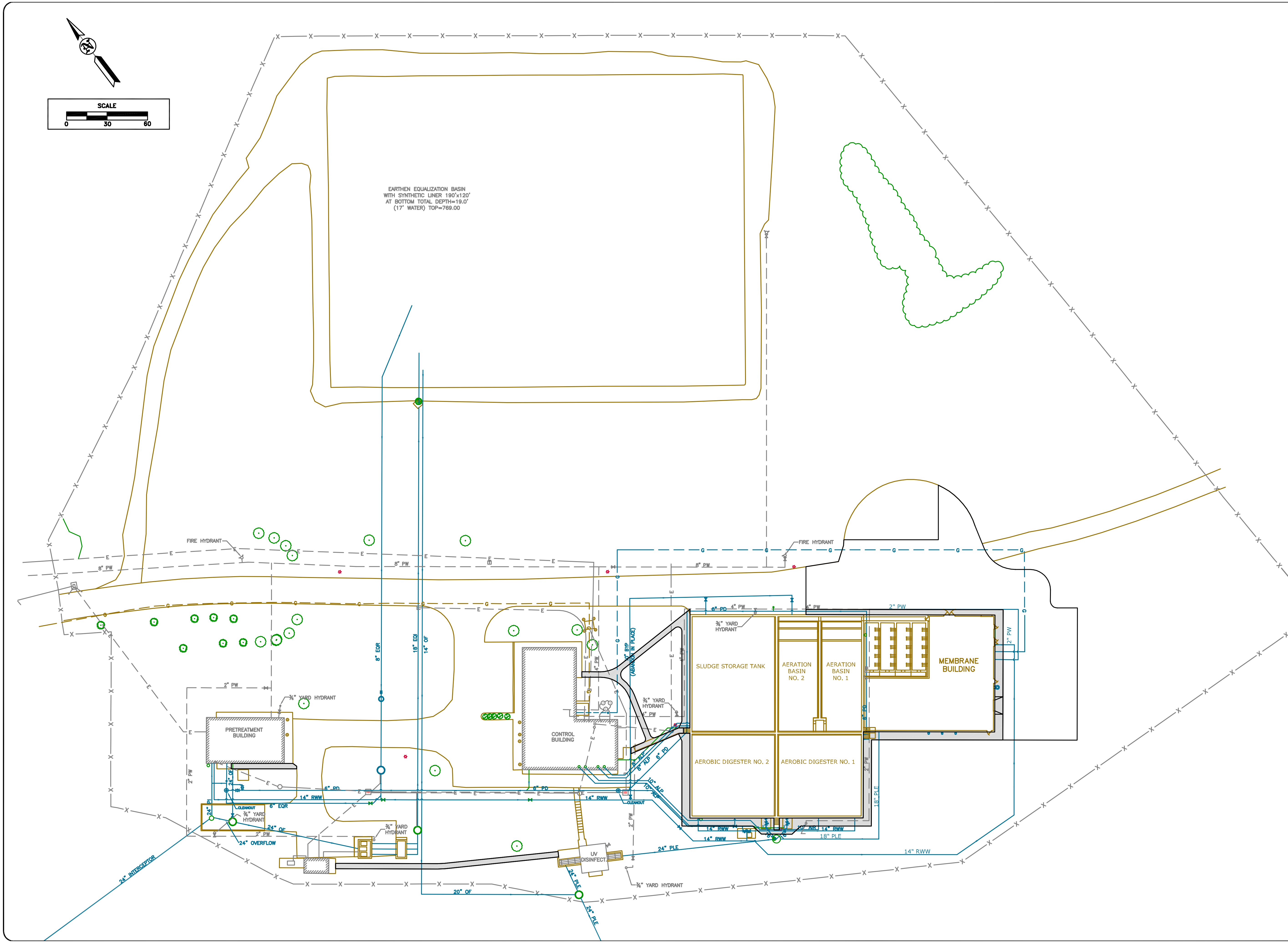
3.02 Treatment Facility

Planning for the existing North Liberty WWTF began in 1994, and construction of the original facility was completed in 1998. The original facility consisted of preliminary treatment (screening and grit removal), activated sludge sequencing batch reactor (SBR) treatment, ultraviolet (UV) disinfection, and aerobic sludge digestion and storage. The 2004 WWTP Improvements project added a flow equalization basin and pumping station. The latest expansion, called the "Phase I WWTP Improvements", converted the sequencing batch reactor process to a membrane bioreactor (MBR) secondary treatment process and greatly increased the capacity of the plant. A planned Phase II expansion was intended to increase the flow capacity by more than 50% and add additional biosolids handling facilities.

The current membrane bioreactor facility includes the major unit processes listed below. A detailed description of each of these major unit processes, along with an evaluation of their capacity and condition, is provided in the following sections. A site plan showing the layout of the current treatment facility is shown in Figure 3.1.

- Flow equalization
- Mechanical screening
- Grit removal system
- Raw wastewater pumping
- Influent flow metering
- Fine screening
- Membrane bioreactors
- Ultraviolet disinfection system
- Aerobic digesters/storage

Wastewater initially enters the preliminary treatment building by gravity. Processes inside the preliminary treatment building include screening, grit removal, raw wastewater pumping and flow measurement. Wastewater first passes through a mechanical cylindrical fine screen with ¼-inch openings. Solids in the wastewater large enough to be caught in the screen are transported by screw auger and deposited in a dumpster for landfill disposal. After screening, the wastewater passes through a grit removal process to remove sand and other grit from the wastewater stream. Debris removed in the grit removal process is also placed in a dumpster for landfill disposal. After the grit removal process, the wastewater stream flows into a concrete wet well, where it is pumped by variable-speed suction-lift pumps to the MBR.



WASTEWATER TREATMENT PLANT
EXISTING SITE PLAN
WASTEWATER FACILITY PLAN UPDATE
CITY OF NORTH LIBERTY, IOWA

FOX engineering
FOX Engineering Associates, Inc.
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PROJECT NO. 2489-04A

DATE	REVISION		BY	DATE
		DESIGNED:	SJT	11-06
		DRAWN:	JAK	11-06
		CHECKED:		
		LAST UPDATE:	4-13-13	

SHEET
FIG. 3.1
OF SHEETS

When raw wastewater first enters the membrane bioreactor complex, it first passes through 1 mm rotary drum fine screens, which remove small particles that can damage the membranes. The wastewater then flows to the MBR.

The MBR process is the “heart” of the treatment facility. It includes two aeration basins and three membrane trains. Within the aeration basin, the wastewater is mixed with biologically active material, where bacteria and other microorganisms digest organic material present in the wastewater. To create an oxygen rich environment for the bacteria and microorganisms to thrive, an aeration system is provided to provide oxygen and mixing in the tanks. Each aeration basin includes an anoxic zone for denitrification and improved membrane filtration. In addition, the aeration system is cycled on and off to more closely meet the oxygen demands and minimize foaming. From the aeration basin, mixed liquor is pumped to the membrane tanks at a rate of up to five times the influent flow rate. The mixed liquor is filtered through the submerged membranes to remove virtually all suspended solids, and overflows from the membrane tanks to the influent channel where it mixes with the incoming raw wastewater and flows back to the aeration basins. The filtered water, or permeate, is then discharged to the receiving stream, Muddy Creek. If necessary, the treated water can be passed through the ultraviolet (UV) disinfection system to kill any pathogenic bacteria that was not removed by the membrane system. Solids handling facilities consist of two aerobic digesters that are used to further digest and stabilize the biological solids that are wasted from the aeration basins. The digested solids (biosolids) are then pumped to the sludge storage tank for storage until it can be land applied.

The current and projected flows and loadings for the facility were developed in the previous section (refer to Tables 2.4, 2.5, 2.7, and 2.8). A summary of the projected flows and loads are shown in Table 3.1 below for reference. In addition, the average, maximum month, peak day, and peak hour flows for the secondary treatment process are included in this table. The secondary process limiting flows are based on the hydraulic capacity of the membranes, and are discussed in further detail in the following sections. These flows and loads were used to evaluate the individual components of the plant for both hydraulic and organic capacity.

Table 3.1 Current and Projected Flow and Loads

Parameter		Current	Phase I	Phase IA	Phase II
Population		15,500*	16,300	20,400	27,800
Flows (MGD)					
Avg. Daily Flow (ADF)		1.373	1.958	2.448	3.330
Avg. Dry Weather Flow (ADW)		1.300	1.794	2.242	3.050
Avg. Wet Weather Flow (AWW)		2.218	2.605	3.256	4.429
Max. Wet Weather Flow (MWW)		7.915	7.915	8.678	10.054
Peak Hour Wet Weather (PHWW)		12.960	12.960	14.261	16.424
Secondary Treatment Flows (MGD)					
Average Day Flow		---	1.958	2.448	3.330
Max. Month Flow		---	2.605	3.256	4.429
Peak Day Flow		---	3.388	4.235	6.310
Peak Hour Flow		---	4.320	5.000	7.000
Loadings (lbs/d)					
BOD_5	Max. Month	2,566	2,770	3,470	4,730
	Max. Day	4,137	4,466	5,594	7,626
TKN	Max. Month	462	540	670	920
	Max. Day	1,054	1,234	1,531	2,102

* 2012 estimated population.

3.02.1 Flow Equalization

<u>General Description:</u> A flow equalization basin and pumping station were added during the 2004 improvements project. The flow equalization (EQ) basin is an earthen basin with synthetic liner, which was recently replaced. During wet weather periods, wastewater flows in excess of the plant capacity overflow into the flow equalization wet well and are pumped to the EQ basin. An 18-inch magnetic flow meter is provided for flow measurement. When the influent flow to the wastewater plant returns to normal, the EQ basin contents can flow by gravity back to the

treatment plant and discharge into the raw wet well. The return flow is measured with a 8-inch magnetic flow meter and controlled by an 8" automated plug valve.

Capacity: The flow equalization basin has a total volume of approximately 5.14 million gallons (MG). The equalization pumping station consists of three submersible pumps, each with a design capacity of 2980 gpm at 74.5 feet. Plant operational data shows that one pump will produce approximately 3,150 gpm. With two pumps operating, the pumping capacity is approximately 6,000 gpm (8.64 MGD). This is the "firm" capacity of the pump station, with one pump out of service. With all three pumps operating, the pumping capacity is approximately 8,000 gpm (11.52 MGD).

The projected PHWW flow is about 12.96 MGD for Phase I, 14.26 MGD for Phase IA, and 16.42 MGD for Phase II. The flow EQ pumps, together with the raw wastewater pumps will need to handle the peak hour flow. The raw wastewater pumping capacity (see Section 3.02.2) is 4.3 MGD total and 3.5 MGD firm. The pumps have firm capacity adequate for projected Phase I peak flows, but not for Phase IA and beyond. Additional pumping capacity, either raw wastewater, flow EQ, or a combination of the two, will be required. At some point, as the flows and loads increase, it is likely that the flow EQ pumps will need to be replaced with larger capacity pumps. Since typical pump life is less than 10 years, the pumps' capacity can be increased when they are due for replacement. This will likely occur sometime during Phase II.

The existing EQ pumps are constant speed, on/off control based on water level in the wet well. Plant operators have noted that the pumps cycle on/off frequently when the flow conditions are right. Consideration should be given to installing variable frequency drives (VFDs) to minimize short cycling of the pumps.

To determine the adequacy of the EQ basin, the peak seven-day flow period from the data set was used to estimate the peak seven-day flow at future conditions. The maximum day design flow of the MBR was then subtracted from the influent flow to determine the amount of flow required to be equalized and the cumulative equalized volume over that 7 day period. The results of this analysis are presented in Appendix D. The results of the analysis showed that the equalization basin volume will be adequate through Phase II. Beyond Phase II, additional volume may be required.

The EQ basin influent and overflow piping will also need to be able to handle the design peak flows. The projected peak pumping rate to the EQ basin is 9.4 MGD (6530 gpm). The existing influent pipe is 18" which is adequate for the projected flows. The overflow pipe from the EQ basin must also be able to handle more than the influent pumping. If all three existing EQ pumps are running the pumping rate is approximately 8,000 gpm. The overflow should be able to handle more than that. The existing overflow pipe is 14" and is not adequate to handle the peak flow. A new overflow pipe and structure should be installed.

Finally, a separate generator is provided for the EQ pumping station. This generator is rated for 350 kW. This should be adequate for the necessary pump size increased through Phase II.

Physical Condition/Performance: Since the equalization basin and pumping station are relatively new, the facilities should be in good physical condition and continue to operate properly within the design parameters.

Return flow from the equalization basin is automatically controlled by an electrically actuated valve and flow meter to maximize the return flow based on the plant capacity and the raw influent flow.

Bypass to the equalization pumping station is currently provided by an overflow in a manhole upstream of the preliminary treatment building (prior to screening and grit removal) and an overflow in the raw wet well (after screening and grit removal). An automated gate is provided on the influent to the preliminary treatment building and is controlled by a float switch in the influent channel just upstream of the screen. If the raw wastewater pumps cannot keep up with the influent flow, the level in the wet well will rise and overflow to the EQ pump station. If the level in the raw wet well continues to rise and backs up into the channel, or if the flow is in excess of the screen capacity, the float switch activates and closes the gate. The raw wastewater is then diverted to the EQ pump station prior to preliminary treatment. The float will also activate and close the gate if the screen becomes plugged and does not allow enough water to pass through.

Summary of Deficiencies -- Flow Equalization
• Increase EQ pumping capacity when the pumps wear out. • Provide VFD's for the EQ pumps. • Install new overflow pipe and structure in EQ basin.

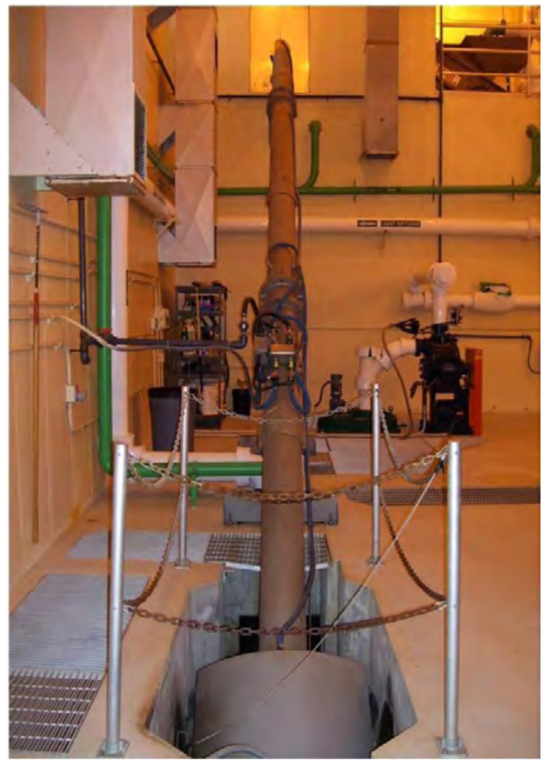
3.02.2 Preliminary Treatment

The preliminary treatment facilities consist of influent flow metering, screening, grit removal, and raw wastewater pumping. The preliminary treatment facilities are located in a building approximately 58 ft x 34 ft. Raw wastewater enters the influent channel in the lower level, approximately 17 ft below ground level. Flow then passes through the screen, grit chamber, and into the raw wet well. From here it is pumped to the secondary treatment facilities through a magnetic flow meter.

a. Mechanical Screening

General Description: Upon entering the preliminary treatment building, flow travels through an open channel to a cylindrical screening unit. The screening unit removes debris from the wastewater stream that could otherwise damage the plant or overload the fine screens (refer to Section 3.03 for information on the fine screens).

The mechanical screening unit in place at the plant is a Lakeside Equipment Co. cylindrical fine screen, Model 40FS, which consists of a screen basket with ¼-inch openings, rotating rake, cleaning comb, concentric screw conveyer, dewatering screw, and a screening press with drive unit. As waste debris is trapped on the screen, it is removed from the screen by the rotating rake. Debris is then collected by the concentric screw conveyer which carries it from the lower level of the pretreatment building to the upper level where the debris is then deposited in a dumpster for removal to the landfill. Of note, the screw conveyer at the North Liberty WWTF is the longest screw conveyer ever constructed and installed by Lakeside Equipment Co. in any of their many screening installations.



Capacity Evaluation: The cylindrical fine screen has a design capacity of 4.79 MGD (3,326 gpm) with a maximum upstream depth of 19-inches. Plant staff reports that the screen has difficult handling flows in excess of 3,000 gpm (4.3 MGD). When flow is in excess of the screen capacity, the cylindrical screen overflows are the channel depth increases. The screen is physically capable of hydraulically passing the higher flows, but with reduced screening efficiency. With the additional fine screening that is provided downstream, reduced screening efficiency is not a major concern. In addition, as discussed in the previous section, if the flow is greater than the screen capacity, excess flow will be diverted to the flow EQ pump station. If the preliminary treatment facilities are designed to handle the peak hour flow of the secondary treatment process (MBR), with the rest being diverted to flow EQ, the screen would be adequate for Phase I, but inadequate for Phase IA and Phase II. Replacing the screen should be considered for Phase IA.

Physical Condition/Performance: The cylindrical fine screen was completely re-built around 2007 and is in good working order. However, plant staff reports plugging issues, which causes wastewater to overflow the screen. The additional screening load reduces the capacity of the 1 mm fine screens downstream. Although the screen is capable of passing higher flows, its ability to collect and remove screenings would be significantly reduced. Consideration should be given to increasing the screen capacity to handle higher flows without reduced performance during Phase IA.

b. Manually Cleaned Bar Screen

General Description: In addition to the mechanically cleaned cylindrical screen located in the primary channel, a manually cleaned screen is located in an adjacent bypass channel. Typically, all flow passes through the cylindrical fine screen. The manually cleaned screen is used only as a bypass to the mechanical screen, for times when the mechanical screen must be taken out of service for maintenance or repairs, or when the screen becomes plugged and cannot handle the flow.

Capacity Evaluation: The bypass channel and manually cleaned bar screen are capable of hydraulically passing more than 7 MGD when the screen is clean. However, the screen plugs very rapidly, and must be manually cleaned frequently to prevent flow from backing up and overflowing channel.

Physical Condition/Performance: The manually cleaned bar screen is in reasonably good condition, but its performance issues are related to frequent plugging. This is inherent to this type of screen. Also this screen is not normally in service, the cylindrical fine screen plugs and/or overflows frequently enough to make the manual cleaning of the bar screen an operational issue. Consideration should be given to replacing the manually cleaned screen with a grinder.

c. Grit Removal System

General Description: The next process following screening is the grit removal unit. This process removes heavy fine particles from the wastewater stream such as sand, gravel, and other fine particles. Equipment used in this process includes a Smith & Loveless Pista Grit Chamber with a self-priming centrifugal pump. This equipment is located on the lower level of the preliminary treatment building. A concentrated slurry of grit and wastewater is pumped from the grit chamber to the ground level, where it passes through a grit classifier. The grit classifier then dewaters the grit slurry, placing dewatered grit into a dumpster for land disposal, and returning the slurry water to the influent wastewater stream.

Capacity Evaluation: The grit system has a design capacity of 7.0 MGD, but can handle higher flows with reduced efficiency.

Following the same philosophy used for the screen, if the preliminary treatment facilities are designed to handle the peak hour flow of the MBR, the existing grit system would be adequate through Phase II. Flows in excess of 7.0 MGD would be diverted to the flow equalization lagoon prior to grit removal such that additional grit capacity would not be required.

Physical Condition/Performance: The grit system is in good working order, and was also re-built in 2007. It should continue to operate properly within its design and flow parameters.

d. Raw Wastewater Pumping

General Description: After passing through screening and grit removal, wastewater flows to a wet well where it is pumped to the secondary treatment facilities. This is done with the use of three 40-hp, Gorman-Rupp self-priming centrifugal pumps. These pumps are located on the lower level of the preliminary treatment building, and have suction lines that extend down into the wet well. The pumps are provided with variable frequency drives (VFDs), which modulate the pump speed to match the influent flow rate, up to the maximum flow set point.

Capacity Evaluation: Each pump has a design capacity of 1700 gpm (2.45 MGD) at 55-ft of total dynamic head (TDH). However, operators report that the maximum pump capacity is less than design. Pump tests confirmed that the maximum capacity of one pump is about 1470 gpm at 52 ft. This lower capacity is likely due to the pumps operating at a lower speed than originally designed (the pumps are belt driven). At this reduced capacity, the firm pumping capacity (with the largest unit out of service) is approximately at 2,470 gpm (3.56 MGD) with two pumps running. With all three pumps running, the capacity is approximately 3,000 gpm (4.32 MGD). The raw wastewater pumps should be capable of pumping the design peak hour flow of the MBR. Flows in excess of this will be automatically diverted to flow equalization. IDNR design standards require that raw wastewater pumping capacity equal the PHWW flow with the largest unit out of service. The raw wastewater pumping capacity includes the three raw wastewater pumps and the three flow EQ pumps. With one EQ pump out of service, the firm raw wastewater pumping capacity is about 12.96 MGD (4.32 MGD raw wastewater pumps and 8.64 MGD flow EQ pumps). This is adequate for Phase I, but additional pumping capacity will be required for Phase IA and II, as noted in the previous section.

Physical Condition/Performance: The Gorman-Rupp pumps were replaced in 2007, but the motors were not. New VFD's were also installed in the last few years. The pumps and associated equipment are in good working condition and should continue to perform adequately within their design parameters.

Operators have expressed concerns with grease accumulation in the wet well. Grease gets trapped in the wet well, and get as thick as 1 - 3 ft. This reduces the operating depth of the wet well. The grease must be sucked out on average every 6 weeks or so. During high flow events, the grease gets sucked into the pumps and passes on through to the fine screens. Excessive grease can cause blinding of the fine screens. See section 3.02.3.b for further discussion of the fine screens. To minimize the grease build-up over time, mixing system should be installed in the wet well.

e. Influent Flow Metering

General Description: Raw wastewater flow metering is provide by a 12" magnetic flow meter on the discharge side of the raw wastewater pumps.

Capacity: The 12" magnetic flow meter has a flow range of around 337 gpm up to 11,000 gpm. At the higher end of the flow range, the velocity is extremely high. The practical flow limit would be around 5,000 gpm (7.2 MGD). The required capacity of the magnetic flow meter would be limited to the peak flow capacity of the MBR system. The existing flow meter should be adequate to handle the flows through Phase II.

Physical Condition/Performance: The magnetic flow meter was installed in 2007, and is in good working condition. It should continue to perform adequately for the foreseeable future.

f. Ventilation

General Description: The preliminary treatment building is ventilated at a high rate to maintain safe work environment. The ventilation system consists of direct fired gas make-up air unit/heater (MAH-1), two exhaust fans (EF-1 and EF-2), and various louvers and grills.

Capacity: The MAH-1 is designed for 7000 cubic feet per minute (cfm), and the two exhaust fans are sized for 3750 cfm and 3650 cfm respectively. IDNR design standards require that ventilation be provided continuously at 12 air changes per hour. This would require approximately 7000 cfm, so the existing ventilation system has adequate capacity.

Physical Condition/Performance: Although the system is in reasonably good condition, the exhaust fans are located approximately 20 feet above the operating floor level. In order to maintain the fans, a scaffolding system must be erected. Consideration should be given to relocating the fans.

The ventilation system exhausts the odorous air from the preliminary treatment building to the atmosphere. At certain times, plant staff report obnoxious odors at the plant emanating from preliminary treatment. As the community continues to grow, longer residence times in the sanitary sewer will increase the potential for odors. Odors may cause a nuisance to the several homes and two schools located in the vicinity of the WWTP. If the city is receiving odor complaints, consideration should be given to installing an odor control system at preliminary treatment.

g. Existing Influent Sewer and Consideration of New Interceptor Sewer and Southeast Growth Corridor Expansion Sewer Projects

The existing 24-inch interceptor sewer enters a manhole (MH1) just upstream of preliminary treatment. A 24-inch sewer runs from MH1 to preliminary treatment. In MH1, a 24-inch bypass pipe is installed approximately 2.3 ft above the invert. The bypass pipe goes from MH 1 to MH 2 to the EQ pump station. When flows exceed the capacity of preliminary treatment, MH1 surcharges and a portion of the flow bypasses to the EQ pump station.

The 24" sewer from MH1 to preliminary treatment will need to be able to handle 7.0 MGD for Phase II. It has a slope of about 4% and can handle more than 28 MGD, therefore has adequate capacity. The 24" bypass pipe from MH1 to MH2 has a slope of nearly 60% and has more than enough for the peak hour flow that needs to be handled through the bypass pipe (9.4 MGD) through Phase II. From MH2 to the pump station, the 24" bypass pipe has a slope of 0.79%. It can handle 14.77 MGD at a depth of 21 inches. This pipe is also adequate for the required flow.

As noted in Section 3.01.2, the city is planning to construct a new parallel interceptor sewer and a new sanitary sewer to serve the Southeast Growth Corridor. When the new sewers are built, all three sewers (existing 24-inch interceptor, new 33-inch interceptor, and new 27-inch SE Growth Corridor sewer) will need to be combined and the flow routed to the preliminary treatment building and/or the flow EQ pumping station. The existing MH1 is not large enough to allow all three sewers to be combined in that structure. A new influent structure will be required. In addition, consideration will need to be given to how the flows will be routed to a new preliminary treatment building that will be required after Phase II.

Summary of Deficiencies – Preliminary Treatment
• Replace the screen with a higher capacity unit in Phase IA. • Replace the manually cleaned screen with a grinder. • Increase the raw wastewater pumping capacity. • Install a mixing system in the raw wet well to minimize grease build-up. • Consideration should be given to installing an odor control system at preliminary treatment. • Construct a new sewer influent structure.

3.02.3 Secondary Treatment – Membrane Bioreactor (MBR)

The secondary treatment system at the North Liberty WWTP utilizes an advanced activated sludge process to remove the undesirable components from the wastewater. Naturally occurring microorganisms convert the organic components of wastewater into biological cell mass, carbon dioxide, and water, and convert ammonia into nitrate nitrogen. The wastewater is then filtered through hollow-fiber submerged membranes to produce verify high quality effluent with almost not suspended solids and virtually no bacteria. The MBR system consists of many components , including: fine screens, aeration basins, aeration system, waste sludge system, mixed liquor recirculation pumps, membrane trains, permeate pumps, backpulse tank, membrane aeration system, chemical feed systems, compressed air system. Prior to analysis of each of the components, a general discussion on membrane system reliability is presented.

a. Membrane System Reliability

IDNR design standards layout unit process reliability criteria for conventional treatment processes. Reliability criteria C (14.5.2.3) would apply to North Liberty. Although not directly applicable to an MBR, these criteria can be utilized to provide guidance when considering reliability criteria for the MBR.

Section 14.5.2.3.1 requires that screens, when used in lieu of primary clarifiers, shall provide peak flow capacity with the largest unit out of service. In addition, Section 15.2.5.2.1 requires a minimum of two screens, each sized for the peak flow capacity. Although the fine screens are not intended to replace primary clarification, applying this criterion would seem reasonable.

Section 14.5.2.3.3 layouts out reliability criteria for aeration basins, which would apply to the North Liberty aeration basins. It requires that, with one basin out of service, the remaining basin be able to handle 50% of the design loading.

As noted, IDNR design standards do not specifically address reliability criteria for MBRs. Since the membrane system accomplishes solids liquid separation, similar to a final clarifier, it would seem reasonable to apply similar reliability criteria.

Section 14.5.2.3.4 requires that final clarifiers provide 75% of the design capacity with one unit out of service.

The preceding criteria will be utilized for evaluating reliability requirements for each of the unit processes within the MBR.

b. Fine Screens

<u>General Description:</u> Raw wastewater that is pumped from preliminary treatment enters the membrane building in the screening room. Two internally fed rotary drum fine screens, with 1 mm openings, provide additional screening of the raw wastewater. The drums are 48” diameter by approximately 9.5 ft long. The fine screens remove hair, fibrous material, and other small particles that could damage and/or foul the membranes. The screenings are deposited into a screw conveyor, which transports them to a screenings wash press. The wash press washes and compacts the screening and deposits them in a dumpster.

The screened wastewater flows out the bottom of the screens, then through a 16” pipe to the influent channel and on to the aeration basins.

<u>Capacity:</u> Each fine screen was designed for a minimum capacity of 2.534 MGD (1760 gpm). This provides a total capacity of 5.068 MGD. IDNR design standards require that a minimum of two units be provided, and they be capable of handling the maximum flow with the largest unit out of service. The maximum flow that the screens can handle with one out of service is 2.534 MGD. The peak flow for Phase IA is 5.0??? (7.34??) MGD. While the two screens can handle this maximum flow together, it does not meet the IDNR criteria with the largest unit out of service. Additional fine screening will be necessary for Phase IA and beyond.

The screenings conveyor and wash press are each designed for at 99 cubic feet of screenings per hour, significantly higher than the screening load that would be experienced at the anticipated flows. Current screenings loads are only about 8 cubic feet per day. The screenings conveyor and wash pressure should be adequate through Phase II.

<u>Physical Condition/Performance:</u> The rotary drum fine screens, wash press, and auger are in good working condition and should continue to perform adequately within their design parameters. The screens do become plugged periodically. Every three months or so the screens must be washed with acid to remove lint,

hair, grease, etc. As previously noted, grease that gets trapped in the wet well periodically gets flushed through to the fine screens. This slug of grease can cause plugging problems. To minimize plugging problems the spray wash system should be modified to include hot water.

c. ***Aeration Basins***

General Description:
From the fine screens, raw wastewater flows through a 16 inch pipe to the influent channel and then on to the aeration basins. The aeration basins provide an aerobic environment for the microorganisms to consume the organics in the wastewater. The contents of the basins are mixed to contact the microorganisms with the wastewater. This is accomplished using submerged mixers and the aeration system. Aeration also provides oxygen utilized by the microorganisms to stabilize the organics. The aeration system is discussed further in the following section. The contents of the aeration basin (mixed liquor) is then pumped by the mixed liquor recirculation pumps to the membrane tanks.

The North Liberty WWTP has two aeration basins. Each basin is 84-ft long by 30 ft 1.5 inches wide, has a maximum side water depth of 20-ft. Total tank depth is 22-ft, allowing for 2-ft of freeboard. Each basin has a total volume of approximately 364,000 gallons.

Each basin is also divided into an anoxic zone and an aerobic zone. The anoxic zone is located at the influent end of the basin, and has a volume of approximately 71,000 gallons. The anoxic zones include a baffle wall to prevent short circuiting, and two submersible mixers. The anoxic zones are designed for denitrification (conversion of nitrate/nitrite to nitrogen gas in an environment devoid of oxygen), which also serves to better condition the mixed liquor for membrane filtration. The aerobic zone has a volume of approximately 293,000 gallons. Mixing is provided by the aeration system.

In addition, the membrane tanks provide some additional aerobic zone volume. Each membrane tank has a volume of approximately 24,000 gallons. With three membrane tanks currently in operation, that provides an additional 72,000 gallons of aeration. The total aeration volume, including the aeration basins and membrane tanks, is approximately 800,000 gallons.

Capacity: The aeration basins were designed for an AWW flow of 2.534 MGD. The peak hydraulic capacity is limited by the peak capacity of the membranes. The system was also designed to treat an average BOD load of 2,815 lbs/day and a maximum day load of 4,926 lbs/d. This was based on an average mixed liquor suspended solids (MLSS) concentration of 7,500 mg/L. Actual operating MLSS concentrations range from around 9,000 to 14,000 mg/L, with an average of 11,000 mg/L and 83% volatile.

IDNR design standards provide typical design parameters for conventional activated sludge systems. Although an MBR is not a conventional system, some of the guidelines can be used for comparison purposes. The typical design loading and design parameters, along with current, Phase I, and Phase IA loadings are presented in Table 3.2 below.

As can be seen in Table 3.2, the organic loading rate is higher than conventional systems. However, with the much higher mixed liquor concentrations achievable with the MBR, the organic loading rates can also be much higher. This can be seen in the food to microorganism ratio, which is much lower than conventional systems. To verify this, an activated sludge model was used to evaluate these loading conditions. The model results, presented in Appendix C, show that the aeration basis will be adequate for the proposed conditions. The aeration basins should be adequate through the projected Phase IA loading rates. Beyond Phase IA, additional aeration basin capacity will be required.

Table 3.2 – Aeration Basin Loading and Design Parameters

Loading / Design Parameter	IDNR Guidelines (1)	Current Loadings	Phase I Loadings	Phase IA Loadings
Max. Month BOD Load (lbs/d)	---	2,566	2,770	3,470
Solids Retention Time, SRT (days)	15 - 25	>25	20	20
Organic Loading Rate, OLR (lbs BOD5/1000 cu. ft /d)	15	24	26	32
Food to Microorganism Ratio, F:M lbs BOD5/lb MLVSS / d) (2)	0.08 - 0.16	0.04	0.06	0.06
Mixed Liquor Suspended Solids (MLSS) (mg/L)	2,000 - 5,000	11,000	8,000	10,000

Notes: (1) IDNR guidelines for conventional combined carbon oxidation /nitrification activated sludge.
(2) Based on average 83% volatile solids concentration.

Physical Condition/Performance: The aeration basins and equipment are in generally good condition and should continue to perform adequately within their design parameters. The facility has consistently met BOD and ammonia effluent limits.

One on-going operational issue with the MBR system is the degree of foaming that occurs in the aeration basins. This is typical of most MBRs, and is not a major issue as long as the foam does not get too deep and can be contained in the basins. Scum troughs are provided to help reduce the amount of foam accumulation. The operators have also used water sprinklers in the summer months to help control foam. One way improve foaming in an MBR is to increase sludge wasting and decrease the solids retention time (SRT). However, due to limitations with the solids handling facilities, increasing sludge wasting is currently not feasible. Improvements in the solids handling facilities, which are discussed in later sections, should help reduce the foaming issues. Recent operational changes have reduced issues with foaming.

Another operational concern with the aeration basins is the inability to consistently maintain the same water depth in each tank. This mainly affects the aeration system, as discussed below. Operators have recently changed the mixed liquor recirculation pump operation by opening isolation valves so that both pumps are pulling from both basins. This has greatly improved this situation, so that the water depths and dissolved oxygen in each tank are nearly the same. While this operational change has corrected the issue, the recirculation flow from each tank may not be the same. To address this concern, opening(s) in the wall between the two tanks should be added to equalize the water level. Gates or valves would be provided to allow these openings to be closed so the tanks could be isolated if need be.

Finally, the submersible mixers in the anoxic basins have been an ongoing maintenance issue. The mixers have been repaired and/or replaced by the manufacturer several times since being placed in service in 2008. The manufacturer made some design modifications to minimize issues with seal failures. While the modifications require some additional preventative maintenance, since they have been implemented the mixers have been operating well.

c. *Aeration System*

<u>General Description:</u> The aeration system provides the oxygen and mixing necessary for the secondary treatment system. It consists of fine bubble diffusers and blowers. The diffusers consist of flexible membrane discs mounted on a PVC piping system over the entire floor of the aeration zone. The discs have small slits in them to release the air in

fine bubbles, which improves the oxygen transfer efficiency. Each basin contains ten 4-inch diameter laterals and a total of 600 diffusers per basin. Compressed air is delivered to the diffusers by three positive displacement blowers, one of which serves as back up. The blowers are equipped with variable frequency drives and are controlled based on dissolved oxygen content in the aeration basins. Dissolved oxygen (D.O.) probes in each basin provide monitoring and feedback to the control system which controls blower speed to meet the oxygen demands and maintain a set D.O. in the basins. However, the minimum speed setting on the blowers does not allow air flow to be reduced enough during most operational periods. To better match the lower oxygen demands, the control system was modified to allow for cyclic on/off control of the blowers. For each hour of the day, the blowers may be set to run from 0 – 60 minutes during that hour. Currently, the blowers are set to cycle on/off based on the times shown in Table 3.3, but this is regularly modified as needed. When the blowers run, the speed is controlled by the D.O. set point. Air flow rate is measured and recorded by a thermal-mass meter.

Table 3.3 – Aeration Cycle Times

Time of Day	Blower Operation
5:30 AM to 11:00 AM	run continuously
11:00 AM to 11:30 AM	off
11:30 AM to 1:00 PM	run continuously
1:00 PM to 1:30 PM	off
1:30 PM to 3:00	run continuously
3:00 PM to 3:30 PM	off
3:30 PM to 5:00 PM	run continuously
5:00 PM to 5:30 PM	off
5:30 PM to 9:00 PM	run continuously
9:00 PM to 9:30 PM	off
9:30 PM to 12:00 PM	run continuously
12:00 PM to 5:00 AM	run ½ hour every hour
5:00 AM t0 5:30 AM	off

<u>Capacity Evaluation:</u> The aeration system was designed to deliver up to 3,200 standard cubic feet per minute (scfm) of air and treat a peak day load of 4,926 lbs/day BOD. Each blower has a design capacity of 1600 scfm at 10 psi. This was a very conservative design, because it did not include credit for the oxygen transferred in the membrane tanks nor did it consider the oxygen credit realized through denitrification. In addition, the blower capacity can be increased by

changing the belts and sheeves to increase the blower speed. The blower output can be increased to approximately 1875 scfm at 10 psi (3750 scfm with two blowers running), which is about a 17% increase.

Operational experience and data has shown that the aeration system is more than adequate to meet the current oxygen demands. During one of the highest CBOD loadings of 3271 lbs/d, experienced on June 9, 2011, the aeration system only operated at about 25% of capacity even though the load was 66% of the design capacity. This same day also had the second highest ammonia loading. On another one of the highest CBOD load (3100 lbs/d) on June 22, 2010, the aeration system operated at less than 25% of capacity. On October 29, 2009 the peak day ammonia load occurred (500 lbs/d) along with a fairly high CBOD load (3054 lbs/d). On this day, the aeration system also operated at less than 25% of capacity. This confirms the conservative nature of the aeration system design, and shows that the membrane aeration and denitrification are significantly reducing the overall oxygen demand that needs to be provided by the aeration system.

The projected Phase I loads are less than the design loads, so the aeration system should have more than enough capacity to handle the revised Phase I conditions. To confirm the capacity of the aeration system to treat the proposed peak BOD load for Phase IA (4,466 lbs/d), an activated sludge model was used (see Appendix C). The model was calibrated based on the operational data for June 9, 2011, June 22, 2010, and October 29, 2009. Calibration was based on assuming partial credit for denitrification and credit for the membrane system aeration. However, when determining the design air flow requirements for Phase I, credit for denitrification and membrane aeration was ignored. For Phase I peak loadings, the model shows that required air flow is approximately 3,143 scfm. This is very conservative because the credit for denitrification and membrane aeration was ignored. The existing aeration system should be adequate through Phase I. If additional aeration is needed, the blower output could be increased. As previously noted, this can be accomplished by changing the belts and sheaves. For Phase IA and Phase II, expansion of the aeration system, along with the aeration basins, will be required.

<u>Physical Condition/Performance:</u> The aeration system is generally in good condition and should be capable of performing adequately within its design parameters. The membrane diffusers generally have a life expectancy of seven years or so, so they may need to be replaced in the next few years. The blowers are also in good condition, and should continue to perform adequately.

The operators have experienced difficulties in controlling the D.O. in the aeration basins, and keeping the D.O. in the two basins equal. This is believed to be caused by small variations in the water depth between the two tanks, which causes more air to go to one tank than the other. As previously noted, operational changes have improved this situation and providing openings between the two tanks should alleviate this concern.

D. Waste Sludge System

General Description: The waste sludge system is used to remove excess biological solids from the aeration basins that are produced during the stabilization of the wastewater. The system is also used to remove foam and scum from the surface of the tanks.

On the effluent side of the aeration basins is a waste sludge/scum pit with a maximum operating volume of about 6800 gallons. Waste sludge and floating scum/foam is removed from the top of the aeration basins via downward opening weir gates (one per basin) that discard into the sludge/scum pit. The gates have electrical actuators for automatic operation. Scum troughs that run the length of each basin also discard into this pit. Two submersible pumps, one duty and one standby, are used to pump the sludge/scum/foam to the digesters. A magnetic flow meter is used to measure and record the amount of waste sludge pumped to the digesters.

The controls are set up so that sludge wasting can be automated, based on a target volume of waste sludge and a set number of wasting cycles per day. A foam wasting cycle is also included in the control system, based on operator input duration and frequency. The water level in the basins is temporarily raised to allow foam/scum to spill over into the troughs. A spray wash system washes the troughs and helps transport the foam to the pit.

Capacity Evaluation: The capacity of the waste sludge system is limited by the capacity of the waste activated sludge (WAS) pumps. Each pump has a capacity of about 390 gpm, which is more than adequate for Phase II design conditions.

Physical Condition/Performance: The physical condition of the waste sludge system is good for the most part, but it has experienced operational difficulties due to the large quantity of foam. The automated sludge wasting and foam wasting cycles are not used. The operators are limited in the amount of sludge wasting that can be done, mainly due to the limited digester/sludge storage volume. Almost all of the wasting that is done is for foam control rather that mixed liquor solids control. In addition, the pumps have experience difficulties handling pumping the foam. Improving the solids handling facilities should allow plant staff to waste sludge more regularly and improve the operation of the waste sludge system.

E. Mixed Liquor Recirculation Pumps

General Description: The mixed liquor recirculation pumps are used to transfer the mixed liquor from the aeration basins to the membrane tanks. Three pumps are provided, one for each aeration basin plus one standby. The design intent is for the pumps to recirculate mixed liquor through the membrane tanks at a rate of five times the influent flow rate (up to the maximum month flow rate). This maintains a relatively high velocity of flow past the membranes to reduce plugging of the membranes.

A magnetic flow meter is provided for each pump to monitor the recirculation rate from each tank. The pumps are provided with variable speed drives, which are controlled by the membrane control system, so that the total recirculation flow rate equals five times the membrane system influent flow rate.

Capacity Evaluation: Each pump has a design capacity of 4,400 gpm at 14.5 ft, but this is at a reduced speed of 590 rpm. The pumps are direct drive with 900 rpm 40 HP motors, and the speed if limited to 590 rpm through the VFD. With two pumps running at 590 rpm, this provides a total return flow of 12.67 MGD which results in a recirculation flow rate of 5 times the original design maximum month flow of 2.534 MGD. The Phase IA maximum month design flow is 3.168 MGD. For a recirculation ratio of 5, this requires 5,650? gpm from each pump. The pumps would need to operate 715 rpm and required 37 HP. This is well within the capability of the existing pumps. For Phase II, additional recirculation pumping capacity will be required.

Physical Condition/Performance: The mixed liquor recirculation pumps are in good working condition and should continue to perform adequately for the foreseeable future.

F. Membrane Trains

General Description: The membrane trains are the heart of the membrane bioreactor process. Each train consists of one tank, 9'-0" wide x 35''-0" long x 10'-3" deep. During Phase I, four membrane tanks were constructed. Three are in operation, and the fourth one is for Phase II expansion. Each train has four membrane cassettes, with a space for adding a fifth cassette. Each cassette has 48 membrane modules, which consist of tens of thousands of membrane fibers. Each membrane module has a total membrane surface area of 340 sq. ft., for a total membrane surface area of 195,840 sq. ft. It should be noted that advancements in the manufacturing process now allow for 370 sq. ft. of membrane surface area per module. When the membranes are replaced, using the higher surface area modules would allow a higher design capacity for the system. This will be discussed further in the next section.

The membrane fibers are submerged in the tanks, and the permeate pumps are used to pull a vacuum on the fibers and "suck" the water through the fibers. The pore openings in the fibers are very tiny, nominally 0.02 µm. The fibers allow the water to pass through, but filter out virtually all suspended solid, bacteria, and some viruses.

There are number of valve and instrumentation that are used to monitor and control membrane system, including a SCADA (supervisory control and data acquisition) system dedicated to the membrane system. There are also many different systems that support the membrane system, including the permeate pumps, backpulse tank, membrane aeration system, chemical feed systems, and compressed air system. These systems are discussed further in the following sections.

<u>Capacity Evaluation:</u> The capacity of the membrane system is limited by the flux, or flow per unit area, that can be pulled through the membranes. Flux is generally measured in gallons of flow per square foot of membrane surface area per day (gfd). Transmembrane pressure (TMP), or the pressure drop across the membranes, also affects the capacity. The maximum TMP across the membranes is 12 psi, but this is typically limited to 10 psi for operational purposes. The TMP will vary depending on a number of conditions, including water temperature, condition of the solids, membrane fouling, and age and condition of the membranes. Often times, permeability is used to describe the overall performance of the membrane system.

Permeability is a combination of flux rate and transmembrane pressure, and is expressed as flow rate per unit area per psi of pressure drop across the membranes, or gfd/psi. Because of the large effect of temperature on permeability, this is often normalized to a standard temperature of 70 deg. F, and is referred to as temperature corrected permeability.

The original design flux rates for the membrane system are listed below in Table 3.4 with all trains in service and with one train out of service. The design allows for treating the maximum month flow with one train out of service. The table also shows the available capacity if the flux rates are increased to the allowable design flux rates. The revised flux rates are based on operational experience at other plants, as well as at the North Liberty plant. The North Liberty plant has already operated at a flux rate of 22.1 gfd for an extended period of time with very little increase in transmembrane pressure. As can be seen in Table 3.4, at the allowable design flux rates, the membranes can handle the revised Phase I flows. Additional membrane capacity will be needed for Phase IA and Phase II flows.

Table 3.4 – Membrane System Flux Rates

Design Condition	Original Design Flux Rates		Allowable Flux Rates	
	Flux (gfd)	Flow (MGD)	Flux (gfd)	Flow (MGD)
All Trains in Service (1)				
Avg. Day	8.6	1.689	10.0	1.958
Max. Month	12.9	2.534	14.6	2.859
Max. Day	14.6	2.859	19.4	3.799
Peak Hour	17.2	3.378	22.1	4.328
One Train out of Service (n-1) (2)				
Max. Month	19.4	2.534	22.1	2.885

Notes: (1) Total membrane surface area = 195,840 sf
(2) Total membrane surface area = 130,560 sf

<u>Physical Condition/Performance:</u> The membrane system is generally in good condition. Plant staff performs routine, preventative maintenance on a regular basis. They also maintain an extensive spare parts inventory, so that if a piece of equipment breaks down it can be returned to service in within hours.

The membranes have been in operation for nearly four years, but still appear to be in very good condition. Membrane life is typically around 7 to 10 years. Membrane effluent quality remains excellent at around 0.04 NTU, while the transmembrane pressures (TMP) are still very low at around 2 psi. Permeability remains good at around 12 gfd/psi.

The membrane system is in good working condition and should continue to perform adequately for the foreseeable future. While the membranes are in good condition, they will need to be replaced at some point. The City is planning for their replacement by putting some money aside each year. The membrane manufacturer provided the City with a guaranteed membrane replacement price (which is tied to the Consumer Price Index) as part of the original purchase agreement. The price guarantee expires in April of 2018, after which time the price will increase significantly. The City should consider purchasing the replacement membranes by April 2018 to take advantage of this guaranteed price.

The membrane tanks have an epoxy coating system to protect the concrete tanks from corrosion during chemical cleaning of the membranes. The epoxy coating system should be inspected on a regular basis (yearly) and repaired as necessary. When the membranes are replaced, the coating system will likely need replaced as well.

Plant staff has indicated a need to cover the membrane tanks with a solid surface to prevent leaves and other debris from entering the tanks, as well as retain heat. Currently the tanks are covered with grating. Plant staff would also like to add a small concrete tank to hold one membrane cassette to facilitate cleaning.

G. Permeate Pumps

General Description: The permeate pumps are utilized to create a vacuum on the membranes and draw the water through the membranes. The membrane filtered water is referred to as permeate. There are three rotary lobe permeate pumps, one per membrane train. There is a magnetic flow meter with each pump to measure the permeate from each individual train, as well as a number of other instrumentation (pressure and temperature transducers and switches) to monitor the performance of the system.

The effluent from the permeate pumps is discharged to the backpulse tank, which is discussed in the following section. The permeate pumps are also used to "backpulse" the membranes. Periodically, the permeate pumps are stopped, and then are started in the reverse direction. Permeate is drawn from the backpulse tank and pumped back through the membranes to knock accumulated solids off of the membranes to help maintain permeability.

The permeate pumps have variable frequency drives and are controlled by the membrane control system. The net permeate flow rate is controlled to match the influent flow rate to the membrane system.

Capacity Evaluation: The permeate pumps are each designed for a flow rate of up to 1133 gpm at 37 ft. However, the maximum flow rate of the permeate pumps does not equate to the maximum production capacity of the membrane system in terms of million gallons per day (MGD). That's because the permeate pumps are not producing permeate continuously. Periodically, the membranes must be backpulsed. The membranes are also "relaxed" periodically, where the pumps are stopped for a brief period of time to allow some of the accumulated solids to slough off of the membranes. As a result, the permeate pumps are only actually withdrawing water from the tanks about 85% of the time. The pump flow rate must be increased to make up for those down times. In addition, the pumps must be sized for the maximum backpulse flow rate. Assuming the net permeate production is 85% of the maximum flow rate, the maximum permeate production capacity of these pumps is about 4.16 MGD. This matches very closely to the maximum capacity reported by the operators (4.32 MGD). The permeate pumps should be capable of handling the peak flow for the MBR. Flows in excess of this will be sent to the EQ basin. The Phase I peak flow for the MBR is 4.32 MGD. The permeate pumps should be adequate for Phase I. The Phase IA peak flow is 5.0 MGD. Additional capacity will be needed for Phases IA and II.

Physical Condition/Performance: The permeate pumps are in good working condition and should continue to perform adequately for the foreseeable future.

H. Backpulse Tank

General Description: The backpulse tank is a 3,500 gallon polyethylene tank located downstream of the permeate pumps. All permeate is pumped into this tank and then overflows to the plant effluent line. The tank is used to store permeate water that is used to backpulse the membrane. In addition, this water is used for non-potable use throughout the plant. Two small booster pumps supply water to the non-potable system.

Capacity Evaluation: The 3,500 gallon capacity tank should be adequate through the Phase II expansion. The maximum backpulse flow rate is approximately 1133 gpm for a duration of 1 minute. In addition, permeate from the other two trains provides additional water for backpulse.

Physical Condition/Performance: The backpulse tank is in good working condition and should continue to perform adequately for the foreseeable future. However, the overflow from the tank can only handle 3,000 gpm. Also, if the UV system were placed in operation, plant operators report that the backpulse tank would overflow out of the top of the tank at less than 3,000 gpm. Modifications will need to be made to allow the plant flow to be increased and the UV system to be placed in service if necessary.

I. Membrane Aeration System

General Description: The membrane aeration system is used to help clean the membranes. When the membranes are in operation, the membrane aeration system operates continuously to agitate the membranes and help knock accumulated solids off. Air is delivered to the bottom of the membrane cassettes through course bubble diffusers. The membrane aeration system consists of three positive displacement blowers, one assigned to each train. There is space for the addition of a fourth blower when the fourth train is installed. The standby blower for the aeration basins also provides backup for the membrane blowers. Each membrane train includes two air headers with automated valves that cycle open and closed so that only half the membranes in a given train are aerated at a time. This is referred to as cyclic aeration. The plant currently operates on 10/10 or 10/30 cyclic aeration, which refers to the number of seconds the aeration is on/off.

Capacity Evaluation: Each membrane aeration blower was designed to deliver up to 1,087 standard cubic feet per minute (scfm). This is adequate for the Phase I design condition. For Phases IA and II, the air flow rate will need to be increased to 1358 scfm. This can be accomplished by replacing the belts and sheaves in the blower to increase the speed.

Physical Condition/Performance: The membrane aeration system is generally in good working condition. The operators have reported on-going maintenance issues with the cyclic valves due to the large number of cycles the valves have to go through. Since the time the plant was constructed, GE/Zenon has developed a modification to the MBR system, referred to as LEAPmbr. Among other things, this technology eliminates the need for the cyclic aeration valves and reduces aeration requirements. This improves reliability, reduces maintenance costs, and results in energy savings. Reduced blower aeration requirements can result in energy savings of around 30%. The conversion to LEAPmbr requires modifications to existing cassettes. GE/Zenon provides conversion kits to allow field modification of the existing cassettes. Other modifications include changes to the controls system and replacing the belts and sheaves on the blower to reduce the air flow to match the requirements for the LEAPmbr system. Preliminary projections show a seven to eight year pay back based on energy savings. In addition, all new GE/Zenon MBRs will utilize the LEAPmbr system, including North Liberty's Phase II improvements. Consideration should be given to implementing the LEAP aeration technology as part of Phase IA to reduce maintenance and improve energy efficiency.

J. *Chemical Feed Systems*

General Description: Chemical feed systems are used to clean the membranes at regular intervals to remove any foulants that accumulate on the membranes and restore their permeability. Citric acid and sodium hypochlorite are used to clean the membranes. Two chemical cleaning schemes are used: maintenance cleans and recovery cleans. Maintenance cleans are typically performed on a monthly basis, and consist of lower chemical doses and relatively short soak times (typically < 30 minutes). The intent of these cleans is to help maintain the permeability. Recovery cleans are more intensive chemical cleans designed to restore the membrane permeability to as close to new condition as possible. Recovery cleans utilize much higher chemical doses and longer soak times (up to 20 hours), and are typically only performed once per year.

Each chemical feed system consists of a storage tank, two feed pumps, and piping and valves to deliver the chemicals to the application point. The chemical feed systems are located in a separate room with a separate entrance to prevent corrosive fumes from entering the rest of the plant.

Capacity Evaluation: The citric acid system includes a 200 gallon storage tank, and two feed pumps each rated for up to 7.5 gpm. The sodium hypochlorite system includes a 500 gallon storage tank and two feed pumps each rated for up to 8 gpm. The capacity of the feed systems is adequate through Phase II.

Physical Condition/Performance: The chemical feed systems are in good working condition and should continue to perform adequately for the foreseeable future.

K. *Compressed Air System*

General Description: The compressed air system is mainly utilized to provide compressed air for operation of automated valves and chemical feed pumps. It consists of two 2-stage reciprocating air compressors, two 240 gallons receiver tanks, two refrigerated air dryers, and associated piping and valves. Two of each component are provided for redundancy.

Capacity Evaluation: Each air compressor is rated for 52 scfm at 175 psi, while the air dryers are rated at 35 cfm. The compressed air system has more than adequate capacity through Phase II.

Physical Condition/Performance: The compressed air system is in good working condition and should continue to perform adequately for the foreseeable future.

Summary of Deficiencies – Secondary Treatment

Fine Screens

- Provide additional fine screening capacity for Phase IA and Phase II.
- Provide hot water spray wash system.

Aeration Basins

- Provide additional aeration basin capacity for Phase II.
- Provide valved opening(s) between the two tanks to allow the water levels in the tanks to equalize.

Aeration System

- Increase the blower capacity for Phase IA.
- Expand the aeration system for Phase II.

Waste Sludge System

- No deficiencies noted.

Mixed Liquor Recirculation Pumps

- Increase the capacity for Phase II.

Membrane Trains

- Provide additional membrane capacity for Phase IA and Phase II flows.
- Replace the membranes prior to April 2018.
- Replace the coating on the membrane tanks when the membranes are replaced.
- Cover the membrane tanks with a solid surface.
- Add a small concrete tank to facilitate membrane cleaning.

Permeate Pumps

- Increase the capacity for Phase IA and Phase II.

Backpulse Tank

- Modify piping to allow increased permeate flow.

Membrane Aeration System

- For Phase IA, convert the existing membrane trains to GE/Zenon's LEAPmbr system.

Chemical Feed Systems

- No deficiencies noted at this time.

Compressed Air System

- No deficiencies noted at this time.

3.02.4 Ultraviolet Disinfection System

General Description: Disinfection of wastewater treatment plant effluent is typically used to destroy pathogens found in the wastewater. Because pathogen limits have been established for the North Liberty Facility, disinfection of the treated wastewater must be performed before final discharge to Muddy Creek. The North Liberty facility was originally designed to include an ultraviolet (UV) light disinfection system to accomplish this purpose. UV disinfection utilizes ultraviolet light to kill pathogenic bacteria present in the wastewater stream. Ultraviolet light is delivered to the wastewater from submerged lamps in the disinfection channel. The lamps are similar to fluorescent lamps in size and shape. The number of lamps in a UV disinfection system is proportional to the flow rate, and clarity of the water (transmittance).

The UV system is located south of the control building and receives treated water from the MBR prior to discharging to Muddy Creek. Bypass piping around the UV system is provided for periods when disinfection is not required.

Since implementation of the MBR, the UV system has not been utilized because the membranes effectively disinfect the effluent by removing all bacteria and most viruses. The plant effluent is routinely tested and consistently shows zero total coliform without the use of the UV system. Although the UV system is not utilized, plant staff has maintained the system so that it could be utilized if necessary.

Capacity: The UV disinfection system is manufactured by Trojan Technologies, and has a rated capacity of 6.50 MGD. The system was originally sized to handle the peak discharge flow rate from the SBRs. Because the SBRs utilized a batch process, discharge was intermittent, resulting in higher peak flows than are experienced from the MBR facility. If it becomes necessary to re-implement the UV system, it should be adequate for the Phase II peak flows through the MBR facility.

Physical Condition/Performance: The UV system has been well maintained and is still in good operational condition. However, the system is 15 years old. Although replacement parts are still available, they are rather costly. Since the UV system is not necessary at this time, no improvements are recommended. If additional disinfection is required in the future, replacing the UV system should be considered.

Summary of Deficiencies – Ultraviolet Disinfection System
• No deficiencies noted at this time.

3.02.5 Solids Handling Facilities – Aerobic Digesters and Sludge Storage

Sludge stabilization at the North Liberty wastewater treatment facility is accomplished with the use of aerobic digesters. Aerobic digesters employ the use of aeration equipment to maintain adequate oxygen concentration in the sludge so that aerobic bacteria can thrive and digest sludge. Sludge storage is also provided to allow sludge to be hauled to land application at reasonable time intervals.

A. Aerobic Digesters

General Description: The North Liberty WWTF utilizes two aerobic digesters to stabilize the sludge. The aerobic digesters are square concrete tanks, 62 ft x 62 ft x 22 ft deep, with a maximum side water depth of 20 ft. Waste sludge and foam/scum from the aeration basins is pumped to the digesters for treatment. The digesters may be operated in series or in parallel.

The aeration system consists of 4 racks of retrievable coarse bubble diffusers in each digester and positive displacement blowers. There are a total of five blowers for the solids handling facilities, which are located in the control building. One blower is assigned to each digester. These two blowers have variable frequency drives, and the other three are constant speed. If additional air is required in the digesters, two more blowers may be used to provide supplemental air to the digesters. These blowers may also be used for the sludge storage tank, which is discussed in the following section. The fifth blower serves as a backup.

A DO probe is located in each digester to monitor the DO level and provide feedback to control the blowers. The speed is controlled to match the DO set point in the digesters. In addition, each digester has a level transducer to monitor the water depth in each tank.

In addition to the mixing provided by the aeration system, each digester also has a 40 HP floating mixer to help maintain solids in suspension during treatment.

Each digester has a submersible pump that may be used to transfer sludge to the other digester or to the sludge storage tank. An overflow pipe is also located between Digester No. 1 and Digester No. 2 to allow gravity flow between the tanks. A telescoping valve is also located in Digester No. 2 to allow gravity flow to the sludge storage tank. In addition, each digester also has a telescoping valve that can be used to decant supernatant after settling.

Capacity: Each digester has volume of about 0.575 MG, for a total digester volume of 1.15 MG. The State of Iowa sludge rules, discussed in Chapter 2, set forth requirements for pollutants, pathogens, and vector attraction reduction. To meet the pathogen requirements, aerobic digesters should have a mean cell residence time (average detention time) of 60 days at 15 degrees C (59 degrees F).

Operating records at North Liberty indicate that digester temperatures drop to around 50 deg. F during the winter months, which indicates that more than 60 days may be required. Vector attraction reduction criteria require that volatile solids be reduced by 38% or more. IDNR design standards require a minimum 15 day detention time at 15 degrees C. Ten-States Standards also provides some guidance for sizing aerobic digesters based on population equivalent (P.E.), and requires a minimum of 5.625 ft^3/P.E. at 59 deg. F and 27 day detention time. For Phase II, that requires a volume of 1.17 MG.

Based on the current and projected digested biosolids data (see Chapter 2), the digesters provide a detention time of about 75 days for the Phase II digested biosolids. This should provide adequate detention time for digestion through Phase II.

IDNR Design Standards require aeration be provided to aerobic digesters to maintain a minimum dissolved oxygen (D.O.) level of 1.0 mg/L. If aeration is used for mixing as well, air must be provided at a minimum rate of 30 CFM per 1,000 cubic feet. This would require a minimum of about 2,300 CFM for the each digester. The existing blowers provide a firm capacity of about 1,176 SCFM for each digester, or a total of about 2352 SCFM. However, since the tanks are equipped with mechanical mixers, the blowers do not need to provide mixing energy. Aeration requirements for sludge digestion were calculated using an aerobic digestion model (see Appendix E) to be 2,462 scfm for Phase IA and 3,290 SCFM for Phase II design conditions. The existing aeration system, in combination with the existing mixers, should be adequate through the Phase IA design conditions, but additional aeration capacity will be required for Phase II.

The sludge transfer pumps in the digesters have a rating of 460 gpm @ 25-ft TDH. This is adequate for existing and projected conditions. However, plant staff would like to have flow meters installed on the pump discharge to record and monitor sludge transfer.

<u>Physical Condition/Performance:</u> The equipment in the digesters is in good working condition. During the 2007 project, all of the diffusers in the digesters were replaced, and the mechanical mixers were rebuilt. The blowers are also in fairly good condition, and have been well maintained. However, the blowers are nearly 15 years old. Consideration should be given to replacing the blowers in Phase II. In addition, the piping supports for the aeration piping around the digesters is corroded and needs replaced.

B. Sludge Storage Tank

<u>General Description:</u> The North Liberty WWTF has one sludge storage tank to storage sludge throughout the year prior to land application. The sludge storage tank is 84 ft x 62 ft x 22 ft deep, with a maximum side water depth of 20 ft. Digested sludge can flow by gravity to the sludge storage tank through a

telescoping valve. It can also be pumped from the digesters to the storage tank with the digester transfer pumps.

The contents of the sludge storage tank is mixed by two 20 HP floating mixers. In addition to the mixers, an aeration system is provided to help mix the tank contents. The aeration system consists of six racks of retrievable coarse bubble diffusers and positive displacement blowers. One of the existing five blowers is typically used to aerated and mix the sludge storage tank. Because the sludge have been previously stabilized, aeration is typically not required. However, if additional air is necessary, two more blowers may be used to provide supplemental air to the storage tank.

Two submersible sludge loadout pumps are provided to remove the sludge from the tank to a land application vehicle. The storage tank also has a telescoping valve that can be used to decant supernatant after settling. In addition, the storage tank has a level transducer to monitor the water depth.

Land application is the preferred method of sludge disposal. Sludge is removed from the storage tank two or three times each year and is land applied. A contract hauler is used for this service. To reduce the volume of sludge that must be land applied, the sludge is allowed to settle in prior to land application. This is accomplished by shutting off aeration and mixing to allow the sludge to settle to the bottom of the tank. If necessary, a coagulation aid (such as a polymer) may be added to the tank to help separate the solids. The "clear water" at the top of the digester is then skimmed from the top using a telescoping valve and returned to the head of the plant. The settled, concentrated sludge is then pumped into a tanker truck for land application to agricultural fields. Sludge is removed from the storage tank with the use of two submersible pumps located in opposite corners of the tank.

<u>Capacity:</u> The storage tank has a volume of about 0.779 MG. Due to cropping practices and weather conditions in Iowa, sludge is typically hauled in the fall and/or spring. To allow sludge to be hauled twice per year, sludge storage tanks typically provide for at least 180 days of sludge storage. At current conditions, the tank only provides about 140 days of storage. Additional sludge storage capacity will be necessary.

IDNR Design Standards require aeration be provided for sludge holding tanks for mixing at a minimum rate of 20 CFM per 1,000 cubic feet (although a variance usually can be obtained). This would require a minimum of about 2080 CFM for the storage tank. The existing blower provides about 635 SCFM. However, since the tanks are equipped with mechanical mixers, the aeration system is not necessary to provide mixing energy. In addition, most sludge storage tanks do not require any aeration since the sludge has already been stabilized. The existing aeration system, in combination with the existing mixers, is adequate for the sludge storage tank.

The sludge loadout pumps are each rated for 640 gpm @ 40-ft TDH, which is adequate for removing sludge from the tank and filling the trucks.

Summary of Deficiencies – Solids Handling Facilities
<u>Aerobic Digesters</u> • Replace the existing blowers and provide additional blower capacity for Phase II. • Install magnetic flow meters for the sludge transfer pumps. • Replace piping supports for the aeration piping in the digesters. ***<u>Sludge Storage Tank</u>*** • Provide additional sludge storage capacity for Phase IA and Phase II.

3.03 Control Building

The Control Building includes administrative offices, laboratory facilities, restroom and shower facilities, breakroom, blower room, garage, and electrical/control room. The building was originally constructed in 1998. As the wastewater plant has expanded, so have the staffing needs and space requirements. Additional office and support facilities should be provided as part of the next expansion.

3.04 Emergency Power

Emergency power is required for the wastewater treatment facility to maintain operation in the event of a power outage. Two existing diesel engine driven emergency generators currently provide backup power for the facility. A 350 kW generator is provide for the EQ pumping station. This generator will be adequate for the necessary improvements through Phase II. Backup power for the rest of the plant is provided by a 2000 kW generator. This generator was installed during the Phase I improvements project, and was designed to handle the Phase II improvements. No improvements to the emergency power system should be required through Phase II.

3.05 Nutrient Removal

As noted in Section 2, North Liberty will be required to consider the feasibility of adding biological nutrient removal in the next plant expansion. This includes total nitrogen removal and phosphorous removal. The existing facilities are designed and operated for biological nutrient removal. Recent operating data shows that the facility is currently achieving less than 10 mg/L total nitrogen. Any expansion will also include the capability to continue biological nutrient removal. As such, no additional facilities will be required for total nitrogen removal.

In order to achieve biological phosphorous removal, anaerobic zones will need to be added and the flow scheme will need to be modified. This is discussed further in Section 4. It's recommended that the City evaluate the feasibility and consider adding biological phosphorous removal as part of the Phase II expansion.

3.06 Separation Requirements & Land Acquisition

Any expansion at the WWTP will require an increase in the "footprint" of the plant. When expanding a WWTP, separation distances dictated by the IDNR must be taken into consideration. IDNR design standards require that a separation distance of at least 1000 feet from the nearest inhabitable residence, commercial building, or other inhabitable structure be maintained. For existing facilities undergoing an expansion, the separation distance, if already less than 1000 feet, may be decreased by 10% in the expansion. This can limit the ability of an existing facility to expand to meet the growing needs of a community.

Due to the rapid development in the general area of the existing treatment facility, it is recommended that the City obtain separation waivers from any individuals that wish to build inhabitable structures within 1,000 ft of the property lines of the existing facilities. Without separation waivers, it could be difficult to construct future improvements, even though the improvements would be within the confines of existing City property.

As the city continues to grow, expansion of the wastewater treatment plant will be inevitable. This will require additional property. In order to secure the future needs of the facility, it is recommended that the city consider acquiring the property directly to the east of the existing treatment plant site. This property could be used for expansion of the facility.

3.06 Summary of Deficiencies

Flow Equalization

- Increase EQ pumping capacity when the pumps wear out.
- Provide VFD's for the EQ pumps.
- Install new overflow pipe and structure in EQ basin.

Preliminary Treatment

- Replace the screen with a higher capacity unit in Phase IA.
- Replace the manually cleaned screen with a grinder.
- Increase the raw wastewater pumping capacity.
- Install a mixing system in the raw wet well to minimize grease build-up.
- Consideration should be given to installing an odor control system at preliminary treatment.
- Construct a new sewer influent structure.

Secondary Treatment

Fine Screens

- Provide additional fine screening capacity for Phase IA and Phase II.
- Provide hot water spray wash system.

Aeration Basins

- Provide additional aeration basin capacity for Phase II.
- Provide valved opening(s) between the two tanks to allow the water levels in the tanks to equalize.

Aeration System

- Increase the blower capacity for Phase IA.
- Expand the aeration system for Phase II.

Waste Sludge System

- No deficiencies noted.

Mixed Liquor Recirculation Pumps

- Increase the capacity for Phase II.

Membrane Trains

- Provide additional membrane capacity for Phase IA and Phase II flows.
- Replace the membranes prior to April 2018.
- Replace the coating on the membrane tanks when the membranes are replaced.
- Cover the membrane tanks with a solid surface.
- Add a small concrete tank to facilitate membrane cleaning.

<u>Secondary Treatment (continued)</u>

Permeate Pumps

- Increase the capacity for Phase IA and Phase II.

Backpulse Tank

- Modify piping to allow increased permeate flow.

Membrane Aeration System

- For Phase IA, convert the existing membrane trains to GE/Zenon's LEAPmbr system.

Chemical Feed Systems

- No deficiencies noted at this time.

Compressed Air System

- No deficiencies noted at this time.

<u>Ultraviolet Disinfection System</u>

- No deficiencies noted at this time.

<u>Solids Handling Facilities</u>

Aerobic Digesters

- Replace the existing blowers and provide additional blower capacity for Phase II.
- Install magnetic flow meters for the sludge transfer pumps.
- Replace piping supports for the aeration piping in the digesters.

Sludge Storage

- Provide additional sludge storage capacity for Phase IA and Phase II.

<u>Control Building</u>

- Expand the control building to provide additional office space and support facilities.

<u>Biological Nutrient Removal</u>

- Consider adding biological phosphorous removal as part of Phase II.

<u>Separation Requirements & Land Acquisition</u>

- Obtain separation waivers from any individuals that wish to build inhabitable structures within 1,000 ft of the property lines of the existing facilities.
- Consider acquiring the property directly to the east of the existing treatment plant site.

4 – Development of Improvement Alternatives

4.01 General

Chapter 3 identifies several needs for the North Liberty wastewater treatment facility and gives recommendations to improve each component to meet the growing needs of the community. In this section, the recommendations for the individual components are combined into overall project alternatives to best address the needs of the overall facility. Due to the relatively rapid growth of the community, the concept of phased expansion will continue to be utilized.

Phase IA would be designed to meet the projected needs for a population of about 20,400. There are several components that need to be addressed in the Phase IA expansion. These are summarized in Table 4.1 below and described in more detail in the following sections. The recommended improvement and alternatives were developed in enough detail to allow preliminary cost opinions to be developed (see Section 5).

Table 4.1 Phase IA Improvements

Flow EQ & Preliminary Treatment Improvements

- Provide VFD's for the Flow EQ Pumps.
- Install new overflow pipe and structure in EQ basin.
- Replace the cylindrical fine screen; add screening wash press and mezzanine level to access new screen and ventilation system.
- Add grinder to replace manually cleaned bar screen in bypass channel.
- Increase capacity of raw wastewater pumps.
- Install mixing system in the raw wet well to minimize grease accumulation.
- Add odor control to preliminary treatment building.
- Construct a new sewer influent structure.

Secondary Treatment Improvements

- Fine screen Improvements.
- Provide valved opening between the aeration basins.
- Increase the aeration blower capacity by replacing the belts and sheaves.
- Add the 5th membrane cassette to each train.
- Cover membrane tanks with fiberglass grating with integral cover plate.
- Add a small concrete tank to facilitate membrane cleaning.
- Replace permeate pumps with higher capacity pumps.
- Modify piping at the backpulse tank to allow increased permeate flow.
- Convert to the LEAPmbr system.

(continued on the next page)

Table 4.1 Phase IA Improvements (continued)

Solids Handling Facilities

- Aerobic digester improvements
- Construct new sludge storage facilities.
- Purchase trailer mounted sludge thickener/dewatering unit.

Control Building

- Expand the control building for additional office space.

Phase II would be designed for a population of about 27,800. Phase II was originally planned for a population of 22,000, so this represents more than a 25% increase. The components required for Phase II expansion are summarized in the Table 4.2.

Table 4.2 Phase II Improvements

Preliminary Treatment Improvements

- Increase firm raw wastewater pumping capacity.

Secondary Treatment Improvements

- Construct building addition onto membrane building.
- Increase capacity of fine screens.
- Expand aeration basins and anoxic zones.
- Expand aeration system and blower capacity.
- Increase mixed liquor return pumping capacity.
- Install membrane equipment for the fourth train.
- Replace the membranes in trains 1 – 3.
- Replace the coating on the membrane tanks.

Solids Handling Facilities

- Convert existing sludge storage tank to aerobic digester.
- Replace digester blowers.
- Provide sludge thickening/dewatering facilities.

Control Building

- Renovate control building for additional office, lab, and support facilities.

In addition, at alternative has been developed for adding biological nutrient removal as part of the Phase II improvements. This discussed further in Section 4.04.

Phase III would handle a design population of about 55,000. Improvements for Phase III were generally considered for future site layout, and to determine site space requirements and limitations. Table 4.3 summarizes the improvements for Phase III. The Phase III improvements are intended to essentially double the capacity of the treatment plant.

Table 4.3 Phase III Improvements

Flow EQ & Preliminary Treatment Improvements

- Provide additional flow EQ basin and pump station.
- Construct new preliminary treatment facilities.

Secondary Treatment Improvements

- Provide additional membrane bioreactor system and additional aeration basins.

Solids Handling Facilities

Provide additional solids handling facilities.

Control Building

- Construct new control building.

4.02 Phase IA Improvements

The Phase IA improvements summarized in Table 4.1 are presented in three categories: Flow EQ and Preliminary Treatment Improvements, Secondary Treatment Improvements, and Solids Handling Facilities. The recommended improvements are further described below. A general site layout for Phase IA improvements is shown in Figure 4.1.

4.02.1 Flow EQ and Preliminary Treatment Improvements

The flow EQ and preliminary treatment improvements will be designed to increase the flow capacity as well as address some operational issues previously identified.

A. Provide Variable Frequency Drives (VFDs) for the Flow EQ Pumps

To minimize the short cycling on the flow EQ pumps during certain flow events, variable frequency drives will be installed to replace the soft starters. These will be installed in the existing EQ control building, in the existing motor control centers in place of the soft starters. The controls will be modified to allow the pumps speed to be controlled to closely match the pumping rate with the influent flow rate.

FIGURE: 4.1

REVISION	NO.	DATE
DRAWN SJT	PROJECT NO. 2489-11A	DATE 5/3/13

WWTP PHASE IA EXPANSION

FACILITY PLAN UPDATE

CITY OF NORTH LIBERTY, IOWA

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FOX engineering

PATH: C:\User\project\2489-11A North Liberty WWTP\Drawings\Civil\WWTP Site Eval REVISED.dwg

B. *Install New Overflow Pipe and Structure in the EQ Basin*

A new 14” overflow pipe will be installed parallel to the existing 14” overflow pipe to increase the overflow capacity to protect the EQ basin from over-topping. The pipe will be connected to the outfall sewer in an existing manhole. A new concrete overflow structure will also be installed in the EQ basin. This structure will be designed with an overflow weir to capacity to handle more the than the proposed peak pumping rate to the EQ basin.

C. *Replace Cylindrical Fine Screen, Add Wash Press and Mezzanine*

To increase flow capacity through preliminary treatment, the cylindrical fine screen will need to be replaced. Because of the depth of the preliminary treatment facilities and the need to lift the screens more than 15 feet to ground elevation, there are a limited number of screen that can be used in this application.

Screens similar to the existing ones were considered, including a Lakeside Raptor and Huber Technology ROTAMAT Series. In order to increase the flow to 7 MGD, the cylindrical screen would need to be significantly larger. It would require increasing the channel width at the screen from 42” to 50”. While this could be done, it would require major demolition and reconstruction of the influent channel. There is a bypass channel, so it would be possible to reconstruct the channel and keep the plant in operation, but it would present some challenges and be disruptive to operations. The advantage of utilizing this type of screen is that it would not require construction of a mezzanine. But since the existing screen will be completely replaced, different types of screens were also considered to address some of the maintenance concerns associated with the existing screen.

A center flow type band screen was considered as an option for replacing the existing screen. These types of screen have the advantage of high solids capture, high flow capacity, and low headloss. A screen sized for 7.0 MGD would fit in the existing channel. However, since the screen will extend vertically a mezzanine level will need to be constructed to allow access for maintenance. A screening wash press would also be installed on the mezzanine level to clean, compact, and dewater the screenings. The screenings would then be deposited into a dumpster in a similar location to the existing one. This is a viable option that could be considered further during design.

Another type of screen considered was a multi-rake bar screen, an automatic, self-cleaning mechanical bar screen. These types of screens are well suited for depth channels and large amounts of screenings. The bar screen with ¼” openings rated for at least 7.0 MGD would fit in the existing channel. The screens would be discharged into a new wash press, located on a mezzanine at ground level, similar to the band screen.

Another type of screen considered was a climber or crawler screen, which is also a bar-type screen similar to the previous one, except that a single rake is raised and lowered to remove the screenings. These types of screens are heavy duty, durable, and easy to maintain with no permanently submerged moving parts. The screenings would be discharged to a new wash press located on a mezzanine similar to the others. The mezzanine would need to be a few feet below ground elevation due to limitations in lifting height of the screen. But the screening wash press would discharge the screening into a dumpster at ground level.

While all of these types of screens are valid selections, for this evaluation it was assumed that a multi-rake screen would be used and a mezzanine level would be constructed at ground level. If desired, alternate types of screens can be explored during design. The mezzanine has the added benefit of allowing access to maintain the existing ventilation equipment.

D. Add Grinder in Bypass Channel

To address the operator's concerns with the existing manually cleaned bar screen, an in-channel grinder will be installed in its place. The grinder will only be utilized when the mechanically cleaned screen is out of service. In addition the grinder, automated control gates will be added to automatically divert flow to the grinder if the screen fails.

E. Increase capacity of raw wastewater pumps

As previously discussed in Section 3, the raw wastewater pumps are not operating at their full capacity. In order to increase the capacity of the raw wastewater pumps to meet the Phase IA design flows, the pump speed would need to be increased. This would require replacing the belts and sheaves to increase the pump speed and replacing the existing motor with a larger horsepower motor to handle the higher flows. Increasing the pump speed to 1350 rpm would increase the firm capacity (with two pumps running) to about 5.6 MGD. This would be more than adequate for Phase IA. The total pumping capacity, will all three pumps running, is about 7.0 MGD. In combination with the flow EQ pumps, the firm pumping capacity would be 14.24 MGD, which is adequate for Phase IA peak hour flow. Increasing the pump speed to 1350 RPM would require increasing the motor size to 75 HP. Replacing the motors would require new variable frequency drives.

In addition to modifying the pumps, the existing discharge piping would need to be modified for the higher flows. The individual discharge piping and valves from each pump would be increased from 8" to 12". The piping would also be modified to allow the check valves to be installed in a horizontal position.

F. Install Mixing System in the Raw Wet Well to Minimize Grease Accumulation

There are several options for mixing systems in wet wells to minimize grease accumulation, including mechanical mixers, pumped systems, and aeration. One of the most common and simplest types is use a side stream from the raw wastewater pumps and inject it back into the wet well for mixing, and is the preferred method for North Liberty. A new pipe would be routed from the pump discharge header back to the wet well, and a nozzle would be installed to increase the pump velocity. An automated valve would be installed on the side stream line to automatically open and close periodically to mix the surface of the wet well.

G. Add odor control to preliminary treatment building

Several options are available for odor control. General categories include: source reduction or elimination, liquid treatment, and air treatment technologies. Due to the difficulty in identifying and eliminating sources and causes of odors in the North Liberty system, this option was not considered as a viable alternative. Liquid treatment technologies generally involve some type of chemical addition to reduce the formation of odorous gases. While these technologies can be effective and do not require a large capital investment to implement, the ongoing cost of chemicals often makes these options cost prohibitive. Air treatment technologies include chemical scrubbers, carbon adsorption, biological filters or scrubbers, and non-carbon adsorption.

Since a detailed odor control study is outside the scope of this facility plan, it was assumed that a carbon adsorption type system would be the best fit for this application. In 2006, odor control at the preliminary treatment building was evaluated on a cursory basis. At that time, carbon adsorption was also considered the most cost effective option. A carbon adsorption system would modifications to the preliminary treatment ventilation system, construction of a new building to house the carbon system, and associated equipment, ductwork, and controls. If the city decides to proceed with implementing some type of odor control, a more detailed evaluation of the options available should be conducted.

H. Construct New Sewer Influent Structure

As noted in Section 3, a new influent structure will be required for the new parallel interceptor sewer and the new SE Growth Corridor sewer. The concrete structure would be constructed southwest of the preliminary treatment building, over the existing 24-inch intercept sewer (see Figure 4-2). The new 33-inch parallel interceptor sewer would be connected to this new structure alongside the 24-inch. The new 27-inch SE Growth Corridor sewer would connect to this structure from the northwest. The combined flow would then flow through the existing 24-inch sewer to MH-1 and to preliminary treatment. An overflow pipe would be installed in this new structure so that flows in excess of 7 MGD (the

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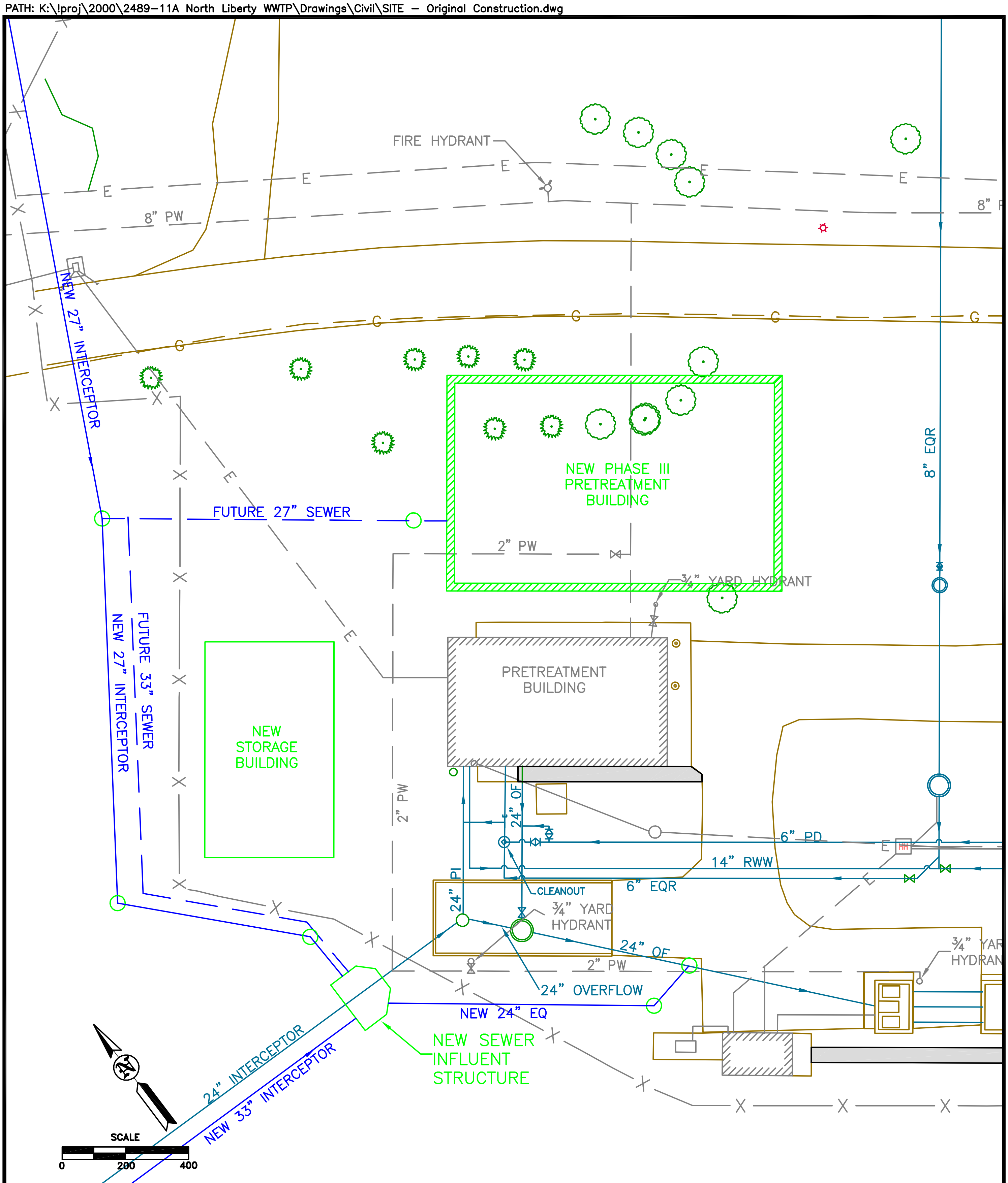

FOX engineering	New Sewer Influent Structure WWTP Facility Plan Update City of North LIberty, Iowa	**FIGURE:** 4.2		
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capacity of preliminary treatment) would be diverted to the flow EQ pumping station.

When Phase II flow capacity is reached, a new preliminary treatment building would be constructed. At that time, a new pipe from the influent structure will be installed to route flow to the new preliminary treatment building.

Although this new influent structure has been included with the Phase IA improvements, it will be constructed as part of the new parallel 33" sewer project. Therefore, the costs for this structure have not been included as part of the Phase IA improvements.

4.02.2 Secondary Treatment Improvements

The secondary treatment improvements related to Phase IA generally include improvements to the MBR system and associated equipment, as well as the aeration basins and associated equipment. Each component is discussed in further detail below. Figure 4.3 illustrates the proposed secondary treatment improvements.

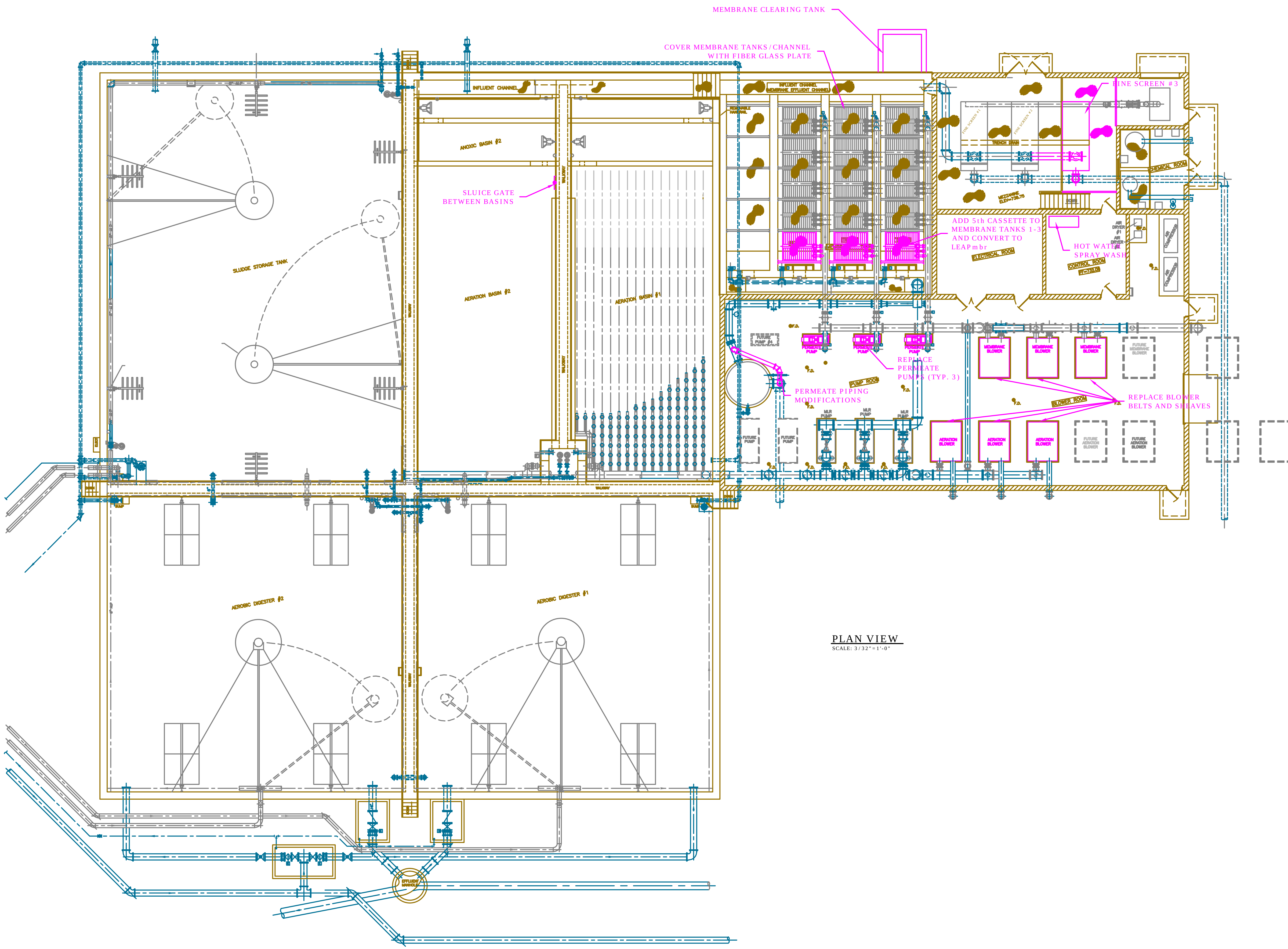
A. Fine Screen Improvements

Additional fine screening capacity will be required for Phase IA. The original design included space for adding a third fine screen in the screening room in the MBR Building. The new screen would be an internally fed rotating drum screen with 1 mm openings, similar to the existing screens. The screen would be sized for the same capacity as the existing ones (2.54 MGD). That would provide a total firm capacity (with one screen out of service) of about 5.0 MGD, which is adequate for Phase IA peak loading on the MBR system. The captured screenings would discharge into the existing auger and be transported to the existing wash press. Only minor modifications would be required to the auger to accept screenings from the third screen.

In order to ensure an equal flow split between the three screens, a magnetic flow meter and modulating valve would be installed on the inlet to each screen.

To address the operators concerns with grease accumulation on the screens, a new hot water system would be installed for the spray wash system. Hot water would help clean grease off of the screen openings and reduce plugging.

The spray wash system for the screens requires 24 gpm, and are typically operated on an intermittent basis. If fouling is high, spray wash may be operated continuously. Although hot water would be effective in removing grease, the cost to heat the water would be significant. For this reason, it is assumed that hot water spray will only be required 10% of the time. The hot water system would include commercial grade water heater(s) and required piping modifications. The water heater(s) would be located in the storage room in the membrane building.



PLAN VIEW

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DRAWN: JTP	05/13
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LAST UPDATE: 5/3/13

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PHASE IA IMPROVEMENTS

SECONDARY TREATMENT IMPROVEMENTS
WWTP FACILITY PLAN UPDATE
CITY OF NORTH LIBERTY, IOWA

PROJECT NO. 2489-11A

FIGURE FIG 4-3

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B. Provide Valved Opening between the Aeration Basins

As discussed in Section 3, a valved opening between the basins will be provided to help maintain the same water level in each basin. A square opening, approximately 3 ft x 3 ft, will be cut in the wall between the two tanks at about mid-depth. A flange mounted sluice gate will then be installed over the opening with an operator extended up to the walkway surface. The gate will normally be left open so that the water level can equalize between the two tanks. The gate can be closed when one of the tanks is taken out of service.

C. Increase Aeration Blower Capacity

Each aeration blower capacity can be increased from about 1600 scfm to about 1875 scfm by simply changing out the belts and sheaves. This will provide a firm blower capacity of 3750 scfm, which is adequate for Phase IA if the denitrification and membrane aeration credits are included. The existing blower motors are 125 HP, which is adequate to handle the additional power requirement. No other modifications to the blowers will be necessary.

D. Add the 5th membrane cassette to each train.

In order to increase the capacity of the membrane system, the 5^{th} membrane cassette will be added to each of the three trains. The new membranes would have 370 sf of membrane area per module compared to the existing modules that have 340 sf. This provides an increase of approximately 9% in membrane surface area. As the existing membranes come due for replacement, they will be replaced with 370 sf modules. Typical membrane life is around 7 to 10 years. The existing membranes have been in service since August 2008, so it is anticipated that all the membranes will be replaced within the next 5 years.

When the new cassettes are installed, the total membrane surface area will be approximately 249,000 sf. The resulting flux rates for the Phase IA design flow conditions are presented in Table 4.4. The flux rates are within the allowable limits. When all the membranes are replaced with 370 modules, this will provide a total membrane surface area of 266,400 sf, which will result in even lower flux rates.

Table 4.4 – Phase IA Membrane System Flux Rates

Design Condition	Phase IA Design Flux Rates		Allowable Flux Rates	
	Flux (gfd)	Flow (MGD)	Flux (gfd)	Flow (MGD)
All Trains in Service (1)				
Avg. Day	10.0	2.448	10.0	2.448
Max. Month	13.3	3.256	14.6	3.574
Max. Day	17.3	4.235	19.4	4.749
Peak Hour	20.4	5.000	22.1	5.410
One Train out of Service (n-1) (2)				
Max. Flow (3)	22.1	3.607	22.1	3.607

Notes: (1) Total membrane surface area = 244,800 sf; assumes all modules are 340 sf.
(2) Total membrane surface area = 163,200 sf; assumes all modules are 340 sf.
(3) Maximum flux rate with one train out of service for a short period of time.

The new membrane cassettes will be provided by the manufacturer of the original system (GE / Zenon Environmental Corp.). The new cassettes will include the necessary valves, piping, and appurtenances required for the installation. GE will also provide installation and commissioning services, as well as any control modifications that are required. To minimize over-fluxing of the new membranes when installed with older membranes that have been in service for a while, the new cassettes should all be installed in the same train.

E. Replace the Belts and Sheaves on the Aeration Blowers

Each aeration blower capacity can be increased from about 1600 scfm to about 1875 scfm by simply changing out the belts and sheaves. The existing blower motors are 125 HP, which is adequate to handle the additional power requirement. No other modifications to the blowers will be necessary.

F. Cover Membrane Tanks with Fiberglass Grating with Integral Cover Plate

To address the operators concerns with leaves and debris entering the membrane tanks and heat retention, the membrane tanks should be covered with a solid surface rather than open grating. This can be accomplished by installing fiberglass grating that includes an integral solid surface cover plate over the grating. The cover plate would include rough surface for slip resistance.

G. Add a Small Concrete Tank for Membrane Cleaning

A small concrete tank will be added on the northeast end of the membrane tanks to facilitate cleaning of the membranes. The tank would be approximately 9 ft x 8 ft x 12 ft deep. The existing overhead bridge crane will be used to install a cassette in the tank for cleaning. One membrane cassette could be installed in the tank at a time. Water piping will be provided to fill the tank and the chemical feed system will also be connected to the water line to allow chemical cleaning of the membranes. A valve and drain pipe will be provided to allow the tank will be drained back to the head of the plant. The tank will be covered with grating/deckplate and provided with a walkway and handrail for safety.

H. Replace permeate pumps with higher capacity pumps

In order to increase the capacity through the membrane system to match the increased design flows, the permeate pumps will need to be replaced. The existing pumps will be replaced with the same type of pump. The existing pumps are designed for 1133 gpm with a 40 HP motor. The proposed new pumps will be designed for 1430 gpm. This will be large enough to handle the Phase II design flows also. The existing motors will be adequate for the new pumps, and will be re-used. The new pumps are slightly larger than the existing and will require some minor piping modifications to accommodate them.

I. Modify Piping at the Backpulse Tank

To address the flow limitations through the backpulse tank, the piping will be modified to pump the permeate from the membrane system directly to the discharge line. The permeate piping will remain connected to the backpulse tank, but an automated valve will be used to fill the tank as needed. During backpulse, the valve will fully open to allow the water to used for backpulsing the membranes. The overflow from the backpulse tank will be connected to the effluent line, as it is now, but a check valve will be installed to prevent water from entering through the over flow

J. Convert to the LEAPmbr System

As discussed in the previous section, the new membrane cassettes will be installed with the LEAPmbr system, and the existing cassettes will be converted on site. The manufacturer, GE/Zenon, will be on site to assist the contract in completing the conversion. Staging will be required, such that one train will be converted at a time. The belts and sheaves on the membrane aeration blowers will also be changed to reduce the blower speed to match the required output. The conversion to LEAPmbr will also require modifications to the membrane control system.

4.02.3 Solids Handling Facilities

The improvements to the solids handling facilities for Phase IA involve adding magnetic flow meters to the sludge transfer pumps, construction of a new 1.5 million gallon (MG) sludge storage tank, and a trailer mounted sludge thickener. Each component is discussed in further detail below.

A. Aerobic Digester Improvements

Each digester has a sludge transfer pump to transfer sludge to the other digester or sludge storage tank. To provide flow monitoring and recording, a magnetic flow meter will be installed on the discharge piping on each pump. The meter will be installed on the vertical piping on the pump discharge, above the walkway level to allow access for maintenance. The meter will be connected to the plant SCADA system for monitoring and recording.

In addition, the piping supports for the aeration piping in the digesters is corroded and in need of replacement. The steel pipe supports will be replaced with stainless supports and stainless steel anchors to minimize corrosion.

B. Alternate 1 – Biosolids Thickening

In order to handle the biosolids produced from Phase IA, additional sludge handling facilities will be required. Alternate 1 assumes that the biosolids will be thickened and stored as a liquid prior to land application.

<u>Sludge Storage Facilities:</u> A new 1.5 million gallon (MG) sludge storage tank will be constructed to increase the storage capacity. The tank is proposed to be located on the property east of the existing treatment plant site that the city intends to acquire. Figure 4.1 illustrates the proposed tank location.

With the existing storage tank, the total sludge storage volume will be about 2.3 MG. This will provide approximately 200 days worth of storage at 2% solids for the Phase IA projected biosolids quantities.

The proposed new tank will be constructed of cast-in place concrete, and will be approximately 108 ft. diameter x 22 ft deep. The bottom will be sloped to a center sump for removing sludge. A decant structure will be provided to allow supernatant to be drained off the top. The tank will be mixed with floating downdraft mixers, similar to the existing ones. A sludge load out station will be provided and include a pump and flow meter. A rock drive will be provided around the tank for truck access.

A new pipe will be installed between the existing sludge storage tank and the new one. The existing sludge load out pumps will be used to transfer sludge to the new tank. A new drain pipe will also be provided to allow supernatant to be returned to the head of the plant.

Sludge Thickening Facilities: To meet Phase II design conditions, in addition to the new sludge storage tank sludge thickening will be required. This is discussed further in the following section. Plant staff would also like the ability the thicken sludge prior to Phase II to increase flexibility and reduce the cost of sludge hauling. This could be accomplished by purchasing a trailer mounted rotary drum thickener. The thickener would reduce the volume of sludge hauled, and the associated cost, by 2 to 3 times. See Section 5 for further discussion.

C. Alternate 2 – Biosolids Dewatering

Alternate 2 assumes that the biosolids will be dewatered and stored as a solid prior to land application.

Sludge Dewatering Facilities: If sludge dewatering is selected as the long term biosolids handling method, a sludge dewatering unit should be provided as part of Phase IA. The unit should be sized to handle the Phase II design conditions. This is discussed further in the following section. This could be accomplished by purchasing a trailer mounted belt filter press dewatering unit. This would reduce the volume of sludge hauled, and the associated costs. See Section 5 for further discussion.

Sludge Storage Facilities: Sludge storage facilities would be constructed to store the dewatered biosolids for a minimum of 180 days. Due to economies of scale associated with constructing this type of facility, it would be sized for the Phase II requirements. For an estimated Phase II sludge production of 925,000 lbs/year (dry solid), and approximately 18% dewatered solids content, dewatered sludge production would be approximately 2570 wet tons per year. For approximately six months of storage, this would require an area of approximately 80 ft x 120 ft square assuming an average of six feet deep. The biosolids storage facility would include a concrete pad, drainage collection, roof structure, and odor control.

4.02.4 Control Building

To provide additional office space for the wastewater treatment plant staff, an addition will be constructed onto the existing control building. The 500 square foot addition will be built on the south side of the building, next to the existing laboratory.

4.03 Phase II Improvements

The Phase II improvements summarized in Table 4.2 are presented in three categories: Preliminary Treatment, Secondary Treatment Improvements, and Solids Handling Facilities. The recommended improvements are further described below. A general site layout for Phase II improvements is shown in Figure 4.4.

FIGURE: 4.4

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WWTP PHASE II EXPANSION

FACILITY PLAN UPDATE

CITY OF NORTH LIBERTY, IOWA

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4.03.1 Preliminary Treatment Improvements

The preliminary treatment will be designed to increase the flow capacity to meet the Phase II requirements.

A. Increase Raw Wastewater Pumping Capacity

With the improvements in Phase IA, the total raw wastewater pumping capacity would be about 7.0 MGD. This is the Phase II design peak flow to the MBR. However, in order to provide firm capacity, a fourth pump will need to be added. Though not ideal, there would be space to install the fourth pump. A new suction pipe to the wet well would be required, and the discharge piping would connect to the existing common header from the other pumps.

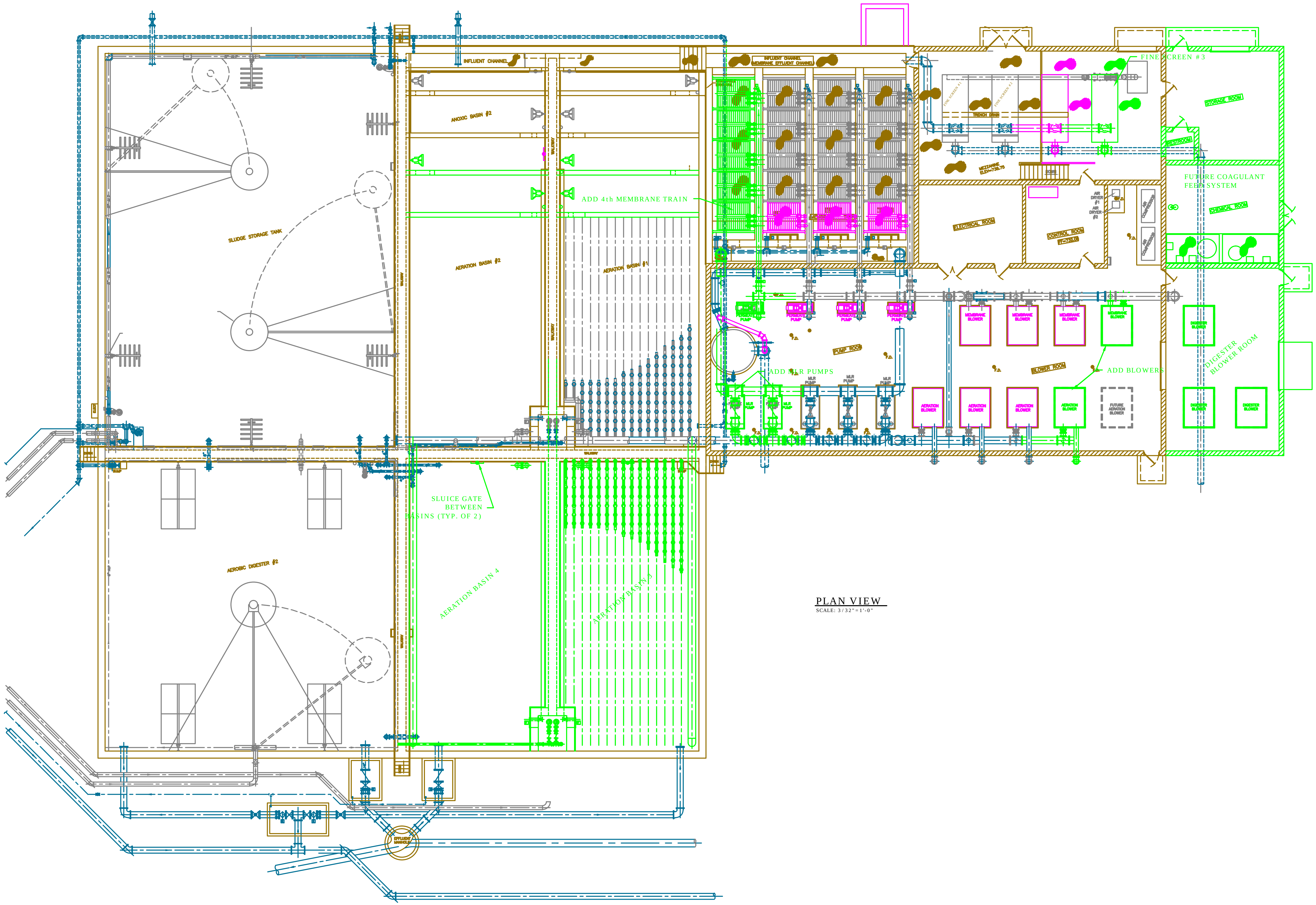
In combination with the flow EQ pumps, the revised firm peak flow pumping capacity would be 15.64 MGD. Total pumping capacity would be about 18.52 MGD. The firm pumping capacity is very close to the projected peak hour demand for Phase II (16.4 MGD). Based on the method used to project peak flows, the firm pumping capacity will be adequate for a population of about 25,500 (year 2024 based on population projections). As previously discussed in Section 3, these pumps should be replaced when the pumps wear out or the firm peak pumping capacity is reached.

4.03.2 Secondary Treatment Improvements

The secondary treatment improvements related to Phase II generally include improvements to the MBR system and associated equipment, as well as the aeration basins and associated equipment. Each component is discussed in further detail below. Figure 4.5 illustrates the proposed secondary treatment improvements.

A. Construct Building Addition to Membrane Building

Because the Phase II peak flow capacity for the membrane system is significantly higher than the original Phase II, additional equipment (particularly fine screening) will be required. In order to provide space to house the additional equipment, a building addition will be constructed to the southeast end of the building. The building addition will be approximately 25 ft wide x 86 ft long (to match existing building width). This will allow the screening room to be expanded, provide space for additional chemical feed systems that will likely be required for future phosphorous limits. The building will also provide additional storage space that can be used for equipment for Phase III expansion.



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PHASE II IMPROVEMENTS
SECONDARY TREATMENT IMPROVEMENTS
WWTP FACILITY PLAN UPDATE
CITY OF NORTH LIBERTY, IOWA

PROJECT NO. 2489-11A

FIGURE
FIG 4-5

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B. Increase capacity of Fine Screens

With the Phase IA expansion, the third fine screen brings to total capacity to about 7.5 MGD and the firm capacity to about 5 MGD. In order to provide firm capacity for the Phase II expansion, an additional fine screen will be required. The new screen would be an internally fed rotating drum screen with 1 mm openings, similar to the existing screens. A magnetic flow meter and modulating

valve would be installed on the inlet of the screen to control influent flow. The screen would be sized for the same capacity as the existing ones (2.54 MGD). That would provide a total firm capacity (with one screen out of service) of about 7.5 MGD, which is adequate for Phase II peak loading on the MBR system.

Similar to the other screens, the captured screenings would discharge into the existing auger and be transported to the existing wash press. The existing auger and wash press will be adequate for the additional screen. Only minor modifications would be required to the auger and wash press to accept screenings from the fourth screen.

C. Expand Aeration Basins and Anoxic Zones

As noted in Section 3, additional aeration basin capacity will be required for Phase II. The original Phase II concept was to expand north and convert the existing sludge storage tank to aeration basins. That would double the aeration basin size for only about a 35% increase in loading. Rather than providing excess aeration basin capacity for Phase II, the proposed expansion will be to the west converting existing Aerobic Digester No. 1 into aeration basins. This will allow a Phase III expansion to the north.

Aerobic Digester No. 1 would be divided into two aeration basins, similar to the existing ones. This will bring the total aeration basin volume to 1.35 million gallons. Additional anoxic zones would be constructed in the existing basins to keep the anoxic volume at about 20% of the total aeration basin volume.

With the expanded aeration basins, the loading and design parameters are shown in Table 4.5. As can be seen in the table, the organic loading rate is higher than conventional systems, but still within acceptable parameters for an MBR. The food to microorganism ratio is still much lower than conventional systems. To verify this, an activated sludge model was used to evaluate these loading conditions. The model results, presented in Appendix C, show that the aeration basis will be adequate for the proposed conditions. The expanded aeration basins will be adequate through the projected Phase II loading rates.

Table 4.5 – Aeration Basin Loading and Design Parameters

Loading / Design Parameter	IDNR Guidelines (1)	Phase II Loadings
Max. Month BOD Load (lbs/d)	---	4,730
Solids Retention Time, SRT (days)	15 - 25	20
Organic Loading Rate, OLR (lbs BOD5/1000 cu. ft /d)	15	26
Food to Microorganism Ratio, F:M lbs BOD5/lb MLVSS / d) (2)	0.08 - 0.16	0.06
Mixed Liquor Suspended Solids (MLSS) (mg/L)	2,000 - 5,000	8,000

Notes: (1) IDNR guidelines for conventional combined carbon oxidation /nitrification activated sludge.
(2) Based on average 83% volatile solids concentration.

D. Expand Aeration System and Blower Capacity

To handle the additional loading and provide aeration and mixing in the new basins, a fine bubble diffused aeration system will be provided in the new basins. This will be similar to the existing system, and will be sized for the required air flow. The activated sludge models in Appendix C show that the maximum required air flow is approximately 5,454 scfm. This is based on the projected maximum loadings, and also includes an additional 50 lbs/d of TKN from the dewater solids filtrate (based on 170 mg/L, 15,000 gpd, and 3 days per week operation). The air requirement also is based on ignoring the credit for denitrification and membrane aeration.

With the Phase IA improvements, the total firm blower capacity is about 3,750 scfm (1875 scfm per blower). One additional blower will bring the total firm blower capacity up to 5,625 scfm, which will be more than enough.

In addition to providing another blower, automated valves will be installed on the drop pipe to each aeration basin. The valves will be used to control the air flow and dissolved oxygen (DO) levels in each basin. The new basins will include DO sensors used to control air flow, similar to the existing ones.

E. Increase Mixed Liquor Return Pumping Capacity

The mixed liquor return (MLR) pumping capacity will need to be increased to maintain a recirculation ratio of 5 times the maximum month flow rate. Two additional MLR pumps will be provided, so that there will be a total of 5 pumps. Two will be assigned to each aeration train and one will serve as a backup. With the addition of these two new pumps, the pumping capacity will be more than enough to provide 5 times the maximum month flow rate.

F. Install Membrane Equipment for Fourth Train

The membrane system capacity will be increased by adding the fourth membrane train. The concrete tank was built in the original Phase I, so only new equipment will need to be added. This will include five new membrane cassettes and header piping, one new permeate pump, and a new membrane aeration blower. The new membrane train will include all necessary valves and instrumentation, same as the existing ones. Modifications to the controls system will also be required to accommodate the fourth train.

When the new train and membrane cassettes are installed, the total membrane surface area will be approximately 333,000 sf (assuming all membranes have been replaced with 370 sf modules). The resulting flux rates for the Phase II design flow conditions are presented in Table 4.6. The flux rates are within the allowable limits.

The new membrane cassettes and associated equipment will be provided by the manufacturer of the original system (GE / Zenon Environmental Corp.). GE will also provide installation and commissioning services, as well as any control modifications that are required.

Table 4.6 – Phase II Membrane System Flux Rates

Design Condition	Phase II Design Flux Rates		Allowable Flux Rates	
	Flux (gfd)	Flow (MGD)	Flux (gfd)	Flow (MGD)
All Trains in Service (1)				
Avg. Day	10.0	3.330	10.0	3.330
Max. Month	13.3	4.429	14.6	4.862
Max. Day	17.3	6.310	19.4	6.460
Peak Hour	21.0	7.000	22.1	7.359
One Train out of Service (n-1) (2)				
Max. Flow (3)	22.1	5.519	22.1	5.519

Notes: (1) Total membrane surface area = 333,000 sf; assumes all modules are 370 sf.
(2) Total membrane surface area = 249,750 sf; assumes all modules are 370 sf.
(3) Maximum flux rate with one train out of service for a short period of time.

G. Replace the Membranes in Trains 1 - 3

As previously noted in Section 3, the membranes have a limited life expectancy. The City also has a guaranteed replacement price for the membranes which expires in April 2018, after which time the price will increase significantly. This applies to the membranes under the original purchase agreement that were in installed in 2008, and includes cassettes 1 – 4 in membrane trains 1 -3. There are 48 membrane modules per cassette, which results in a total of 576 membrane modules that would need to be replaced. Since the time period when Phase II will be implemented will likely coincide with the need for membrane replacement, it is recommended that the membranes be replaced in Phase II. Since the City has been putting money aside for replacing the membranes, the costs for this have not be included in the capital cost for Phase II (see Section 5).

In addition to the membranes, there are other components on the membrane cassettes that wear out and will eventually need to be replaced. These include PVC pipes and fittings, o-rings, and hardware. When the membranes are replaced, these components should be evaluated and replaced as needed. The costs for replacing these components have been included in the Phase II capital costs.

H. Replace Coating in Membrane Tanks

As noted in Section 3, the protective coating in the membrane trains will eventually need replaced. A good time to do that is when the membranes are being replaced. Since the membranes are expected to be replaced in Phase II, the tank coating should also be replaced.

4.03.3 Solids Handling Facility Improvements

The solids handling facility improvements related to Phase II include providing sludge thickening facilities to increase storage capacity. Figure 4.4 illustrates the proposed location of the solids handling improvements.

A. Convert Existing Sludge Storage Tank to Aerobic Digester

With Aerobic Digester No. 1 being converted to an aeration basin, additional digestion capacity will be needed. This will be accomplished by converting the existing sludge storage tank to an aerobic digester. No modifications will be required to convert it to a digester. The existing aeration diffusers and mixers will continue to be used. The existing decant valves and piping, and existing sludge transfer pumps will continue to be used as well.

B. Replace Digester Blowers

To provide additional aeration capacity for the Phase II conditions, additional blower capacity will be needed. Because the existing blowers are nearly 15 years old now, and will likely be close to 20 years or more when Phase II is complete, the existing blowers should also be replaced. The new blowers will be installed in the membrane building addition. Three blowers will be provided, two duty and one standby, to meet the required aeration demands for Phase II. The blowers will be provided with variable frequency drives to allow control of air flow to meet demands.

C. Alternate 1 – Biosolids Thickening

Sludge thickening facilities will be provided to increase the storage capacity for Phase II. The rotary drum thickener purchased in Phase IA will be removed from the trailer and installed in a permanent facility. The thickener will be used to thicken the sludge to about 5% or 6% solids, and the thickened sludge will be transferred to the sludge storage tank prior to land application. Projected Phase II sludge production is approximately 5.56 MG per year at 2% solids. If sludge is thickened to 5%, the total volume will be reduced to about 2.22 MG per year. The 1.5 MG storage tank constructed in Phase IA would then provide more than 240 days worth of storage.

The new sludge thickening facilities would include a new building on the east edge of the treatment plant site. The building would house the sludge thickener, polymer feed system, feed pumps, and thickened sludge pumps.

D. Alternate 2 – Biosolids Dewatering

Sludge dewatering facilities will be provided to increase the storage capacity for Phase II. The belt filter press purchased in Phase IA will be removed from the trailer and installed in a permanent facility. The dewatering unit will be used to dewater the sludge to about 18% solids, and the dewatered sludge will be transferred to the biosolids storage facility prior to land application.

The new sludge dewatering facilities would include a new building on the east edge of the treatment plant site. The building would house the sludge dewatering unit, polymer feed system, feed pumps, and conveyor.

4.03.4 Control Building

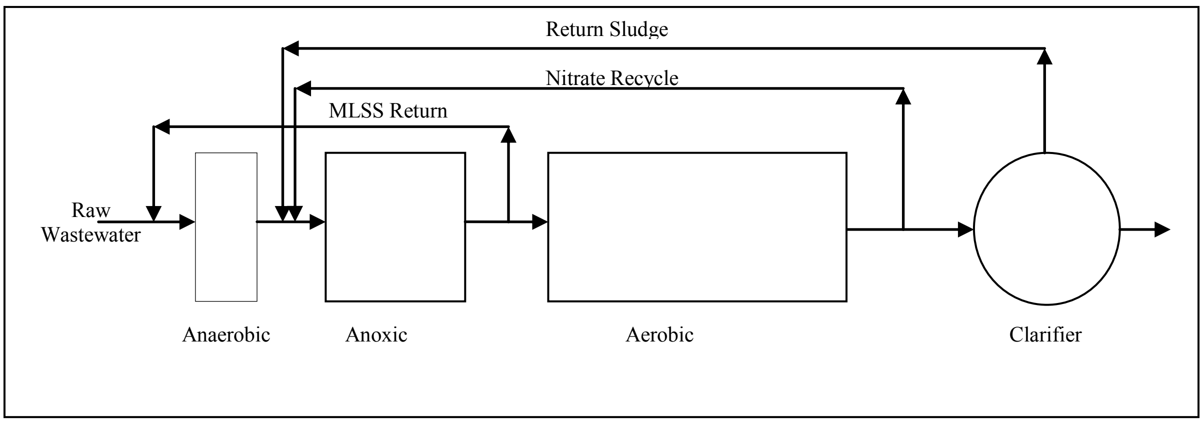
In Phase II, the existing control building will be renovated to provide additional support facilities for plant staff. The existing blower room and garage area will be renovated and converted to provide new locker room, restroom, break room, and office facilities.

4.04 Nutrient Removal Considerations

As noted in Section 2, the Nutrient Reduction Strategy implemented by IDNR requires North Liberty to consider nutrient reduction in the coming years. The total nitrogen and phosphorous limits being proposed (10 mg/L TN and 1 mg/L P) should be able to be achieved through biological nutrient removal (BNR). Total nitrogen removal is achieved through denitrification in anoxic zones coupled with aerobic zones, while phosphorous removal is achieved by phosphorous removing organisms (PAOs) in anaerobic zones. There are several different processes for biological nutrient removal, one of which (UCT process) is illustrated in Figure 4.6. It consists of an anaerobic zone, followed by an anoxic zone and an aerobic zone. The raw wastewater enters the anaerobic zone, and is combined with mixed liquor returned from the anoxic zone. Mixed liquor is recirculated from the aerobic zone to the anoxic zone.

The current aeration basin configuration at North Liberty includes anoxic zones for denitrification. In order to implement the UCT process, an anaerobic zone would need to be added at the head of the aeration basin. Modifications would also be required to the influent and membrane tank overflow to separate the two flow streams and direct the raw influent to the anaerobic zone and the membrane tank overflow to the anoxic zone. Mixed liquor recirculation from the anoxic zone to the anaerobic zone would also need to be added. Biological nutrient removal could be added to the North Liberty facility, with some modifications to the existing facilities and proposed design.

Figure 4.6 UCT Biological Nutrient Removal Process



The existing facilities and proposed improvements should be able to achieve the total nitrogen limit without modification. Another option for achieving the phosphorous limits is through chemical precipitation. This requires a smaller capital investment, but the cost of chemicals and additional sludge disposal is high. However, the proposed improvements, with some modification, can accommodate either BNR or chemical precipitation. Section 5 includes an alternate cost opinion for implementing biological phosphorous removal as part of Phase II.

4.05 Phase III Improvements

As North Liberty's population continues to grow, expansion beyond Phase II will likely be required. The Phase III was presented earlier in this report as being sized for a population of about 55,500, or roughly double the population served by Phase II. While it is likely that Phase III will be broken up into multiple phases when it is implemented, it is presented here as a single phase.

The Phase III expansion project will require significant improvements to all areas of the treatment facility: preliminary treatment and flow equalization, secondary treatment, and solids Handling Facilities. A detailed analysis of the Phase III expansion is beyond the scope of this plan, and since it will likely not occur for many years, would not be of real value at this time. Phase III is discussed here in general terms as far as what will likely be required, and how those improvements could potentially be implemented at the existing site. Figure 4.7 (at the end of this section) shows a potential layout for the Phase III facilities.

4.05.1 Preliminary Treatment and Flow Equalization Improvements

For Phase III, new preliminary treatment facilities will be required for the higher flows anticipated. Figure 4.7 shows construction of a new building north of the existing one. This would include new screens, grit removal, and pumping facilities. It is likely that the existing preliminary treatment facilities would be modified and incorporated into the new facility.

Additional flow equalization pump and storage volume will also be required for Phase III (see Figure 4.7). A new flow EQ pumping station for Phase III is shown north of the new preliminary treatment facility. A new flow EQ basin is shown east of the existing plant site on property to be acquired.

4.05.2 Secondary Treatment Improvements

Secondary improvements for Phase III would require a new membrane bioreactor facility the same size at the completed Phase II. The Phase III expansion concept involves converting the aerobic digesters (currently aerobic digester No. 2 and the Sludge Storage Tank) into aeration basins. New membrane tanks would be built between the existing tank and control building. A new building would also be constructed to house the membrane process equipment. Because of space limitations, the existing control building would be demolished to allow room for the new MBR facility. A new control building, including lab and office space, would be constructed on the east end of the plant site. A new plant entrance off of the new Forevergreen Road would be built. This would eliminate the need for chemical deliveries and sludge hauling to use Abigail Avenue next to the elementary school.

4.05.3 Solids Handling Facility Improvements

Solids handing facility improvements for Phase III would involve construction of new aerobic digesters, and additional sludge thickening/dewatering and storage facilities. The proposed facilities are shown on Figure 4.7.

4.06 Beyond Phase III - Phase IV Improvements

Because of North Liberty's rapid growth, it's prudent to at least consider the possibility of expansion beyond Phase III. Since this is likely several decades into the future, the plans presented here will likely change significantly. However, having some foresight into how Phase IV might be implemented, and planning prior expansions with that in mind, will at least keep the possibility of expanding beyond Phase III as a viable option.

The Phase IV expansion concept presented here is intended to serve a population of approximately 80,000. It would include construction of a new flow equalization basin. It is assumed that the new preliminary treatment facilities constructed in Phase III would be sized to handle the Phase IV flows with only minor modifications, such as the addition of new or larger screens, pumps, etc. Phase IV would also include construction of an additional MBR facility, and expansion of the solids handling facilities. Refer to Figure 4.7 for the proposed layout for Phase IV.

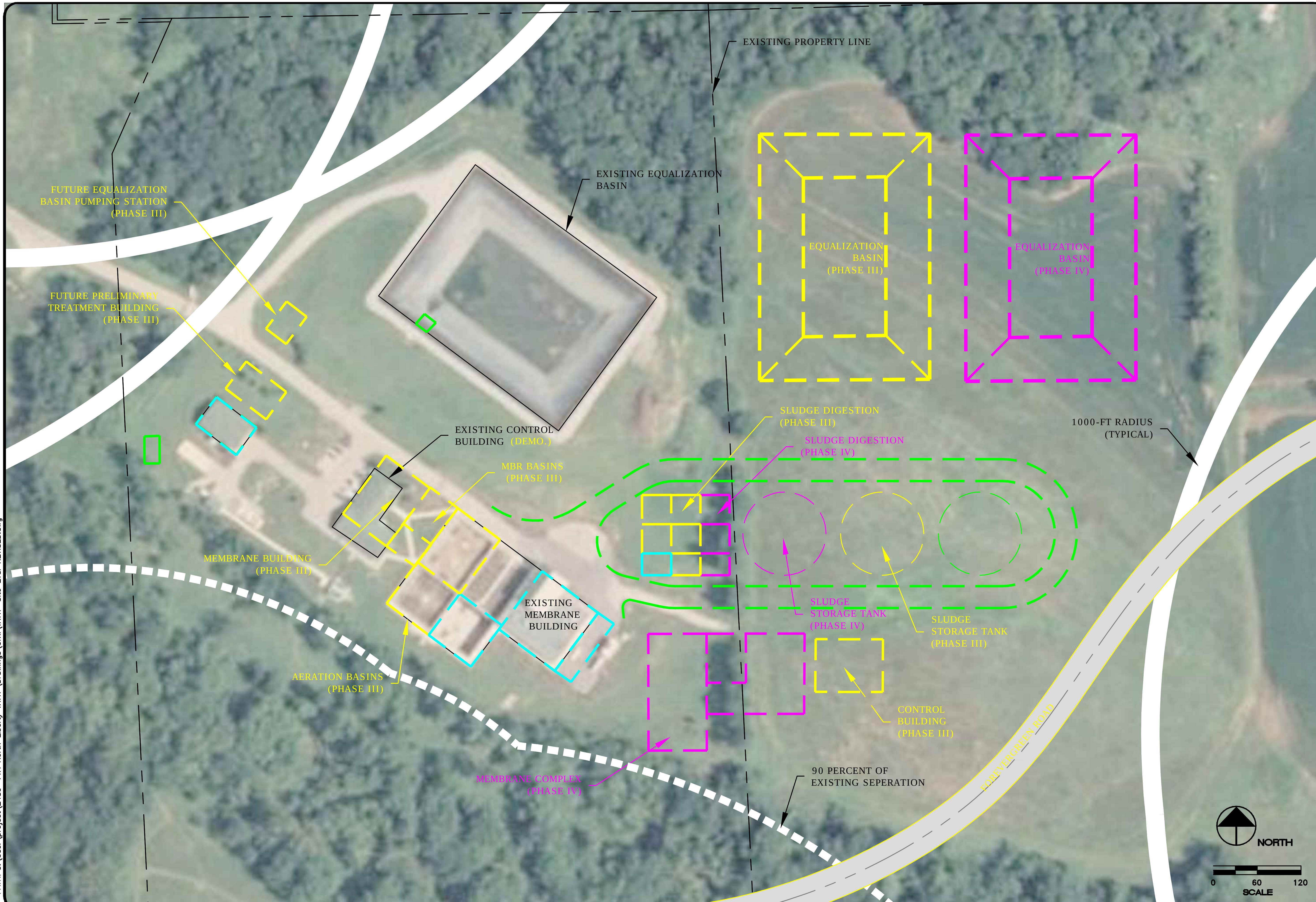


FIGURE: 4.7

REVISION	NO.	DATE
DRAWN SJT	PROJECT NO. 2489-11A	DATE 5/3/13

WWTP PHASE III & IV EXPANSION

FACILITY PLAN UPDATE

CITY OF NORTH LIBERTY, IOWA

FOX Engineering Associates, Inc.
1601 Golden Aspen Drive, Suite 103
Ames, Iowa 50010
Phone: (515) 233-0000
FAX: (515) 233-0103

FOX engineering

PATH: C:\User\project\2489-11A North Liberty WWTP\Drawings\Civil\WWTP Site Eval REVISED.dwg

5 – Opinion of Cost of Improvements

5.01 Capital Costs

For the improvements identified in Section 4, budgetary capital cost opinions have been prepared. The opinions of cost involve a significant amount of judgment at this early stage of planning and should be considered only approximate in nature. Generally, planning level estimates are considered to have an accuracy of +/- 25 percent. More refined estimates will be possible during subsequent design phases of the project.

Costs were derived using previous FOX Engineering cost data, supplier quotations, and published cost data. Capital cost opinions are intended to include all project costs, including construction cost, contingencies, design fees, field exploration, construction-phase engineering services, and an allowance for owner's legal and administrative fees. All capital cost estimates are based on recent economic conditions, with no allowance for future inflation.

5.01.1 Capital Cost Opinion – Phase IA

The opinion of probable capital cost for Phase IA improvements is presented in Table 5.1. It includes all the Phase IA improvements noted in Section 4. For the odor control improvements, an allowance of $525,000 is included. This is based on costs for a similar odor control project that used a carbon system. As noted in Section 4, if the City decides to include odor control in the project, a more detailed evaluation of the alternative systems should be completed.

The capital cost opinion presented in Table 5.1 includes purchasing a trailer mounted thickener/dewatering unit. Although not required for Phase IA, this will significantly reduce the cost of sludge hauling and improve flexibility. For sludge thickening, the cost for the trailer mounted thickener, including polymer system and thickened sludge pump, is approximately $240,000. The thickener would be used to thicken the sludge to approximately 5% to 6% solids. This would reduce the sludge volume and hauling cost in half. Current sludge hauling cost is about $0.045 per gallon. About 2 MG of sludge was hauled last year, at a cost of about $90,000. Reducing the sludge volume in half would save about $45,000 per year in sludge hauling costs. However, there would be some additional costs associated with operating the sludge thickener (polymer, labor, and electricity). The net savings would likely be in the range of $30,000 to $35,000 per year. At that rate, it would take approximately seven or eight years recover the cost of the thickener. Savings would be more for dewatering, but the capital cost is higher, so payback would be similar. However, during Phase II the thickener/dewatering unit would be permanently installed in a new building. The cost of the Phase II improvements would be reduced by cost of the thickener/dewatering unit. It's recommended that a trailer mounted thickener/dewatering unit be included as part of Phase IA.

Table 5.1 Phase IA Improvements – Opinion of Probable Cost

Item	Alt. 1 Thickening	Alt. 2 Dewatering
Flow EQ & Preliminary Treatment Improvements		
EQ Overflow Structure/Pipe, Pump VFDs	$173,000	$173,000
New Screen, Wash Press, & Bypass Grinder	$516,000	$516,000
Raw Wastewater Pumping	$101,000	$101,000
Odor Control Allowance	$525,000	$525,000
Secondary Treatment Improvements		
Fine Screening Improvements	$365,000	$365,000
Aeration Basin & Blower Improvements	$36,000	$36,000
Add Membrane Cassettes & Convert to LEAPmbr	$578,000	$578,000
Cover Membrane Tanks	$95,000	$95,000
Add Concrete Tank for Membrane Cleaning	$54,000	$54,000
Replace Permeate Pumps	$148,000	$148,000
Modify Piping at Backpulse Tank	$29,000	$29,000
Solid Handling Facility Improvements		
Digester Improvements	$25,000	$25,000
Sludge Storage	$1,014,000	$1,028,000
Purchase Thickener/Dewatering Unit	$242,000	$378,000
Control Building Addition	$53,000	$53,000
Electrical & Controls	$623,000	$647,000
SUBTOTAL	$4,577,000	$4,751,000
Contingency	$690,000	$710,000
Engineering/Legal/Administrative	$790,000	$820,000
TOTAL	**$6,057,000**	**$6,281,000**

5.01.2 Capital Cost Opinion – Phase II

The opinion of probable capital cost for Phase II improvements are presented in Table 5.2. It includes all the Phase II improvements noted in Section 4. As noted in Section 4, the cost for replacing the original membranes is not included, but the cost of refurbishing the membrane cassettes and re-coating the concrete tanks is.

Table 5.2 Phase II Improvements – Opinion of Probable Cost

Item	Alt. 1 Thickening	Alt. 2 Dewatering
Preliminary Treatment Improvements		
Raw Wastewater Pumping	$72,000	$72,000
Secondary Treatment Improvements		
Membrane Building Addition	$580,000	$580,000
Fine Screening Improvements	$277,000	$277,000
Aeration Basin & Aeration System Improvements	$779,000	$779,000
Mixed Liquor Return Pumps	$288,000	$288,000
Add Fourth Membrane Train	$1,212,000	$1,212,000
Refurbish Membrane Cassettes and Recoat Tanks	$56,000	$56,000
Solid Handling Facility Improvements		
Replace Digester Blowers	$321,000	$321,000
Sludge Thickening /Dewatering	$640,000	$500,000
Control Building Renovations	$93,000	$93,000
Electrical & Controls & HVAC	$680,000	$658,000
SUBTOTAL	$4,998,000	$4,836,000
Contingency	$750,000	$725,000
Engineering/Legal/Administrative	$862,000	$834,000
TOTAL	**$6,610,000**	**$6,395,000**

5.01.3 Capital Cost Opinion – Adding Biological Phosphorous Removal

The opinion of probable capital cost for adding biological phosphorous removal is presented in Table 5.3. The improvements include constructing new concrete tanks to create anaerobic zones, re-routing the raw wastewater to the anaerobic zone, and installing a mixed liquor recirculation system from the anoxic zone to the anaerobic zone.

Table 5.3 Adding Biological Phosphorous Removal – Opinion of Probable Cost

Item	Cost Opinion
Site Work and Site Piping	$156,000
Splitter Structure and Channel Modifications	$135,000
Anaerobic Tanks & Equipment	$578,000
Anoxic Mixed Liquor Return Pumping	$165,000
Electrical & Controls	$163,000
SUBTOTAL	$1,197,000
Contingency	$180,000
Engineering/Legal/Administrative	$210,000
TOTAL	**$1,587,000**

6 – Summary and Recommendations

6.01 Summary

The wastewater treatment facility is nearing its capacity. As North Liberty continues to grow, expansion of the wastewater treatment plant should commence in the near future to prevent the plant from becoming overloaded.

The Phase I improvements, completed in 2008, were intended for a design population 14,000. The original Phase II design was intended to a population of 22,000. The current population estimate is around 15,500. In order to meet the ever increasing wastewater needs of the community, revisions to the original phases are proposed. An intermediate Phase IA was evaluated to increase the design population to around 20,400. Modifications to the Phase II design will increase its design population to 27,800.

Evaluation of the existing facilities identified several needed improvements to meet the Phase IA and Phase II design capacities. The Phase IA improvements include increasing the capacity of the screen and raw wastewater pumping in preliminary treatment, adding odor control facilities, modifications to the EQ overflow and pumps, and constructing a new influent structure for the proposed sanitary sewer improvements. Secondary treatment improvements include additional fine screening, adding more membrane cassettes and converting to LEAPmbr, increasing the permeate pumping capacity, and other minor improvements. For Alternate 1, improvements to the solids handling facilities include a new sludge storage tank and a trailer mounted thickener. The opinion of probable cost for the proposed Phase IA improvements with thickening (Alt. 1) is around $6.06 million. For Alternate 2, improvements to the solids handling facilities include a new biosolids storage facility and a trailer mounted dewatering unit. The opinion of probable cost for the proposed Phase IA improvements with dewatering (Alt. 2) is around $6.28 million.

Phase II improvements include increasing raw wastewater pumping capacity, building an addition onto the membrane building, adding another fine screen, and adding the fourth membrane train and associated equipment. It's anticipated that Phase II will also include replacing the existing membranes, as well as re-coating the membrane tanks and refurbishing the membrane cassettes. The cost for replacing the membranes has not been included in the capital cost, as this is a regular maintenance item that the city has budgeted and planned for. Additional Phase II improvements include expanding the aeration basins by converting the existing Aerobic Digester No. 1 to aeration basins. For Alternate 1, improvements to the solids handling facilities will include replacing the digester blowers and adding a new sludge thickening building and equipment. The opinion of probable cost for the proposed Phase II improvements with thickening (Alt. 1) is around $6.61 million. For Alternate 2, improvements to the solids handling facilities will adding a new sludge dewatering building and equipment. The opinion of probable cost for the proposed Phase II improvements with dewatering (Alt. 2) is around $6.40 million.

If population projections are accurate, the Phase IA population will be reached around year 2018 and Phase II population will be reached around year 2026. In that case, planning and design for Phase II will need to begin prior to the completion of construction for Phase IA, and construction of Phase II would need to start shortly after the completion Phase IA. Because of the potential need to implement Phase II shortly after completing Phase IA, it's recommended that the City implement both Phase IA and Phase II at the same time. In addition, due to the similar costs for both thickening and dewatering and the reduced volume of biosolids to haul and the associated costs, it is recommended that Alternate 2, biosolids dewatering, be implemented.

In addition to Phase IA and Phase II expansions for increasing plant capacity, adding biological nutrient removal was also considered. IDNR has recently adopted a nutrient reduction strategy that established requirements for nitrogen and phosphorous reduction. The rules require facilities undergoing a major expansion to evaluate the cost of adding biological nutrient removal. The next NPDES permit that is issued to the City will include requirements for complying with the nutrient reduction strategy. The opinion of probable cost for the adding biological nutrient removal as part of Phase II improvements is around $1.59 million. In order to comply with the new nutrient reduction strategy in the most cost effective way, it's recommended to include biological phosphorous removal as part of the project.

The facility plan also considers expansion beyond Phase II. Although a detailed analysis and cost opinion is not presented, a conceptual plan has been developed for Phase III and Phase IV expansions at the plant.

6.02 Financing Options

The options available to finance the proposed capital improvements are relatively limited. Major municipal capital improvements are normally funded by selling bonds. The bonds can be General Obligation (G.O.) Bonds that are normally repaid through a property tax levy or Revenue Bonds that are normally repaid through user fees paid by the customers. Each has some advantages and disadvantages that should be considered. G.O. bonds usually attract about a 1% better interest rate than Revenue Bonds since they are supported by the community's ability to levy taxes. There is, however, a limit on the amount of G.O. Bond indebtedness a community can have (5% of property value) and this is the only source of capital for a number of community improvements. Considering the growth of the community and other likely demands of GO bonding ability in supporting this growth, use of GO bonds can not be strongly recommended.

Revenue bonds are supported by the user fees generated in the utility system. The City can set those fees at any rate required to generate funds to repay the debt. The interest paid on these bonds, as with the G.O. bonds, is tax free to the investor and therefore is lower than an open market loan. The investors typically require that the utility have a rate structure in place that generates from 25% to 40% higher revenue than anticipated expenses in order to attract the best interest rate. This is a viable financing option and should be considered.

The State Revolving Fund (SRF) is also available to support construction of improvements to community wastewater systems. The loans have an interest rate of 1.75% plus an annually fee of 0.25% (effective 2% interest rate) and a repayment period of up to twenty (20) years. There are some additional regulations, applications, and permits required for this process, but it should be considered as a very viable source of funds for this Project.

Other funding sources available for local governments to finance wastewater facility improvement projects include Community Development Block Grants (CDBG) or US Department of Agriculture Rural Development Administration grants and loans. It would not be expected that North Liberty would qualify for either of these programs. These sources of financing are need-based to a large extent, and North Liberty would not likely show adequate levels of need.

6.03 Impact on User Rates

Based on the proposed improvements, the City Administrator and financial advisors performed a rate analysis to determine the impact on user rates. Refer to Appendix F for details of the rate analysis and proposed increases. The rate projections were prepared based on projected revenues and expenditures through fiscal year 2025. The projections were based on estimated revenue increase of 2% per year. This is a relatively conservation growth projection, given that the projected wastewater needs are based on a higher population growth. The projections show that rate increases will be necessary through fiscal year 2020 to fund the needed improvements. Rate increases will vary from year to year, but will range between 2% to 15%.

6.04 Recommendations and Schedule

Based on the evaluations presented in this report, the following recommendations are offered:

1. Expansion of the wastewater treatment facility should proceed in the near future, per the recommended schedule shown below.

2. Due to the anticipated rapid growth in North Liberty, Phase II expansion would likely need to be implemented shortly after completion of Phase IA. Therefore, it's recommended that the city proceed with both the Phase IA and Phase II expansions at the same time.

3. In order to meet newly implemented nutrient reduction requirements, it's recommended that the plant expansion include biological nutrient removal.

4. The concepts presented in this Facility Plan should be reviewed and discussed and decisions made regarding the specific features and components to be included in the selected plan.

5. Part of the decision process will include deciding how quickly to expand the facilities to meet the growing needs of the community. The City should concur with the proposed components as presented or direct that revised analyses be made.

6. Following acceptance by the City, the facility plan should be submitted to IDNR for review and approval.

7. Following comment by the IDNR, the preliminary design phase of the selected project should be initiated, as appropriate.

Once a decision is reached, then discussions can proceed on various preliminary design aspects associated with the selected plan. Some of the recommendations and analyses discussed in this report may merit more detailed examination. During the design development stage, numerous decision points will arise regarding specific features of the proposed project. It can then be decided which of the recommendations to include in the selected plan and which deviations to make from the concepts proposed by this analysis.

The following schedule is proposed for completing the selected improvements as outlined in this report:

Item	Begin Date	End Date
Submit Facility Plan to IDNR for review	Jan. 2014	Feb. 2014
Preliminary and Final Design	Feb. 2014	Dec. 2014
Bidding	Jan. 2015	Feb. 2015
Construction	Apr. 2015	Apr. 2017

APPENDIX A

NPDES PERMIT

IOWA DEPARTMENT OF NATURAL RESOURCES

National Pollutant Discharge Elimination System (NPDES) Permit

RECORD COPY

File Name: ____________
File Number: 52-52-0-01
Sender's Initials: ____________

PERMITTEE

CITY OF NORTH LIBERTY
CITY CLERK, CITY HALL
5 EAST CHERRY STREET
NORTH LIBERTY, IA 52317

IDENTITY AND LOCATION OF FACILITY

NORTH LIBERTY CITY OF STP
Section 19, T 80N, R 6W
JOHNSON County, Iowa

IOWA NPDES PERMIT NUMBER: 5252001

DATE OF ISSUANCE: 11-12-2002

DATE OF EXPIRATION: 11-11-2007

RECEIVING STREAM

IOWA RIVER

7001 1670 0009 5250 6949

ROUTE OF FLOW

MUDDY CREEK TO THE IOWA RIVER

YOU ARE REQUIRED TO FILE
FOR RENEWAL OF THIS PERMIT BY: 05-15-2007

EPA NUMBER: IA0032905

This permit is issued pursuant to the authority of section 402(b) of the Clean Water Act (33 U.S.C 1342(b)), Iowa Code section 455B.174, and rule 567--64.3, Iowa Administrative Code. You are authorized to operate the disposal system and to discharge the pollutants specified in this permit in accordance with the effluent limitations, monitoring requirements and other terms set forth in this permit.

You may appeal any conditions of this permit by filing a written notice of appeal and request for administrative hearing with the director of this department within 30 days of your receipt of this permit.

Any existing, unexpired Iowa operation permit or Iowa NPDES permit previously issued by the department for the facility identified above is revoked by the issuance of this permit. This provision does not apply to any authorization to discharge under the terms and conditions of a general permit issued by the department or to any permit issued exclusively for the discharge of storm water.

FOR THE DEPARTMENT OF NATURAL RESOURCES

By ____________
Wayne Farrand, Supervisor
Wastewater Section
ENVIRONMENTAL SERVICES DIVISION

Facility Name: NORTH LIBERTY CITY OF STP

Permit Number: 5252001

Outfall Number	Description
001	DISCHARGE FROM A SEQUENCING BATCH REACTOR WASTEWATER TREATMENT FACILITY.
002	HEADWORKS BY-PASS MANHOLE

Facility Name: NORTH LIBERTY CITY OF STP

Permit Number: 5252001

Effluent Limitations

Outfall No.: 001 DISCHARGE FROM A SEQUENCING BATCH REACTOR WASTEWATER TREATMENT FACILITY.

Interim Limits Start: 11/12/2002 Interim Limits End: 01/31/2004

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
CBOD5	YEARLY	INTER	85	40.0	25.0		MG/L	387.0	242.0		LBS/DAY
CBOD5	YEARLY	FINAL	85	40.0	25.0		MG/L	387.0	242.0		LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	INTER	85	45.0	30.0		MG/L	435.0	290.0		LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL	85	45.0	30.0		MG/L	435.0	290.0		LBS/DAY
AMMONIA NITROGEN (N)	JAN	FINAL			36.0	36.0	MG/L		300.0	300.0	LBS/DAY
AMMONIA NITROGEN (N)	FEB	FINAL			42.0	42.0	MG/L		350.0	350.0	LBS/DAY
AMMONIA NITROGEN (N)	MAR	FINAL			30.0	30.0	MG/L		256.0	256.0	LBS/DAY
AMMONIA NITROGEN (N)	APR	FINAL			22.0	22.0	MG/L		186.0	186.0	LBS/DAY
AMMONIA NITROGEN (N)	MAY	FINAL			22.0	22.0	MG/L		186.0	186.0	LBS/DAY
AMMONIA NITROGEN (N)	JUN	FINAL			22.0	22.0	MG/L		186.0	186.0	LBS/DAY
AMMONIA NITROGEN (N)	JUL	FINAL			23.0	23.0	MG/L		192.0	192.0	LBS/DAY
AMMONIA NITROGEN (N)	AUG	FINAL			19.0	19.0	MG/L		165.0	165.0	LBS/DAY
AMMONIA NITROGEN (N)	SEP	FINAL			26.0	26.0	MG/L		213.0	218.0	LBS/DAY
AMMONIA NITROGEN (N)	OCT	FINAL			26.0	26.0	MG/L		218.0	218.0	LBS/DAY
AMMONIA NITROGEN (N)	NOV	FINAL			22.0	22.0	MG/L		186.0	186.0	LBS/DAY
AMMONIA NITROGEN (N)	DEC	FINAL			26.0	26.0	MG/L		218.0	218.0	LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	INTER		6.0		9.0	STD UNITS				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6.0		9.0	STD UNITS				
COLIFORM, FECAL	SUMMER	INTER				200.0	#/100 ML				

Note: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: NORTH LIBERTY CITY OF STP

Permit Number: 5252001

Effluent Limitations

Outfall No.: 001 DISCHARGE FROM A SEQUENCING BATCH REACTOR WASTEWATER TREATMENT FACILITY.

Interim Limits Start: 11/12/2002 Interim Limits End: 01/31/2004

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

Wastewater Parameter	Season	Type of Limit	% Removal	EFFLUENT LIMITATIONS							
				Concentration				Mass			
				7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
COLIFORM, FECAL	SUMMER	FINAL				200.0	#/100 ML				
ACUTE TOXICITY, CERIODAPHNIA	YEARLY	INTER							1.0		NO TOXICITY
ACUTE TOXICITY, CERIODAPHNIA	YEARLY	FINAL							1.0		NO TOXICITY
ACUTE TOXICITY, PIMEPHALES	YEARLY	INTER							1.0		NO TOXICITY
ACUTE TOXICITY, PIMEPHALES	YEARLY	FINAL							1.0		NO TOXICITY

Note: If seasonal limits apply, summer is from April 1 through October 31, and winter is from November 1 through March 31.

Facility Name: NORTH LIBERTY CITY OF STP

Permit Number: 5252001

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater.

(b) Analytical and sampling methods as specified in 40 CFR Part 136 or other methods approved in writing by the department, shall be utilized.

(c) Chapter 63 of the rules provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit. This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each month.

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
001	FLOW	7/WEEK	24 HR TOTAL	RAW WASTE
001	CBOD5	2/WEEK	24 HR COMP	RAW WASTE
001	TOTAL SUSPENDED SOLIDS	1/WEEK	24 HR COMP	RAW WASTE
001	PH (MINIMUM - MAXIMUM)	2/WEEK	GRAB	RAW WASTE
001	TEMPERATURE	2/WEEK	GRAB	RAW WASTE
001	CBOD5	2/WEEK	24 HR COMP	FINAL EFFLUENT
001	TOTAL SUSPENDED SOLIDS	1/WEEK	24 HR COMP	FINAL EFFLUENT
001	AMMONIA NITROGEN (N)	2/WEEK	24 HR COMP	FINAL EFFLUENT
001	PH (MINIMUM - MAXIMUM)	2/WEEK	GRAB	FINAL EFFLUENT
001	COLIFORM,FECAL	1/MONTH	GRAB	FINAL EFFLUENT
001	SETTLEABLE SOLIDS	3/WEEK	GRAB	FINAL EFFLUENT
001	TEMPERATURE	2/WEEK	GRAB	FINAL EFFLUENT
001	ACUTE TOXICITY, CERIODAPHNIA	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
001	ACUTE TOXICITY, PIMEPHALES	1/12 MONTHS	24 HR COMP	FINAL EFFLUENT
001	DISSOLVED OXYGEN (MINIMUM)	3/WEEK	GRAB	DIGESTER CONTENTS
001	DISSOLVED OXYGEN (MINIMUM)	3/WEEK	GRAB	AERATION BASIN CONTENTS
001	SOLIDS,MIXED LIQUOR SUSPENDED	3/WEEK	GRAB	AERATION BASIN CONTENTS
001	TEMPERATURE	3/WEEK	GRAB	AERATION BASIN CONTENTS
001	30-MINUTE SETTLEABILITY	3/WEEK	GRAB	AERATION BASIN CONTENTS

Outfall Number	Description
001	CBOD5

CONTROL OF THE 24-HOUR COMPOSITE SAMPLER SHALL BE SET SO THAT SAMPLES FOR CBOD5, NH3-N, AND TSS ARE COLLECTED ONLY WHEN A SEQUENTIAL DISCHARGE FROM THE TREATMENT PLANT ACTUALLY OCCURS. THE SAMPLER SHALL NOT OPERATE WHEN THERE IS NO DISCHARGE. ONLY SAMPLES THAT ARE REPRESENTATIVE OF THE ACTUAL EFFLUENT SHALL BE COLLECTED. NO COMPOSITE SAMPLES OF WATER STANDING IN CONCRETE EFFLUENT STRUCTURES SHALL BE COLLECTED BY THE SAMPLER WHEN THERE IS NO DISCHARGE.

DESIGN CAPACITY - STANDARD CONDITIONS

Facility Name: North Liberty, City of **NPDES Permit number:** 52-52-0-01

Outfall: 001 - Discharge from a Sequencing Batch Reactor Wastewater Treatment Facility

Design Capacity: The design capacity for the wastewater treatment facility is specified in Construction Permit Number 97-374-S issued August 25, 1997 and Schedule G dated November 8, 1996. The wastewater treatment facility is designed to treat an average dry weather (ADW) flow of 0.884 MGD, an average wet weather (AWW) flow of 1.160 MGD, and a maximum wet weather (MWW) flow of 2.270 MGD. The design organic loading is 1,511 pounds of BOD_5 per day.

Iowa Administrative Code 567—62.1(7): Wastes in such volumes or quantities as to exceed the design capacity of the treatment works or reduce the effluent quality below that specified in the operation permit of the treatment works are considered to be a waste which interferes with the operation or performance of a publicly owned treatment works or a privately owned domestic sewage treatment works and are prohibited.

Facility Name: North Liberty, City of
Permit Number: 52-52-0-01

Outfall Number: 001 Discharge from a Sequencing Batch Reactor Wastewater Treatment Facility

Ceriodaphnia and Pimephales Toxicity Effluent Testing

1. For facilities that have not been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within three (3) months of permit issuance. For facilities that have been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within twelve months (12) of the last toxicity test.

2. The test organisms that are to be used for acute toxicity testing shall be *Ceriodaphnia dubia* and *Pimephales promelas*. The acute toxicity testing procedures used to demonstrate compliance with permit limits shall be those listed in 40 CFR Part 136 and adopted by reference in rule 567--63.1(1). The method for measuring acute toxicity is specified in USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

3. **The diluted effluent sample must contain a minimum of 37.6 % effluent and no more than 62.4 % of culture water.**

4. One valid positive toxicity result will require quarterly testing for effluent toxicity.

5. Two successive valid positive toxicity results or three positive results out of five successive valid effluent toxicity tests will require a toxic reduction evaluation to be completed to eliminate the toxicity.

6. A non-toxic test result shall be indicated as a "1" on the monthly operation report. A toxic test result shall be indicated as a "2" on the monthly operation report. DNR Form 542-1381 shall also be submitted to the DNR field office along with the monthly operation report.

Ceriodaphnia and Pimephales Toxicity Effluent Limits

The 30 day average mass limit of "1" for the parameters Acute Toxicity, Ceriodaphnia and Acute Toxicity, Pimephales means no positive toxicity results.

Definition: "Positive toxicity result" means a statistical difference of mortality rate between the control and the diluted effluent sample. For more information see USEPA. 1993. Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms. Fourth Edition. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio August 1993, EPA/600/4-90/027F.

Revised: July 31, 1996 cwf

Facility Name: NORTH LIBERTY, CITY OF STP

Permit Number: 5252001

COMPLIANCE SCHEDULE

Compliance with final **ammonia nitrogen** limits shall be achieved according to the following schedule:

1. The City shall monitor its effluent to determine if the facility can comply with ammonia nitrogen effluent limits. Ammonia nitrogen samples shall be collected and analyzed according to the frequency listed on page 5 for the duration of the effluent monitoring study and permit.

    - Begin effluent monitoring study by **December 1, 2002**.
    - End effluent monitoring study by **November 30, 2003**.
    - Submit effluent monitoring report that determines the ability of the facility to comply with ammonia nitrogen limits by **January 1, 2004**.

2. Comply with final ammonia nitrogen limits by **February 1, 2004**.

Within fourteen(14) days following each interim and final date of compliance, the City shall provide written notice of compliance with the interim or final requirement. The written notice shall be sent to:

Iowa Department of Natural Resources
Environmental Protection Division
Regional Field Office #6
1023 W. Madison Street
Washington, IA 52353

Iowa Department of Natural Resources
Wastewater Section
Henry A. Wallace Building
502 E. 9th Street
Des Moines, IA 50319

SLUDGE HANDLING AND DISPOSAL REQUIREMENTS

1. The permittee shall comply with all existing Federal and State laws and regulations that apply to the use and disposal of sewage sludge and with technical standards developed pursuant to Section 405(d) of the Clean Water Act when such standards are promulgated. If an applicable numerical limit or management practice for pollutants in sewage sludge is promulgated after issuance of this permit that is more stringent than a sludge pollutant limit or management practice specified in existing Federal or State laws or regulations, this permit shall be modified, or revoked and reissued, to conform to the regulations promulgated under Section 405(d) of the Clean Water Act. The permittee shall comply with the limitation no later than the compliance deadline specified in the applicable regulations.

2. The permittee shall provide written notice to the Department of Natural Resources prior to any planned changes in sludge disposal practices.

3. Land application of municipal sewage sludge shall be conducted in accordance with criteria established rule IAC 567--67.1 through 67.11(455B).

MAJOR CONTRIBUTING INDUSTRIES
LIMITATIONS, MONITORING AND REPORTING REQUIREMENTS

1. You are required to notify the department, in writing, of any of the following:

   (a) 180 days prior to the introduction of pollutants to your facility from a major contributing industry. A major contributing industry means an industrial user of a treatment works that:

      (1) Has a flow of 50,000 gallons or more per average work day;

      (2) Has a flow greater than five percent (5%) of the flow carried by the treatment works receiving the waste;

      (3) Has in its waste a toxic pollutant in toxic amounts as defined in standards issued under Section 307 (a) of the Clean Water Act and adopted by reference in Rule 62.5(455B); or

      (4) Is found by the department in connection with the issuance of an NPDES permit to have a significant impact, either alone or in combination with other contributing industries, on the treatment works or on the quality of effluent from the treatment works.

   (b) 60 days prior to a proposed expansion, production increase or process modification that may result in the discharge of a new pollutant or a discharge in excess of limitations stated in the existing treatment agreement.

   (c) 10 days prior to any commitment by you to accept waste from any new major contributing industry.

   Your written notification must include a new or revised treatment agreement in accordance with rule 64.3(5)(455B).

2. You shall require all users of your facility to comply with Sections 204(b), 307 and 308 of the Clean Water Act.

   Section 204(b) requires that all users of the treatment works constructed with funds provided under Sections 201(g) or 601 of the Act to pay their proportionate share of the costs of operation, maintenance and replacement of the treatment works.

   Section 307 of the Act requires users to comply with pretreatment standards promulgated by EPA for pollutants that would cause interference with the treatment process or would pass through the treatment works.

   Section 308 of the Act requires users to allow access at reasonable times to state and EPA inspectors for the purpose of sampling the discharge and reviewing and copying records.

3. You shall limit and monitor pollutants for each major contributing industry as required elsewhere in this permit, and submit sample results to the department monthly. Your report shall be submitted by the fifteenth day of the following month.

Revised: August 18, 1993 cwf

STANDARD CONDITIONS

1. DEFINITIONS

(a) 7 day average means the sum of the total daily discharges by mass, volume or concentration during a 7 consecutive day period, divided by the total number of days during the period that measurements were made. Four 7 consecutive day periods shall be used each month to calculate the 7-day average. The first 7-day period shall begin with the first day of the month.

(b) 30 day average means the sum of the total daily discharges by mass, volume or concentration during a calendar month, divided by the total number of days during the month that measurements were made.

(c) daily maximum means the total discharge by mass, volume or concentration during a twenty-four hour period.

2. DUTY TO COMPLY

You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Issuance of this permit does not relieve you of the responsibility to comply with all local, state and federal laws, ordinances, regulations or other legal requirements applying to the operation of your facility.
{See 40 CFR 122.41(a) and 567-64.3(11) IAC}

3. DUTY TO REAPPLY

If you wish to continue to discharge after the expiration date of this permit you must file an application for reissuance at least 180 days prior to the expiration date of this permit.
{See 567-64.8(1) IAC}

4. NEED TO HALT OR REDUCE ACTIVITY

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
{See 567-64.7(5)(j) IAC}

5. DUTY TO MITIGATE

You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
{See 567-64.7(5)(i) IAC}

6. PROPERTY RIGHTS

This permit does not convey any property rights of any sort or any exclusive privileges.

7. TRANSFER OF TITLE

If title to your facility, or any part of it, is transferred the new owner shall be subject to this permit.
{See 567-64.14 IAC}

You are required to notify the new owner of the requirements of this permit in writing prior to any transfer of title. The Director shall be notified in writing within 30 days of the transfer

8. PROPER OPERATION AND MAINTENANCE

All facilities and control systems shall be operated as efficiently as possible and maintained in good working order. A sufficient number of staff, adequately trained and knowledgeable in the operation of your facility shall be retained at all times and adequate laboratory controls and appropriate quality assurance procedures shall be provided to maintain compliance with the conditions of this permit.
{See 40 CFR 122.41(e) and 567 64.7(5)(f) IAC}

9. DUTY TO PROVIDE INFORMATION

You must furnish to the Director, within a reasonable time, any information the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. You must also furnish to the Director, upon request, copies of any records required to be kept by this permit.

10. MAINTENANCE OF RECORDS

You are required to maintain records of your operation in accordance with 567-63.2 IAC.

11. PERMIT MODIFICATION, SUSPENSION OR REVOCATION

(a) This permit may be modified, suspended, or revoked and reissued for cause including but not limited to those specified in 567-64.3(11) IAC.

(b) This permit may be modified due to conditions or information on which this permit is based, including any new standard the department may adopt that would change the required effluent limits.
{See 567-64.3(11)© IAC}

(c) If a toxic pollutant is present in your discharge and more stringent standards for toxic pollutants are established under Section 307(a) of the Clean Water Act, this permit will be modified in accordance with the new standards.
{See 567-64.7(5)(g) IAC}

The filing of a request for a permit modification, revocation or suspension, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

12. SEVERABILITY

The provisions of this permit are severable and if any provision or application of any provision to any circumstance is found to be invalid by this department or a court of law, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected by such finding.

13. INSPECTION OF PREMISES, RECORDS, EQUIPMENT, METHODS AND DISCHARGES

You are required to permit authorized personnel to:

(a) Enter upon the premises where a regulated facility or activity is located or conducted or where records are kept under conditions of this permit.

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

(c) Inspect, at reasonable times, any facilities, equipment, practices or operations regulated or required under this permit.

(d) Sample or monitor, at reasonable times, for the purpose of assuring compliance or as otherwise authorized by the Clean Water Act.

14. TWENTY-FOUR HOUR REPORTING

You shall report any noncompliance that may endanger human health or the environment. Information shall be provided orally within 24 hours from the time you become aware of the circumstances. A written submission that includes a description of noncompliance and its cause; the period of noncompliance including exact dates and times, whether the noncompliance has been corrected or the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent a reoccurrence of the noncompliance must be provided within 5 days of the occurrence. The following instances of noncompliance must be reported within 24 hours of occurrence:

(a) Any unanticipated bypass which exceeds any effluent limitation in the permit.
{See 40 CFR 122.44(g)}

(b) Any upset which exceeds any effluent limitation in the permit.
{See 40 CFR 122.44(n)}

(c) Any violation of a maximum daily discharge limit for any of the pollutants listed by the Director in the permit to be reported within 24 hours.
{See 40 CFR 122.44(g)}

15. OTHER NONCOMPLIANCE

You shall report all instances of noncompliance not reported under Condition #14 at the time monitoring reports are submitted.

16. ADMINISTRATIVE RULES

Rules of this Department which govern the operation of your facility in connection with this permit are published in Part 567 of the Iowa Administrative Code (IAC) in Chapters 60-64 and 120-122. Reference to the term "rule" in this permit means the designated provision of Part 567 of the Iowa Administrative Code.

17. NOTICE OF CHANGED CONDITIONS

You are required to report any changes in existing conditions or information on which this permit is based:

(a) Facility expansions, production increases or process modifications which may result in new or increased discharges of pollutants must be reported to the Director in advance. If such discharges will exceed effluent limitations, your report must include an application for a new permit.
{See 567-64.7(5)(a) IAC}

(b) If any modification of, addition to, or construction of a disposal system is to be made, you must first obtain a written permit from this Department.
{See 567-64.2 IAC}

(c) If your facility is a publicly owned treatment works or otherwise may accept waste for treatment from industrial contributors see 567-64.3(5) IAC for further notice requirements.

(d) You shall notify the Director as soon as you know or have reason to believe that any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in this permit.
{See 40 CFR 122.42(a)}

You must also notify the Director if you have begun or will begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application

18. OTHER INFORMATION

Where you become aware that you failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report, you must promptly submit such facts or information.

19. UPSET PROVISION

(a) Definition - "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense in an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph *"c"* of this condition are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for demonstration of an upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed, contemporaneous operating logs, or other relevant evidence that;

(1) An upset occurred and that the permittee can identify the cause(s) of the upset.
(2) The permitted facility was at the time being properly operated; and
(3) The permittee submitted notice of the upset to the Department in accordance with 40 CFR 122.41(l)(6)(ii)(B).
(4) The permittee complied with any remedial measures required by Item #5 of the Standard Conditions of this permit.

(d) Burden of Proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

20. FAILURE TO SUBMIT FEES

This permit may be revoked, in whole or in part, if the appropriate permit fees are not submitted within thirty (30) days of the date of notification that such fees are due.

21. BYPASSES

(a) Definition - Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

(b) Prohibition of bypass, Bypass is prohibited and the department may take enforcement action against a permittee for bypass unless:

(1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance;

(3) The permittee submitted notices as required by paragraph *"d"* of this section.

(c) The Director may approve an anticipated bypass after considering its adverse effects if the Director determines that it will meet the three conditions listed above.

(d) Reporting bypasses. Bypasses shall be reported in accordance with 567-63.6 IAC.

22. SIGNATORY REQUIREMENTS

Applications, reports or other information submitted to the Department in connection with this permit must be signed and certified as required by 567-64.3(8) IAC.

23. USE OF CERTIFIED LABORATORIES

Effective October 1, 1996, analyses of wastewater, groundwater or sewage sludge that are required to be submitted to the department as a result of this permit must be performed by a laboratory certified by the State of Iowa. Routine, on-site monitoring for pH, temperature, dissolved oxygen, total residual chlorine and other pollutants that must be analyzed immediately upon sample collection, settleable solids, physical measurements, and operational monitoring tests specified in 567-63.3(4) are excluded from this requirement.

APPENDIX B

PLANT FLOW AND LOADING DATA

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
1/1/09	1.157	0.001	0	1.158												
1/2/09	1.225	0	0	1.225	8.1	57										
1/3/09	1.224	0	0	1.224												
1/4/09	1.195	0.002	0	1.197												
1/5/09	1.188	0	0	1.188	8	58										
1/6/09	1.095	0.001	0	1.096	8.1	58		100	914	274	2,505					
1/7/09	1.068	0	0	1.068	8.2	59										
1/8/09	1.067	0.087	0.099	1.055	8.1	57		190	1,672	180	1,584					
1/9/09	1.152	0	0	1.152	8.3	58										
1/10/09	1.038	0	0	1.038												
1/11/09	1.136	0	0	1.136												
1/12/09	1.121	0	0	1.121	8.1	60										
1/13/09	0.973	0.001	0	0.974	8	57		130	1,056	254	2,063					
1/14/09	0.997	0	0	0.997	7.9	56										
1/15/09	1.023	0.003	0	1.026	8.2	55		130	1,112	194	1,660					
1/16/09	1.240	0	0	1.24	8.3	55										
1/17/09	0.833	0.001	0	0.834												
1/18/09	1.082	0	0	1.082												
1/19/09	1.104	0.005	0.004	1.105	8.1	57										
1/20/09	0.971	0	0	0.971	8	58		170	1,377	178	1,441					
1/21/09	0.980	0	0	0.98	8.4	58										
1/22/09	0.985	0.002	0	0.987	8.3	58		150	1,235	203	1,671					
1/23/09	0.937	0.001	0	0.938	8.4	58										
1/24/09	1.122	0	0.001	1.121												
1/25/09	1.015	0.001	0.001	1.015												
1/26/09	1.082	0.074	0.084	1.072	8.3	57										
1/27/09	0.956	0.001	0.001	0.956	8.2	58		190	1,515	354	2,822					
1/28/09	0.985	0.083	0.088	0.98	8.3	57										
1/29/09	0.988	0.019	0.032	0.975	8.3	57		150	1,220	214	1,740					
1/30/09	1.067	0	0	1.067	8.3	56										
1/31/09	1.044	0.002	0.003	1.043												
Average Day	1.066	0.009	0.010	1.065	8.2	57		151	1263	231	1936					
Max. Day	1.240	0.087	0.099	1.240	8.4	60		190	1672	354	2822					
Min. Day	0.833	0.000	0.000	0.834	7.9	55		100	914	178	1441					
Total	33.050	0.284	0.313	33.021					10,100		15,487					
2/1/09	1.018	0	0	1.018												
2/2/09	1.081	0.076	0.079	1.078	8.3	58										
2/3/09	0.970	0	0	0.97	8.3	57		154	1,246	207	1,675					
2/4/09	0.922	0.001	0	0.923	8.3	57										
2/5/09	0.971	0	0	0.971	8.4	57		180	1,458	220	1,782					
2/6/09	1.371	0.002	0.005	1.368	8.1	58										
2/7/09	1.651	0	0.005	1.646												
2/8/09	1.392	0	0	1.392												
2/9/09	1.752	0.016	0.014	1.754	8.2	57										
2/10/09	1.566	0.073	0.103	1.536	8	55		82	1,050	136	1,742					
2/11/09	1.426	0	0	1.426	8.1	56										
2/12/09	1.278	0	0.002	1.276	8.1	56		76	809	152	1,618					
2/13/09	1.303	0.002	0	1.305	8.2	56										
2/14/09	1.223	0	0.013	1.21												
2/15/09	1.190	0	0	1.19												
2/16/09	1.299	0	0	1.299	8.2	54										
2/17/09	1.173	0.001	0	1.174	8	52		130	1,273	234	2,291					
2/18/09	1.303	0.004	0.002	1.305	8.2	56										
2/19/09	1.164	0	0	1.164	8.3	56		90	874	201	1,951					
2/20/09	1.102	0.011	0.009	1.104	8.3	55										
2/21/09	1.200	0	0	1.2												
2/22/09	1.167	0	0	1.167												
2/23/09	1.182	0	0	1.182	8.3	55										
2/24/09	1.082	0.002	0.001	1.083	8.4	55		130	1,174	231	2,086					
2/25/09	1.120	0	0	1.12	8.2	55										
2/26/09	1.677	0.034	0.06	1.651	8.3	55		170	2,341	150	2,065					
2/27/09	1.313	0	0	1.313	8.1	54										
2/28/09	1.295	0.001	0	1.296												
Average Day	1.257	0.008	0.010	1.254	8.2	56		127	1278	191	1901					
Max. Day	1.752	0.076	0.103	1.754	8.4	58		180	2341	234	2291					
Min. Day	0.922	0.000	0.000	0.923	8.0	52		76	809	136	1618					
Total	35.191	0.223	0.293	35.121					10,224		15,210					

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
3/1/09	1.333	0	0	1.333												
3/2/09	1.258	0	0	1.258	8.5	56										
3/3/09	1.092	0	0	1.092	8.2	56		120	1,093	164	1,494					
3/4/09	1.128	0.001	0	1.129	8.2	56										
3/5/09	1.140	0.002	0.001	1.141	8.3	57		130	1,237	245	2,331					
3/6/09	1.185	0.001	0.007	1.179	8.2	56										
3/7/09	2.098	0.109	0.027	2.18												
3/8/09	2.378	1.159	0.065	3.472												
3/9/09	2.850	0.539	0.482	2.907	7.8	53										
3/10/09	2.854	0.255	0.72	2.389	7.8	51		53	1,056	61	1,215					
3/11/09	2.820	0.348	1.112	2.056	7.8	48										
3/12/09	1.658	0.041	0.041	1.658	8	53		60	830	49	678					
3/13/09	1.814	0.002	0.002	1.814	7.9	54										
3/14/09	1.488	0.001	0.001	1.488												
3/15/09	1.296	0.001	0.001	1.296												
3/16/09	1.423	0.029	0.029	1.423	7.9	53										
3/17/09	1.363	0.386	0.386	1.363	8	54		120	1,364	174	1,978					
3/18/09	1.272	0.001	0.001	1.272	8	54										
3/19/09	1.253	0.001	0.001	1.253	7.8	54		130	1,359	182	1,902					
3/20/09	1.370	0.005	0.005	1.37	8.1	54										
3/21/09	1.232	0.001	0.001	1.232												
3/22/09	1.223	0.001	0.001	1.223												
3/23/09	1.292	0	0	1.292	8.2	55										
3/24/09	1.322	0.001	0.001	1.322	8.1	56		120	1,323	183	2,018					
3/25/09	1.297	0.001	0.001	1.297	8.2	54										
3/26/09	1.253	0.001	0.001	1.253	8.2	55		120	1,254	187	1,954					
3/27/09	1.202	0	0	1.202	8.2	54										
3/28/09	1.304	0.001	0.001	1.304												
3/29/09	1.386	0	0	1.386												
3/30/09	1.387	0.001	0.001	1.387	8.2	55										
3/31/09	1.299	0.001	0.001	1.299	8.2	56		100	1,083	206	2,232					
Average Day	1.525	0.093	0.093	1.525	8.1	54		106	1178	161	1756					
Max. Day	2.854	1.159	1.112	3.472	8.5	57		130	1364	245	2331					
Min. Day	1.092	0.000	0.000	1.092	7.8	48		53	830	49	678					
Total	47.270	2.889	2.889	47.270					10,599		15,801					
4/1/09	1.236	0	0	1.236	8.2	56										
4/2/09	1.229	0.004	0.004	1.229	8.2	56		150	1,537	193	1,978					
4/3/09	1.243	0.001	0.001	1.243	8.2	55										
4/4/09	1.235	0	0	1.235												
4/5/09	1.315	0.001	0.001	1.315												
4/6/09	1.304	0	0	1.304	8.2	56										
4/7/09	1.212	0.001	0.001	1.212	8.3	56		120	1,213	179	1,809					
4/8/09	1.231	0.003	0.003	1.231	8.3	56										
4/9/09	1.114	0.001	0.001	1.114	8.3	57		110	1,022	183	1,700					
4/10/09	1.185	0	0	1.185												
4/11/09	1.054	0	0	1.054												
4/12/09	1.096	0.001	0.001	1.096												
4/13/09	1.357	0.018	0.018	1.357	8.1	57										
4/14/09	1.199	0.001	0.001	1.199	8.1	55		120	1,200	201	2,010					
4/15/09	1.172	0.014	0.014	1.172	8.3	57										
4/16/09	1.124	0	0	1.124	8.2	58		130	1,219	276	2,587					
4/17/09	1.182	0	0	1.182	8.3	58										
4/18/09	1.215	0.001	0	1.216												
4/19/09	1.106	0	0	1.106												
4/20/09	1.102	0	0	1.102	8.3	58										
4/21/09	1.091	0.071	0.106	1.056	8.2	56		140	1,233	237	2,087					
4/22/09	1.207	0	0	1.207	8.3	58										
4/23/09	1.137	0	0	1.137	8.3	58		160	1,517	201	1,906					
4/24/09	1.091	0.001	0	1.092	8.3	58										
4/25/09	1.331	0	0.039	1.292												
4/26/09	1.730	0.01	0.023	1.717												
4/27/09	1.103	0.096	0.034	1.165	7.9	57										
4/28/09	1.568	0.044	0.189	1.423	8.1	57		98	1,163	116	1,377					
4/29/09	1.578	0.002	0.017	1.563	8.1	56										
4/30/09	1.676	0.003	0.002	1.677	7.8	58		87	1,217	154	2,154					
Average Day	1.247	0.009	0.015	1.241	8.2	57		124	1258	193	1957					
Max. Day	1.730	0.096	0.189	1.717	8.3	58		160	1537	276	2587					
Min. Day	1.054	0.000	0.000	1.054	7.8	55		87	1022	116	1377					
Total	37.423	0.273	0.455	37.241					11,321		17,609					

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
5/1/09	1.645	0.001	0	1.646	8	56										
5/2/09	1.493	0	0	1.493												
5/3/09	1.414	0.008	0.003	1.419												
5/4/09	1.350	0	0	1.35	8.1	58										
5/5/09	1.363	0.002	0	1.365	8.2	58		120	1,366	231	2,630					
5/6/09	1.335	0.002	0	1.337	8	58										
5/7/09	1.237	0.001	0	1.238	8.2	59		110	1,136	217	2,241					
5/8/09	1.368	0	0.02	1.348	8.1	58										
5/9/09	1.485	0	0	1.485												
5/10/09	1.364	0.002	0	1.366												
5/11/09	1.415	0.003	0	1.418	8.2	59										
5/12/09	1.303	0.001	0.003	1.301	8.2	60		120	1,302	185	2,007					
5/13/09	1.492	0	0.017	1.475	8.1	60										
5/14/09	1.412	0	0.004	1.408	8	59		120	1,409	171	2,008					
5/15/09	1.819	0.004	0.024	1.799	8	59										
5/16/09	1.727	0	0	1.727												
5/17/09	1.493	0.037	0.031	1.499												
5/18/09	1.555	0.001	0	1.556	8	60										
5/19/09	1.373	0.001	0.001	1.373	8.1	60		69	790	216	2,473					
5/20/09	1.272	0	0	1.272	8.1	61										
5/21/09	1.284	0.001	0	1.285	8.2	61		150	1,608	187	2,004					
5/22/09	1.248	0	0	1.248	8.2	60										
5/23/09	1.267	0	0	1.267												
5/24/09	1.132	0	0	1.132												
5/25/09	1.287	0.001	0	1.288												
5/26/09	1.435	0	0.028	1.407	8.1	60										
5/27/09	1.255	0.776	0.503	1.528	8.1	61		97	1,236	193	2,459					
5/28/09	1.291	0.326	0.604	1.013	8.1	60		90	760	130	1,098					
5/29/09	1.172	0.001	0	1.173	8.2	61										
5/30/09	1.256	0	0	1.256												
5/31/09	1.125	0	0	1.125												
Average Day	1.376	0.038	0.040	1.374	8.1	59		110	1201	191	2115					
Max. Day	1.819	0.776	0.604	1.799	8.2	61		150	1608	231	2630					
Min. Day	1.125	0.000	0.000	1.013	8.0	56		69	760	130	1098					
Total	42.667	1.168	1.238	42.597					9,607		16,921					
6/1/09	1.274	0	0	1.274	8.1	62										
6/2/09	1.201	0.001	0	1.202	7.7	61		82	822	218	2,185					
6/3/09	1.128	0	0	1.128	8.1	61										
6/4/09	1.122	0	0	1.122	8.2	61		130	1,216	198	1,853					
6/5/09	1.094	0.006	0.002	1.098	8.2	61										
6/6/09	1.159	0	0.001	1.158												
6/7/09	1.244	0	0	1.244												
6/8/09	1.234	0.019	0.017	1.236	7.8	62										
6/9/09	1.127	0.016	0.012	1.131	8	62		130	1,226	180	1,698					
6/10/09	1.127	0.02	0.017	1.13	8.1	62										
6/11/09	1.091	0.001	0	1.092	8.1	62		160	1,457	243	2,213					
6/12/09	1.264	0	0.009	1.255	8.1	62										
6/13/09	1.100	0	0	1.1												
6/14/09	1.182	0.001	0	1.183												
6/15/09	1.202	0	0	1.202	7.9	62										
6/16/09	1.200	0.02	0.024	1.196	8.2	62		130	1,297	202	2,015					
6/17/09	1.437	0	0.047	1.39	8.1	63										
6/18/09	1.765	0	0	1.765	7.8	62		130	1,914	370	5,446					
6/19/09	1.754	0.381	0.166	1.969	8	63										
6/20/09	2.176	0.073	0.365	1.884												
6/21/09	2.091	0.041	0.055	2.077												
6/22/09	1.972	0.05	0.044	1.978	7.8	63										
6/23/09	1.803	0.044	0.056	1.791	7.8	64		83	1,240	176	2,629					
6/24/09	1.198	0.021	0.021	1.198	7.7	64										
6/25/09	1.553	0	0	1.553	7.9	64		78	1,010	216	2,798					
6/26/09	1.537	0.001	0	1.538	7.8	63										
6/27/09	1.325	0	0	1.325												
6/28/09	1.296	0.003	0	1.299												
6/29/09	1.376	0	0	1.376	7.9	64										
6/30/09	1.290	0.042	0.031	1.301	7.9	64		140	1,519	215	2,333					
Average Day	1.377	0.025	0.029	1.373	8.0	62		118	1300	224	2574					
Max. Day	2.176	0.381	0.365	2.077	8.2	64		160	1914	370	5446					
Min. Day	1.091	0.000	0.000	1.092	7.7	61		78	822	176	1698					
Total	41.322	0.740	0.867	41.195					11,701		23,170					

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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7/1/09	1.173	0.001	0	1.174	8.2	64										
7/2/09	1.129	0	0	1.129	8.1	64		160	1,507	235	2,213					
7/3/09	1.181	0	0.008	1.173												
7/4/09	1.337	0.001	0.022	1.316												
7/5/09	1.233	0	0	1.233												
7/6/09	1.285	0	0	1.285	8.1	64										
7/7/09	1.161	0	0.003	1.158	7.9	64		100	966	203	1,961					
7/8/09	1.191	0.004	0.003	1.192	8	65										
7/9/09	1.168	0	0.005	1.163	8	65		130	1,261	241	2,338					
7/10/09	2.954	0.466	0.14	3.28	7.8	65										
7/11/09	2.388	0.026	0.263	2.151												
7/12/09	1.825	0.001	0.211	1.615												
7/13/09	1.644	0.037	0.031	1.65	7.8	64										
7/14/09	1.460	0.001	0	1.461	8	65		85	1,036	149	1,816					
7/15/09	1.338	0	0	1.338	8	66										
7/16/09	1.277	0	0	1.277	7.9	65		100	1,065	198	2,109					
7/17/09	1.198	0	0	1.198	8	64										
7/18/09	1.194	0	0	1.194												
7/19/09	1.213	0	0	1.213												
7/20/09	1.232	0.047	0.036	1.243	8.1	65										
7/21/09	2.204	0.043	0.147	2.1	7.9	65		170	2,977	202	3,538					
7/22/09	1.825	0	0	1.825	7.8	65		87	1,324	176	2,679					
7/23/09	1.580	0.001	0	1.581	7.8	65										
7/24/09	1.940	0.005	0.029	1.916	8	65										
7/25/09	1.664	0	0	1.664												
7/26/09	1.496	0.001	0	1.497												
7/27/09	1.728	0.012	0.007	1.733	8	65										
7/28/09	1.348	0.002	0.001	1.349	8	65		120	1,350	165	1,856					
7/29/09	1.297	0	0	1.297	7.9	65										
7/30/09	1.325	0.006	0.001	1.33	7.9	65		140	1,553	164	1,819					
7/31/09	1.257	0	0	1.257	8.1	65										
Average Day	1.492	0.021	0.029	1.484	8.0	65		121	1449	193	2259					
Max. Day	2.954	0.466	0.263	3.280	8.2	66		170	2977	241	3538					
Min. Day	1.129	0.000	0.000	1.129	7.8	64		85	966	149	1816					
Total	46.245	0.654	0.907	45.992					13,039		20,327					
8/1/09	1.199	0.001	0	1.2												
8/2/09	1.158	0	0	1.158												
8/3/09	1.324	0	0	1.324	7.9	66										
8/4/09	1.171	0.013	0.003	1.181	7.8	66		180	1,773	213	2,098					
8/5/09	1.116	0.003	0.001	1.118	8	66										
8/6/09	1.119	0.002	0	1.121	8.1	66		140	1,309	216	2,019					
8/7/09	1.944	0.036	0.101	1.879	8.2	66										
8/8/09	1.586	0	0	1.586												
8/9/09	1.458	0.001	0.022	1.437												
8/10/09	1.622	0	0	1.622	7.9	66										
8/11/09	1.384	0.001	0	1.385	7.9	67		85	982	163	1,883					
8/12/09	1.316	0	0.001	1.315	8	66										
8/13/09	1.294	0.046	0.038	1.302	8.1	67		100	1,086	177	1,922					
8/14/09	1.238	0	0	1.238	8	67										
8/15/09	1.348	0	0.035	1.313												
8/16/09	1.654	0.018	0.019	1.653												
8/17/09	1.758	0.084	0.105	1.737	7.8	67										
8/18/09	1.550	0.004	0.001	1.553	7.9	67		85	1,101	175	2,267					
8/19/09	1.681	0.039	0.055	1.665	8	67										
8/20/09	1.674	0.032	0.025	1.681	8	68		130	1,823	172	2,411					
8/21/09	1.571	0	0	1.571	8	67										
8/22/09	1.377	0.001	0	1.378												
8/23/09	1.295	0	0	1.295												
8/24/09	1.409	0.018	0.014	1.413	8	67										
8/25/09	1.492	0.154	0.17	1.476	7.9	67		140	1,723	268	3,299					
8/26/09	2.276	0.978	0.111	3.143	7.9	68										
8/27/09	2.886	1.246	0.011	4.121	7.6	67		70	2,406	150	5,155					
8/28/09	3.410	0.064	0.91	2.564	7.7	66										
8/29/09	3.452	0.066	1.438	2.08												
8/30/09	1.794	0.001	0.045	1.75												
8/31/09	1.664	0.017	0.013	1.668	7.9	66										
Average Day	1.652	0.091	0.101	1.643	7.9	67		116	1525	192	2632					
Max. Day	3.452	1.246	1.438	4.121	8.2	68		180	2406	268	5155					
Min. Day	1.116	0.000	0.000	1.118	7.6	66		70	982	150	1883					
Total	51.220	2.825	3.118	50.927					12,202		21,055					

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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9/1/09	1.475	0.003	0.002	1.476	7.9	66		79	972	122	1,502					
9/2/09	1.349	0.223	0.114	1.458	8.1	66										
9/3/09	1.522	0	0.085	1.437	7.9	65				145	1,738					
9/4/09	1.519	0.003	0.002	1.52	8	66		82	1,039							
9/5/09	1.215	0	0	1.215												
9/6/09	1.251	0	0	1.251												
9/7/09	1.246	0	0	1.246												
9/8/09	1.285	0	0	1.285	8.2	68										
9/9/09	1.173	0.028	0.02	1.181	8.1	67		120	1,182	185	1,822					
9/10/09	1.166	0	0	1.166	7.9	67		100	972	224	2,178					
9/11/09	1.221	0.001	0	1.222	8.1	68										
9/12/09	1.310	0	0	1.31												
9/13/09	1.206	0	0	1.206												
9/14/09	1.266	0.005	0.003	1.268	8.1	67										
9/15/09	1.152	0	0	1.152	8.2	68		120	1,153	203	1,950					
9/16/09	1.108	0	0	1.108	8.1	68										
9/17/09	1.105	0	0	1.105	8.2	68		210	1,935	234	2,156					
9/18/09	1.162	0	0	1.162	8.3	67										
9/19/09	1.097	0	0	1.097												
9/20/09	1.116	0	0	1.116												
9/21/09	1.184	0	0.002	1.182	8.3	68										
9/22/09	1.081	0.01	0.005	1.086	8.1	68		160	1,449	262	2,373					
9/23/09	1.050	0	0	1.05	8.2	68		120	1,051	207	1,813					
9/24/09	1.060	0	0.009	1.051	8.1	68										
9/25/09	1.175	0	0.01	1.165	8.1	67										
9/26/09	1.279	0	0	1.279												
9/27/09	0.951	0	0	0.951												
9/28/09	1.165	0	0	1.165	8.3	67										
9/29/09	1.153	0.003	0.001	1.155	8.2	67		220	2,119	248	2,389					
9/30/09	1.065	0	0	1.065	8.3	67										
Average Day	1.204	0.009	0.008	1.204	8.1	67		135	1319	203	1991					
Max. Day	1.522	0.223	0.114	1.520	8.3	68		220	2119	262	2389					
Min. Day	0.951	0.000	0.000	0.951	7.9	65		79	972	122	1502					
Total	36.107	0.276	0.253	36.130					11,874		17,921					
10/1/09	1.734	0.002	0.072	1.664											24.8	344
10/2/09	1.667	0	0.002	1.665	8.1	66										
10/3/09	1.325	0	0	1.325												
10/4/09	1.286	0	0	1.286												
10/5/09	1.371	0	0.006	1.365	8.1	65										
10/6/09	1.439	0	0	1.439	7.8	66		73	876	179	2,148	90.5	162	1,944	17.78	213
10/7/09	1.291	0.007	0.003	1.295	8.1	65										
10/8/09	1.416	0	0.006	1.41	8	65		120	1,411	190	2,234				18.58	218
10/9/09	1.420	0.086	0.08	1.426	8.1	66										
10/10/09	1.270	0	0	1.27												
10/11/09	1.307	0.018	0.01	1.315												
10/12/09	1.318	0	0.004	1.314	8.2	66										
10/13/09	1.194	0.033	0.028	1.199	8.2	65	356	150	1,500	165	1,650				19.05	190
10/14/09	1.176	0	0.001	1.175	8.2	65										
10/15/09	1.245	0	0	1.245	7.9	65		150	1,557	206	2,139				20.5	213
10/16/09	1.322	0	0	1.322	8.1	65										
10/17/09	1.125	0	0	1.125												
10/18/09	1.161	0	0	1.161												
10/19/09	1.206	0	0	1.206	8.2	65										
10/20/09	1.088	0	0	1.088	8	66		130	1,180	228	2,069				20	181
10/21/09	1.096	0	0.002	1.094	8.1	66										
10/22/09	2.250	0	0.073	2.177	8.2	65		77	1,398	214	3,885				23.6	428
10/23/09	2.803	0.046	0.063	2.786	7.8	63										
10/24/09	2.021	0	0	2.021												
10/25/09	1.624	0.001	0.004	1.621												
10/26/09	1.774	0.011	0.009	1.776	8	64										
10/27/09	1.559	0.001	0	1.56	8	64		45	585	181	2,355				13.18	171
10/28/09	1.459	0	0	1.459	8	64										
10/29/09	3.200	0.513	0.051	3.662	8.1	64		100	3,054	138	4,215				16.37	500
10/30/09	3.050	0.016	0.278	2.788	7.7	62										
10/31/09	2.371	0.003	0.316	2.058												
Average Day	1.599	0.024	0.033	1.590	8.0	65	356	106	1445	188	2587	91	162	1944	19	273
Max. Day	3.200	0.513	0.316	3.662	8.2	66	356	150	3054	228	4215	91	162	1944	25	500
Min. Day	1.088	0.000	0.000	1.088	7.7	62	356	45	585	138	1650	91	162	1944	13	171
Total	49.568	0.737	1.008	49.297					11,562		20,695			1,944		2,461

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
11/1/09	1.665	0	0	1.665												
11/2/09	1.709	0.024	0.018	1.715	7.9	64										
11/3/09	1.496	0.002	0	1.498	7.9	63		82	1,024	185	2,311				13.46	168
11/4/09	1.465	0	0	1.465	7.9	64										
11/5/09	1.419	0.102	0.097	1.424	8.1	64		77	914	292	3,468				15.96	190
11/6/09	1.533	0.003	0	1.536	8.1	64										
11/7/09	1.327	0	0	1.327												
11/8/09	1.384	0	0	1.384												
11/9/09	1.38	0	0	1.38	7.8	64										
11/10/09	1.224	0	0	1.224	8	64	348	130	1,327	201	2,052	92.5	186	1,898	18.11	185
11/11/09	1.308	0.002	0	1.31	8.2	63										
11/12/09	1.188	0	0	1.188	8.2	64		120	1,189	190	1,883				20.7	205
11/13/09	1.22	0	0	1.22	8	63										
11/14/09	1.199	0	0	1.199												
11/15/09	1.216	0	0	1.216												
11/16/09	1.399	0	0.03	1.369	8.2	64										
11/17/09	1.47	0	0	1.47	8	63		120	1,471	191	2,342				16.6	204
11/18/09	1.348	0	0	1.348	8	64										
11/19/09	1.323	0	0	1.323	8.2	63		120	1,324	157	1,732				18.11	200
11/20/09	1.269	0.002	0	1.271	8.1	63										
11/21/09	1.45	0	0	1.45												
11/22/09	1.268	0	0	1.268												
11/23/09	1.368	0	0	1.368	8.2	63										
11/24/09	1.371	0	0.001	1.37	8	63		110	1,257	191	2,182				19.05	218
11/25/09	1.665	0.002	0	1.667	7.8	62		110	1,529	173	2,405				18.92	263
11/26/09	1.331	0	0	1.331												
11/27/09	1.347	0	0	1.347												
11/28/09	1.291	0	0	1.291												
11/29/09	1.234	0	0	1.234												
11/30/09	1.125	0.857	0.497	1.485	8.2	63										
Average Day	1.366	0.033	0.021	1.378	8.0	63	348	109	1255	198	2297	93	186	1898	18	204
Max. Day	1.709	0.857	0.497	1.715	8.2	64	348	130	1529	292	3468	93	186	1898	21	263
Min. Day	1.125	0.000	0.000	1.188	7.8	62	348	77	914	157	1732	93	186	1898	13	168
Total	40.992	0.994	0.643	41.343					10,036		18,375			1,898		1,632
12/1/09	0.733	1.206	0.733	1.206	8.2	62		93	935	179	1,800				18.66	188
12/2/09	0.616	1.104	0.616	1.104	8.2	62										
12/3/09	1.137	0.126	0.366	0.897	8.2	62		120	898	164	1,227				23.8	178
12/4/09	1.512	0.005	0.33	1.187	8.2	59										
12/5/09	1.577	0	0.392	1.185												
12/6/09	1.518	0	0.308	1.21												
12/7/09	1.264	0	0.041	1.223	7.9	57										
12/8/09	1.138	0	0	1.138	8.2	60	348	99	940	238	2,259	90.3	215	2,040	21.7	206
12/9/09	1.178	0.081	0.078	1.181												
12/10/09	1.127	0	0	1.127	8.3	59		110	1,034	195	1,833				25.4	239
12/11/09	1.163	0.007	0.008	1.162	8.3	60										
12/12/09	1.14	0	0	1.14												
12/13/09	1.102	0	0	1.102												
12/14/09	1.294	0.16	0.164	1.29	8.3	61										
12/15/09	1.183	0.033	0.031	1.185	8.4	60		97	959	202	1,996				19.23	190
12/16/09	1.121	0.001	0	1.122	8.3	60										
12/17/09	1.132	0	0	1.132	8.3	61		108	1,020	181	1,709				23.7	224
12/18/09	1.081	0	0	1.081	8.3	60										
12/19/09	1.215	0.002	0.001	1.216												
12/20/09	1.051	0	0	1.051												
12/21/09	1.185	0	0	1.185	8.3	59										
12/22/09	1.072	0	0	1.072	8.3	59		261	2,333	225	2,012				20.9	187
12/23/09	1.31	0.003	0.011	1.302	8.1	58		134	1,455	215	2,335				24	261
12/24/09	2.553	0.002	0.061	2.494												
12/25/09	2.446	0.011	0.013	2.444												
12/26/09	1.796	0	0	1.796												
12/27/09	1.552	0.003	0.001	1.554												
12/28/09	1.506	0	0	1.506	8	56										
12/29/09	1.501	0	0	1.501	8.1	56		75	939	66	826				14.83	186
12/30/09	1.611	0.002	0.002	1.611	8	56		100	1,344	73	981				15.85	213
12/31/09	1.319	0	0	1.319												
Average Day	1.327	0.089	0.102	1.314	8.2	59	348	120	1186	174	1698	90	215	2040	21	207
Max. Day	2.553	1.206	0.733	2.494	8.4	62	348	261	2333	238	2335	90	215	2040	25	261
Min. Day	0.616	0.000	0.000	0.897	7.9	56	348	75	898	66	826	90	215	2040	15	178
Total	41.133	2.746	3.156	40.723					11,856		16,977			2,040		2,070

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1/1/10	1.292	0	0	1.292												
1/2/10	1.289	0	0	1.289												
1/3/10	1.346	0	0	1.346												
1/4/10	1.333	0.024	0.02	1.337	8.2	57										
1/5/10	1.205	0.002	0.002	1.205	8.2	56	326	110	1,105	204	2,050				18.41	185
1/6/10	1.24	0.003	0.002	1.241	8.3	57										
1/7/10	1.186	0.012	0.009	1.189	8.1	56		130	1,289	198	1,963				20.9	207
1/8/10	1.119	0	0	1.119	8.3	56										
1/9/10	1.194	0	0	1.194												
1/10/10	1.248	0	0	1.248												
1/11/10	1.203	0	0	1.203	8.3	57										
1/12/10	1.094	0	0	1.094	8.2	56		99	903	217	1,980				22.1	202
1/13/10	1.16	0	0	1.16	8.2	58										
1/14/10	1.118	0.003	0.002	1.119	8.3	58		140	1,307	337	3,145				22.5	210
1/15/10	1.062	0	0	1.062	8.3	57										
1/16/10	1.141	0.001	0.001	1.141												
1/17/10	1.163	0	0	1.163												
1/18/10	1.301	0	0	1.301	8.3	55										
1/19/10	1.129	0	0	1.129	8.3	57		140	1,318	232	2,184	89.2	207	1,949	22	207
1/20/10	1.257	0	0	1.257	8.4	56										
1/21/10	1.191	0	0	1.191	7.9	57		96	954	212	2,106				23.7	235
1/22/10	1.139	0	0	1.139	8.3	56										
1/23/10	2.555	0.024	0.08	2.499												
1/24/10	2.514	0	0.011	2.503												
1/25/10	1.928	0	0	1.928	8	54										
1/26/10	1.598	0.044	0.035	1.607	8	54		75	1,005	136	1,823				13.3	178
1/27/10	1.551	0	0	1.551	8.1	55										
1/28/10	1.412	0.003	0.002	1.413	8.2	54		92	1,084	151	1,779				15.07	178
1/29/10	1.315	0	0	1.315	8.1	54										
1/30/10	1.402	0	0	1.402												
1/31/10	1.407	0	0	1.407												
Average Day	1.358	0.004	0.005	1.356	8.2	56	326	110	1121	211	2129	89	207	1949	20	200
Max. Day	2.555	0.044	0.080	2.503	8.4	58	326	140	1318	337	3145	89	207	1949	24	235
Min. Day	1.062	0.000	0.000	1.062	7.9	54	326	75	903	136	1779	89	207	1949	13	178
Total	42.092	0.116	0.164	42.044					8,966		17,031			1,949		1,602
2/1/10	1.38	0.003	0.002	1.381	8.2	55										
2/2/10	1.208	0	0	1.208	8.2	55	314	100	1,007	184	1,854				17.26	174
2/3/10	1.191	0	0	1.191	8.3	55										
2/4/10	1.176	0	0	1.176	8.1	55		150	1,471	194	1,903				20.2	198
2/5/10	1.188	0.029	0.023	1.194	8.3	55										
2/6/10	1.238	0	0	1.238												
2/7/10	1.264	0	0	1.264												
2/8/10	1.229	0	0	1.229	8.1	55										
2/9/10	1.166	0	0	1.166	8.2	54		140	1,361	206	2,003	93.2	192	1,867	20.3	197
2/10/10	1.097	0	0	1.097	8.3	55										
2/11/10	1.081	0	0	1.081	8.3	55		150	1,352	184	1,659				22.8	206
2/12/10	1.065	0	0	1.065	8	56										
2/13/10	1.144	0.003	0	1.147												
2/14/10	1.185	0	0	1.185												
2/15/10	1.212	0	0	1.212	8.2	55										
2/16/10	1.052	0	0	1.052	8.3	55		150	1,316	100	877				20.3	178
2/17/10	1.185	0.003	0	1.188	8.1	56										
2/18/10	1.056	0	0	1.056	8.2	53		180	1,585	234	2,061				22.8	201
2/19/10	1.004	0	0	1.004	8.1	56										
2/20/10	1.102	0	0	1.102												
2/21/10	1.187	0	0	1.187												
2/22/10	1.178	0	0	1.178	8.3	55										
2/23/10	1.119	0	0	1.119	8.3	55		140	1,307	247	2,305				20.1	188
2/24/10	1.072	0	0	1.072	8.3	54										
2/25/10	1.108	0	0	1.108	8.2	54		120	1,109	125	1,155				24.3	225
2/26/10	1.024	0.002	0	1.026	8.4	54										
2/27/10	1.109	0	0	1.109												
2/28/10	1.28	0	0	1.28												
Average Day	1.154	0.001	0.001	1.154	8.2	55	314	141	1314	184	1727	93	192	1867	21	196
Max. Day	1.380	0.029	0.023	1.381	8.4	56	314	180	1585	247	2305	93	192	1867	24	225
Min. Day	1.004	0.000	0.000	1.004	8.0	53	314	100	1007	100	877	93	192	1867	17	174
Total	32.300	0.040	0.025	32.315					10,509		13,817			1,867		1,566

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3/1/10	1.116	0	0	1.116	8.2	57										
3/2/10	1.15	0	0	1.15	8.4	54	344	170	1,630	239	2,292				22.5	216
3/3/10	1.153	0.011	0	1.164	8.3	55										
3/4/10	1.202	0.003	0	1.205	8.2	56		110	1,105	244	2,452				21.4	215
3/5/10	1.281	0	0	1.281	8.1	56										
3/6/10	1.675	0	0.049	1.626												
3/7/10	2.169	0	0.009	2.16												
3/8/10	1.871	0	0	1.871	8	53										
3/9/10	2.512	0.117	0.151	2.478	8	52		84	1,736	143	2,955	91.6	131	2,707	13.55	280
3/10/10	2.625	0	0.016	2.609	7.7	52										
3/11/10	2.199	0	0	2.199	7.9	53		70	1,284	112	2,054				9.06	166
3/12/10	1.994	0.002	0.009	1.987	7.9	53										
3/13/10	2.096	0	0	2.095												
3/14/10	2.095	0.002	0.005	2.092												
3/15/10	2.925	0.006	0.002	1.792	7.9	53										
3/16/10	3.358	0.038	0.024	1.901	7.8	55		62	983	83	1,316				8.09	128
3/17/10	3.279	0	0	1.543	7.8	56										
3/18/10	3.173	0.021	0.012	1.857	7.8	57		43	666	71	1,100				6.12	95
3/19/10	3.108	0.114	0.091	1.593	7.8	56										
3/20/10	3.201	0	0.005	1.624												
3/21/10	3.261	0	0	1.809												
3/22/10	3.115	0.002	0	1.679	7.9	58										
3/23/10	3.123	0.075	0.057	1.649	7.9	59		73	1,004	82	1,128				7.98	110
3/24/10	2.018	0	0	0.923	7.9	59										
3/25/10	1.471	0	0	1.471	8.2	54		86	1,055	117	1,435				14.03	172
3/26/10	1.285	0	0	1.285	8.1	54										
3/27/10	1.362	0.002	0	1.364												
3/28/10	1.42	0	0	1.42												
3/29/10	1.346	0	0	1.346	8.2	55										
3/30/10	1.278	0	0	1.278	8.1	54		130	1,386	197	2,100				18.37	196
3/31/10	1.253	0	0	1.253	8.2	57		150	1,568	192	2,006				18.79	196
Average Day	2.100	0.013	0.014	1.639	8.0	55	344	98	1242	148	1884	92	131	2707	14	177
Max. Day	3.358	0.117	0.151	2.609	8.4	59	344	170	1736	244	2955	92	131	2707	23	280
Min. Day	1.116	0.000	0.000	0.923	7.7	52	344	43	666	71	1100	92	131	2707	6	95
Total	65.114	0.393	0.430	50.820					12,417		18,838			2,707		1,774
4/1/10	1.202	0	0	1.202	8.2	57										
4/2/10	1.179	0.003	0.001	1.181												
4/3/10	1.231	0	0	1.231												
4/4/10	1.186	0	0	1.186												
4/5/10	1.295	0	0.008	1.287	8.3	57										
4/6/10	1.26	0	0.001	1.259	8.1	57	322	130	1,365	214	2,247				20.8	218
4/7/10	1.286	0	0	1.286	8.1	58										
4/8/10	1.252	0	0	1.252	8.1	57		140	1,462	168	1,754				20	209
4/9/10	1.215	0.003	0	1.218	8.3	57										
4/10/10	1.266	0	0	1.266												
4/11/10	1.301	0	0	1.301												
4/12/10	1.279	0	0	1.279	8.2	57										
4/13/10	1.146	0	0	1.146	8.1	57		146	1,395	194	1,854	93.3	181	1,730	19.23	184
4/14/10	1.138	0.013	0.003	1.148	8.1	59										
4/15/10	1.18	0	0	1.18	8.2	58		180	1,771	182	1,791				21.2	209
4/16/10	1.071	0	0	1.071	8.2	58										
4/17/10	1.153	0	0	1.153												
4/18/10	1.223	0	0	1.223												
4/19/10	1.201	0.005	0.001	1.205	8.3	59										
4/20/10	1.086	0.029	0.014	1.101	8.3	59		160	1,469	203	1,864				22.1	203
4/21/10	1.105	0	0	1.105	8.3	60										
4/22/10	1.07	0	0	1.07	8	60		170	1,517	241	2,151				24.4	218
4/23/10	1.098	0	0.007	1.091	8.1	60										
4/24/10	1.604	0	0	1.604												
4/25/10	1.492	0.002	0.044	1.45												
4/26/10	1.49	0	0	1.49	8.1	58										
4/27/10	1.327	0	0	1.327	8.2	59		100	1,107	168	1,859				17.38	192
4/28/10	1.294	0.002	0	1.296	8.2	58										
4/29/10	1.233	0	0	1.233	8.3	59		130	1,337	202	2,077				17.62	181
4/30/10	1.442	0	0.026	1.416	8.2	60										
Average Day	1.244	0.002	0.004	1.242	8.2	58	322	145	1428	197	1950	93	181	1730	20	202
Max. Day	1.604	0.029	0.044	1.604	8.3	60	322	180	1771	241	2247	93	181	1730	24	218
Min. Day	1.070	0.000	0.000	1.070	8.0	57	322	100	1107	168	1754	93	181	1730	17	181
Total	37.305	0.057	0.105	37.257					11,423		15,598			1,730		1,614

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5/1/10	1.424	0	0	1.424												
5/2/10	1.441	0	0	1.441												
5/3/10	1.273	0.003	0	1.276	8.2	59										
5/4/10	1.299	0.209	0.168	1.34	7.7	60	338	140	1,565	184	2,056				22	246
5/5/10	1.219	0.017	0.008	1.228	7.9	60										
5/6/10	1.181	0	0.003	1.178	8	60		150	1,474	172	1,690				20.3	199
5/7/10	1.238	0.015	0.015	1.238	8	58										
5/8/10	1.22	0	0.001	1.219												
5/9/10	1.221	0	0	1.221												
5/10/10	1.625	0	0.047	1.578	8.2	59										
5/11/10	1.786	0	0	1.786	7.9	59		119	1,773	195	2,905	88.7	173	2,576	17.86	266
5/12/10	2.408	0.015	0.064	2.359	8	59										
5/13/10	2.531	0.023	0.022	2.532	7.7	58		71	1,499	119	2,513				12.94	273
5/14/10	1.882	0.033	0.024	1.891	7.8	58										
5/15/10	1.668	0	0	1.668												
5/16/10	1.631	0	0	1.631												
5/17/10	1.596	0	0	1.596	7.9	59										
5/18/10	1.405	0.003	0	1.408	8	60		120	1,409	165	1,938				15.6	183
5/19/10	1.341	0	0	1.341	8.1	60										
5/20/10	1.383	0	0	1.383	8.1	61		130	1,499	150	1,730				19.05	220
5/21/10	1.303	0	0	1.303	8.1	60										
5/22/10	1.347	0	0	1.347												
5/23/10	1.354	0	0	1.354												
5/24/10	1.328	0.003	0	1.331	8	63										
5/25/10	1.42	0	0.039	1.381	8	61		160	1,843	215	2,476				24.1	278
5/26/10	1.614	0	0.001	1.613	7.9	62										
5/27/10	1.488	0	0	1.488	7.9	62		110	1,365	150	1,861				15.85	197
5/28/10	1.33	0	0	1.33	7.9	62										
5/29/10	1.258	0	0	1.258												
5/30/10	1.221	0	0	1.221												
5/31/10	1.31	0.002	0	1.312												
Average Day	1.476	0.010	0.013	1.473	8.0	60	338	125	1553	169	2146	89	173	2576	18	233
Max. Day	2.531	0.209	0.168	2.532	8.2	63	338	160	1843	215	2905	89	173	2576	24	278
Min. Day	1.181	0.000	0.000	1.178	7.7	58	338	71	1365	119	1690	89	173	2576	13	183
Total	45.745	0.323	0.392	45.676					12,427		17,169			2,576		1,862
6/1/10	1.366	0	0.005	1.361	7.1	62										
6/2/10	1.249	0	0	1.249	7.8	63	326	140	1,458	208	2,167				19.5	203
6/3/10	1.249	0.007	0.001	1.255	8.1	63		170	1,779	190	1,989				19.5	204
6/4/10	1.358	0.034	0.031	1.361	8.1	63										
6/5/10	1.246	0	0	1.246												
6/6/10	1.295	0	0	1.295												
6/7/10	1.263	0	0	1.263	7.9	63										
6/8/10	1.295	0.008	0.016	1.287	7.9	63		160	1,717	192	2,061				20.5	220
6/9/10	1.294	0.002	0	1.296	8	63										
6/10/10	1.344	0.039	0.05	1.333	8.1	63		180	2,001	205	2,279				22.2	247
6/11/10	1.361	0.004	0.013	1.352	8	64										
6/12/10	2.157	0	0.055	2.102												
6/13/10	2.221	0	0.021	2.2												
6/14/10	2.015	0	0	2.015	7.8	63										
6/15/10	2.268	0.062	0.075	2.255	7.8	64		76	1,429	145	2,727				12.76	240
6/16/10	1.803	0.018	0.01	1.811	7.8	63										
6/17/10	1.684	0	0.007	1.677	7.9	64		100	1,399	122	1,706				13.18	184
6/18/10	3.03	0.523	0.068	3.485	7.8	63										
6/19/10	2.719	0	0.238	2.481												
6/20/10	2.273	0.001	0.249	2.025												
6/21/10	1.97	0	0.001	1.969	7.8	64										
6/22/10	2.078	0.167	0.18	2.065	7.8	64		180	3,100	150	2,583	88.7	133	2,291	12.08	208
6/23/10	2.935	0.062	0.08	2.917	7.5	65										
6/24/10	2.017	0.002	0.001	2.018	7.8	64		60	1,010	91	1,532				8.43	142
6/25/10	1.927	0	0.02	1.907	7.7	64										
6/26/10	2.07	0	0.001	2.069												
6/27/10	1.952	0.002	0	1.954												
6/28/10	1.793	0	0	1.793	7.8	64										
6/29/10	1.655	0	0	1.655	7.9	65		80	1,104	128	1,767				14	193
6/30/10	1.542	0.002	0.001	1.543	7.9	65										
Average Day	1.814	0.031	0.037	1.808	7.8	64	326	127	1666	159	2090	89	133	2291	16	205
Max. Day	3.030	0.523	0.249	3.485	8.1	65	326	180	3100	208	2727	89	133	2291	22	247
Min. Day	1.246	0.000	0.000	1.246	7.1	62	326	60	1010	91	1532	89	133	2291	8	142
Total	54.429	0.933	1.123	54.239					14,998		18,810			2,291		1,842

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
7/1/10	1.44	0	0	1.44	8	65		116	1,393	170	2,042				17.26	207
7/2/10	1.349	0	0	1.349	7.9	64										
7/3/10	1.32	0	0	1.32												
7/4/10	1.701	0.003	0.068	1.636												
7/5/10	2.309	0	0.002	2.307												
7/6/10	2.283	0.123	0.103	2.303	7.7	66										
7/7/10	1.685	0	0	1.685	7.7	66	310	79	1,110	143	2,010				12.45	175
7/8/10	1.562	0.01	0.004	1.568	7.7	66		76	994	147	1,922				12.47	163
7/9/10	1.465	0.003	0	1.468	7.8	65										
7/10/10	1.432	0	0	1.432												
7/11/10	1.444	0	0	1.444												
7/12/10	1.63	0.002	0.019	1.613	7.9	67										
7/13/10	1.503	0.023	0.014	1.512	7.9	66		130	1,639	185	2,333	86.5	160	2,018	16.37	206
7/14/10	1.403	0.058	0.04	1.421	7.9	67										
7/15/10	1.381	0	0	1.381	7.9	67		100	1,152	166	1,912				16.56	191
7/16/10	1.283	0	0	1.283	8	66										
7/17/10	1.301	0	0	1.301												
7/18/10	1.319	0.003	0	1.322												
7/19/10	1.358	0	0	1.358	8	67										
7/20/10	1.277	0	0	1.277	7.9	67		220	2,343	224	2,386				18.49	197
7/21/10	1.244	0.003	0	1.247	8	67										
7/22/10	1.266	0	0	1.266	7.9	68		130	1,373	203	2,143				20.7	219
7/23/10	1.228	0	0.01	1.218	8	67										
7/24/10	1.299	0	0.001	1.298												
7/25/10	1.293	0	0	1.293												
7/26/10	1.398	0	0	1.398	8	68										
7/27/10	1.302	0	0	1.302	8	68		120	1,303	210	2,280				19.14	208
7/28/10	1.192	0	0	1.192	8	68										
7/29/10	1.1963	0.002	0	1.1983	7.8	68		140	1,399	200	1,999				20.7	207
7/30/10	1.184	0	0	1.184	8	68										
7/31/10	1.191	0	0	1.191												
Average Day	1.427	0.007	0.008	1.426	7.9	67	310	123	1412	183	2114	87	160	2018	17	197
Max. Day	2.309	0.123	0.103	2.307	8.0	68	310	220	2343	224	2386	87	160	2018	21	219
Min. Day	1.184	0.000	0.000	1.184	7.7	64	310	76	994	143	1912	87	160	2018	12	163
Total	44.238	0.230	0.261	44.207					12,706		19,026			2,018		1,773
8/1/10	1.258	0	0	1.258												
8/2/10	1.417	0	0.06	1.357	7.7	68										
8/3/10	1.403	0.003	0.011	1.395	7.8	69	328	110	1,280	238	2,769				21.4	249
8/4/10	1.323	0	0	1.323	8	68										
8/5/10	1.28	0.009	0.004	1.285	7.8	68		150	1,608	179	1,918				19.91	213
8/6/10	1.186	0	0	1.186	7.8	67										
8/7/10	1.259	0	0.003	1.256												
8/8/10	1.402	0	0.017	1.385												
8/9/10	1.715	0	0.011	1.704	7.8	69										
8/10/10	1.852	0.004	0.047	1.809	7.6	69		100	1,509	150	2,263	89.3	134	2,021	16.03	242
8/11/10	1.994	0.006	0.003	1.997	7.7	69										
8/12/10	1.617	0.003	0	1.62	7.8	70		90	1,216	130	1,756				12.45	168
8/13/10	2.013	0.029	0.057	1.985	7.8	69										
8/14/10	1.904	0	0	1.904												
8/15/10	1.67	0	0	1.67												
8/16/10	1.624	0.003	0	1.627	7.9	68										
8/17/10	1.516	0	0	1.516	7.9	69		85	1,075	158	1,998				15.78	200
8/18/10	1.483	0	0	1.483	7.9	68										
8/19/10	1.405	0	0	1.405	8	70		89	1,043	177	2,074				18.41	216
8/20/10	1.447	0.002	0.014	1.435	8	70										
8/21/10	1.467	0	0	1.467												
8/22/10	1.471	0	0	1.471												
8/23/10	1.444	0	0	1.444	7.7	69										
8/24/10	1.297	0.031	0.016	1.312	7.9	69		110	1,204	218	2,385				18.54	203
8/25/10	1.261	0	0	1.261	8.1	69										
8/26/10	1.268	0.001	0	1.269	8.1	69		150	1,588	172	1,820				20.7	219
8/27/10	1.171	0.002	0	1.173	8.1	70										
8/28/10	1.252	0	0	1.252												
8/29/10	1.35	0	0	1.35												
8/30/10	1.294	0	0	1.294	8.1	71										
8/31/10	1.547	0.002	0.073	1.476	8.1	70		150	1,846	172	2,117				22.4	276
Average Day	1.471	0.003	0.010	1.464	7.9	69	328	115	1374	177	2122	89	134	2021	18	221
Max. Day	2.013	0.031	0.073	1.997	8.1	71	328	150	1846	238	2769	89	134	2021	22	276
Min. Day	1.171	0.000	0.000	1.173	7.6	67	328	85	1043	130	1756	89	134	2021	12	168
Total	45.590	0.095	0.316	45.369					12,367		19,101			2,021		1,985

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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9/1/10	1.588	0.005	0.002	1.591	7.6	70										
9/2/10	1.671	0	0	1.671	7.7	70		130	1,812	151	2,104				17.66	246
9/3/10	1.233	0	0	1.233	8	69										
9/4/10	1.202	0.002	0.001	1.203												
9/5/10	1.253	0	0	1.253												
9/6/10	1.358	0	0	1.358												
9/7/10	1.307	0.02	0.007	1.32	8.1	69		150	1,651	298	3,281				22.5	248
9/8/10	1.174	0	0	1.174	8.2	69										
9/9/10	1.225	0	0	1.225	8.1	69		100	1,022	194	1,982				21.3	218
9/10/10	1.246	0	0.004	1.242	8.1	69										
9/11/10	1.247	0	0	1.247												
9/12/10	1.318	0	0	1.318												
9/13/10	1.733	0.002	0	1.735	8	69										
9/14/10	1.336	0	0	1.336	8.3	70		140	1,560	248	2,763	92.3	229	2,551	21.3	237
9/15/10	1.193	0	0	1.193	8.1	70										
9/16/10	1.135	0.005	0	1.14	8	69	362	200	1,902	346	3,290				21.1	201
9/17/10	1.088	0	0.001	1.087	8.2	68										
9/18/10	1.235	0	0.014	1.221												
9/19/10	1.332	0	0.002	1.33												
9/20/10	1.217	0.001	0	1.218	8.2	69										
9/21/10	1.4233	0.006	0.004	1.4253	8.1	71		170	2,021	223	2,651				21.8	259
9/22/10	1.372	0	0	1.372	8.1	69										
9/23/10	1.475	0.003	0.035	1.443	7.9	70		130	1,565	181	2,178				21	253
9/24/10	1.494	0.017	0.012	1.499	8.1	69										
9/25/10	1.623	0	0.01	1.613												
9/26/10	1.675	0.002	0	1.677												
9/27/10	1.55	0	0	1.55	8	67										
9/28/10	1.359	0	0	1.359	8.1	68		120	1,360	196	2,221				17.38	197
9/29/10	1.408	0	0	1.408	8.1	69										
9/30/10	1.34	0	0	1.34	8.1	69		130	1,453	185	2,067				18.75	210
Average Day	1.360	0.002	0.003	1.359	8.1	69	362	141	1594	225	2504	92	229	2551	20	230
Max. Day	1.733	0.020	0.035	1.735	8.3	71	362	200	2021	346	3290	92	229	2551	23	259
Min. Day	1.088	0.000	0.000	1.087	7.6	67	362	100	1022	151	1982	92	229	2551	17	197
Total	40.810	0.063	0.092	40.781					14,344		22,538			2,551		2,068
10/1/10	1.22	0	0	1.22	8.2	68										
10/2/10	1.258	0	0	1.258												
10/3/10	1.328	0	0	1.328												
10/4/10	1.286	0	0	1.286	8.3	68										
10/5/10	1.223	0.037	0.016	1.244	8.2	69		160	1,660	212	2,199				20	207
10/6/10	1.208	0	0	1.208	8	69										
10/7/10	1.135	0.019	0	1.154	8.3	68		140	1,347	186	1,790				22.9	220
10/8/10	1.033	0.069	0	1.102	8.23	68										
10/9/10	1.156	0	0	1.156												
10/10/10	1.196	0	0	1.196												
10/11/10	1.184	0.044	0	1.228	8.3	69										
10/12/10	1.107	0	0	1.107	8.2	68	366	160	1,477	213	1,966	87.8	187	1,727	23.1	213
10/13/10	1.078	0	0	1.078	8.3	69										
10/14/10	1.114	0	0	1.114	8.1	68		150	1,394	195	1,812				26.5	246
10/15/10	1.063	0	0	1.063	8	68										
10/16/10	1.111	0	0	1.111												
10/17/10	1.16	0	0	1.16												
10/18/10	1.173	0	0	1.173	8.2	68										
10/19/10	1.083	0	0	1.083	8.3	68		160	1,445	209	1,888				24.8	224
10/20/10	1.072	0	0	1.072	8.3	68										
10/21/10	1.059	0	0	1.059	8.3	68		150	1,325	224	1,978				26.1	231
10/22/10	0.973	0.269	0.167	1.075	8.3	67										
10/23/10	1.519	0	0.201	1.318												
10/24/10	1.388	0	0	1.388												
10/25/10	1.364	0.002	0.011	1.355	8.2	68										
10/26/10	1.345	0.047	0.04	1.352	8	67		140	1,579	272	3,067				20.1	227
10/27/10	1.319	0	0	1.319	8.3	68										
10/28/10	1.222	0	0	1.222	8.3	67		140	1,427	190	1,936				23.3	237
10/29/10	1.261	0	0	1.261	8.3	66										
10/30/10	1.174	0	0	1.174												
10/31/10	1.224	0	0	1.224												
Average Day	1.195	0.016	0.014	1.196	8.2	68	366	150	1457	213	2080	88	187	1727	23	226
Max. Day	1.519	0.269	0.201	1.388	8.3	69	366	160	1660	272	3067	88	187	1727	27	246
Min. Day	0.973	0.000	0.000	1.059	8.0	66	366	140	1325	186	1790	88	187	1727	20	207
Total	37.036	0.487	0.435	37.088					11,654		16,637			1,727		1,806

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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11/1/10	1.215	0	0	1.215	8.3	67										
11/2/10	1.099	0	0	1.099	8	66		160	1,467	251	2,301				23.3	214
11/3/10	1.022	0	0	1.022	8.3	67										
11/4/10	1.184	0	0	1.184	8.4	67		150	1,481	221	2,182				25.1	248
11/5/10	1.057	0	0	1.057	8.43	66										
11/6/10	1.136	0	0	1.136												
11/7/10	1.236	0.003	0	1.239												
11/8/10	1.111	0	0	1.111	8.4	67										
11/9/10	1.029	0	0	1.029	8.3	67	368	150	1,287	228	1,957	86	196	1,683	25.5	219
11/10/10	1.025	0	0	1.025	8.3	67										
11/11/10	1.054	0	0	1.054	8.1	66		230	2,022	236	2,075				27.1	238
11/12/10	1.063	0	0	1.063	8.3	66										
11/13/10	1.149	0	0	1.149												
11/14/10	1.315	0	0	1.315												
11/15/10	1.097	0	0	1.097	8.2	65										
11/16/10	1.075	0.022	0.015	1.082	8.3	65		160	1,444	233	2,103				26.4	238
11/17/10	1.073	0	0	1.073	8.1	65										
11/18/10	1.067	0	0	1.067	8.2	65		190	1,691	230	2,047				23.4	208
11/19/10	1.047	0	0	1.047	8.3	65										
11/20/10	1.107	0	0	1.107												
11/21/10	1.267	0	0	1.267												
11/22/10	1.136	0.002	0	1.138	8.2	65		200	1,898	358	3,398				26.1	248
11/23/10	1.069	0	0	1.069	8.3	64		150	1,337	222	1,979				26.5	236
11/24/10	1.149	0	0.012	1.137	8.3	63										
11/25/10	1.063	0	0	1.063												
11/26/10	0.981	0	0	0.981												
11/27/10	1.034	0	0	1.034												
11/28/10	1.14	0	0	1.14												
11/29/10	1.304	0	0.018	1.286	8.3	64										
11/30/10	1.146	0	0	1.146	8.1	63		140	1,338	232	2,217				22	210
Average Day	1.115	0.001	0.002	1.114	8.3	66	368	170	1552	246	2251	86	196	1683	25	229
Max. Day	1.315	0.022	0.018	1.315	8.4	67	368	230	2022	358	3398	86	196	1683	27	248
Min. Day	0.981	0.000	0.000	0.981	8.0	63	368	140	1287	221	1957	86	196	1683	22	208
Total	33.450	0.027	0.045	33.432					13,965		20,258			1,683		2,059
12/1/10	1.204	0	0	1.204	8.3	63										
12/2/10	1.125	0.003	0.001	1.127	8.3	63		150	1,410	214	2,011				25.6	241
12/3/10	1.039	0	0	1.039	8.4	62										
12/4/10	1.098	0	0	1.098												
12/5/10	1.186	0	0	1.186												
12/6/10	2.698	0	0	1.0863	8.4	63										
12/7/10	2.741	0.066	0.05	1.1453	8	62	282	74	707	108	1,032				11.19	107
12/8/10	2.776	0	0	1.1643	8	62										
12/9/10	2.791	0	0	1.1793	8.1	63		62	610	76	747				9.68	95
12/10/10	2.77	0.184	0.156	1.1863	8	63										
12/11/10	3.033	0	0.017	1.4043												
12/12/10	1.17	0	0	1.17												
12/13/10	2.078	0.632	0.889	1.442	7.9	53										
12/14/10	2.073	0.016	0.107	1.603	8.3	57		160	2,139	314	4,198				21.2	283
12/15/10	1.085	0.003	0.001	1.087	8.3	61										
12/16/10	1.082	0	0	1.082	8.3	61		170	1,534	232	2,094	89.2	207	1,867	26.1	236
12/17/10	1.073	0	0	1.073	8.4	61										
12/18/10	1.137	0	0	1.137												
12/19/10	1.187	0	0	1.187												
12/20/10	1.186	0.004	0.001	1.189	8.4	60		180	1,785	248	2,459				25.2	250
12/21/10	1.072	0	0	1.072	8.4	60		180	1,609	232	2,074				23.1	207
12/22/10	1.063	0	0	1.063	8.3	59										
12/23/10	1.076	0.002	0.002	1.076												
12/24/10	0.991	0	0	0.991												
12/25/10	0.891	0	0	0.891												
12/26/10	0.991	0	0	0.991												
12/27/10	1.058	0	0	1.058	8.3	57		220	1,941	300	2,647				28.1	248
12/28/10	1.187	0.017	0.009	1.195	8.4	58		230	2,292	207	2,063				23.9	238
12/29/10	1.092	0	0	1.092	8.3	58										
12/30/10	1.594	0	0.032	1.562												
12/31/10	1.541	0	0	1.541												
Average Day	1.519	0.030	0.041	1.172	8.3	60	282	158	1559	215	2147	89	207	1867	22	212
Max. Day	3.033	0.632	0.889	1.603	8.4	63	282	230	2292	314	4198	89	207	1867	28	283
Min. Day	0.891	0.000	0.000	0.891	7.9	53	282	62	610	76	747	89	207	1867	10	95
Total	47.088	0.927	1.265	36.322					14,027		19,325			1,867		1,904

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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1/1/11	1.34	0	0	1.34												
1/2/11	1.382	0.003	0	1.385												
1/3/11	1.39	0	0	1.39	8.2	58										
1/4/11	1.279	0	0	1.279	8.2	57	330	140	1,493	199	2,123				21.4	228
1/5/11	1.361	0.003	0.001	1.363	8.1	58										
1/6/11	1.191	0	0	1.191	8.1	59		63	626	184	1,828				22.5	223
1/7/11	1.123	0	0	1.123	8.1	59										
1/8/11	1.2	0	0	1.2												
1/9/11	1.237	0	0	1.237												
1/10/11	1.197	0.004	0.001	1.2	8.3	58										
1/11/11	1.079	0	0	1.079	8.2	58		200	1,800	292	2,628				24.2	218
1/12/11	1.091	0.003	0.003	1.091	8.3	58										
1/13/11	1.08	0	0	1.08	8.3	58		210	1,892	221	1,991	90	199	1,792	26.6	240
1/14/11	1.046	0.082	0.068	1.06	8.4	58										
1/15/11	1.135	0	0	1.135												
1/16/11	1.25	0	0	1.25												
1/17/11	1.175	0.003	0.001	1.177	8.3	56										
1/18/11	1.042	0	0	1.042	8.3	58		220	1,912	224	1,947				27.2	236
1/19/11	1.033	0.007	0.004	1.036	8.2	58										
1/20/11	1.057	0.007	0.005	1.059	8.1	58		200	1,766	240	2,120				26.2	231
1/21/11	1.023	0.02	0.012	1.031	8.4	56										
1/22/11	1.116	0	0	1.116												
1/23/11	1.283	0.003	0.002	1.284												
1/24/11	1.042	0	0	1.042	8.2	58										
1/25/11	1.042	0	0	1.042	8.4	57		240	2,086	278	2,416				28.6	249
1/26/11	1.034	0.09	0.08	1.044	8.4	58										
1/27/11	1.034	0.003	0.002	1.035	8.4	57		170	1,467	240	2,072				28.8	249
1/28/11	1.005	0	0	1.005	8.3	58										
1/29/11	1.118	0	0	1.118												
1/30/11	1.262	0.004	0.001	1.265												
1/31/11	1.019	0	0	1.019	8.3	57										
Average Day	1.151	0.007	0.006	1.152	8.3	58	330	180	1630	235	2140	90	199	1792	26	234
Max. Day	1.390	0.090	0.080	1.390	8.4	59	330	240	2086	292	2628	90	199	1792	29	249
Min. Day	1.005	0.000	0.000	1.005	8.1	56	330	63	626	184	1828	90	199	1792	21	218
Total	35.666	0.232	0.180	35.718					13,042		17,122			1,792		1,874
2/1/11	1.081	0	0	1.081	8.3	56	362	190	1,713	233	2,101				28.1	253
2/2/11	1.123	0.033	0.024	1.132	8.3	56										
2/3/11	1.012	0	0	1.012	8.3	56		260	2,194	226	1,907				29.9	252
2/4/11	0.985	0	0	0.985	8.4	57										
2/5/11	1.08	0	0	1.08												
2/6/11	1.214	0.003	0.002	1.215												
2/7/11	1.025	0	0	1.025	8.4	57										
2/8/11	1	0	0	1	8.2	57		250	2,085	262	2,185	89.7	235	1,960	27.7	231
2/9/11	1.024	0.058	0.046	1.036	8.4	56										
2/10/11	1.031	0	0	1.031	8.4	56		170	1,462	202	1,737				28.4	244
2/11/11	0.985	0	0	0.985	8.4	57										
2/12/11	1.143	0.054	0.05	1.147												
2/13/11	1.339	0.009	0.017	1.331												
2/14/11	1.412	0	0.022	1.39	8.4	56										
2/15/11	1.44	0	0.006	1.434	8.2	55		170	2,033	239	2,858				21.3	255
2/16/11	1.847	0	0.03	1.817	8.2	56										
2/17/11	2.214	0.002	0.005	2.211	8	53		100	1,844	164	3,024				16.87	311
2/18/11	1.684	0.017	0.011	1.69	8.1	54										
2/19/11	1.688	0	0.013	1.675												
2/20/11	2.378	0.003	0.012	2.369												
2/21/11	1.872	0	0	1.872	8	53										
2/22/11	1.585	0.027	0.017	1.595	8.1	54		110	1,463	141	1,876				14.66	195
2/23/11	1.5	0	0	1.5	7.9	55										
2/24/11	1.512	0	0	1.512	8.2	55		130	1,639	153	1,929				19.41	245
2/25/11	1.384	0.041	0.036	1.389	8.2	55										
2/26/11	1.429	0	0	1.429												
2/27/11	1.481	0	0	1.481												
2/28/11	1.467	0	0	1.467	8.2	54										
Average Day	1.391	0.009	0.010	1.389	8.2	55	362	173	1804	203	2202	90	235	1960	23	248
Max. Day	2.378	0.058	0.050	2.369	8.4	57	362	260	2194	262	3024	90	235	1960	30	311
Min. Day	0.985	0.000	0.000	0.985	7.9	53	362	100	1462	141	1737	90	235	1960	15	195
Total	38.935	0.247	0.291	38.891					14,434		17,617			1,960		1,987

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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3/1/11	1.408	0.003	0.001	1.41	8.2	54	308	160	1,882	175	2,058				18.37	216
3/2/11	1.391	0	0	1.391	8.2	54										
3/3/11	1.432	0	0	1.432	8.2	55		150	1,791	189	2,257				20.6	246
3/4/11	1.461	0.003	0	1.464	8.2	55										
3/5/11	1.572	0	0	1.572												
3/6/11	1.616	0	0	1.616												
3/7/11	1.52	0.003	0	1.523	8.2	55										
3/8/11	1.721	0	0	1.721	8.2	55		150	2,153	177	2,541	84.7	150	2,152	18.49	265
3/9/11	2.051	0.003	0	2.054	7.9	53										
3/10/11	1.815	0	0	1.815	8.1	54		78	1,181	136	2,059				12.91	195
3/11/11	1.626	0.003	0	1.629	8.1	54										
3/12/11	1.528	0	0	1.528												
3/13/11	1.492	0	0	1.492												
3/14/11	1.49	0.003	0	1.493	8.1	53										
3/15/11	1.349	0	0	1.349	8.2	54		130	1,463	210	2,363				17.1	192
3/16/11	1.334	0	0	1.334	8.1	53										
3/17/11	1.281	0	0	1.281	8.2	55		170	1,816	173	1,848				19.23	205
3/18/11	1.265	0.002	0	1.267	8.2	54										
3/19/11	1.298	0	0	1.298												
3/20/11	1.642	0	0	1.642												
3/21/11	1.549	0.003	0	1.552	8.1	55										
3/22/11	1.605	0.038	0.125	1.518	8.2	55		150	1,899	200	2,532				16.9	214
3/23/11	1.58	0.002	0	1.582	8.1	55										
3/24/11	3.217	0.009	0.001	1.781	7.9	56		120	1,782	157	2,332				17.02	253
3/25/11	3.14	0.216	0.187	1.725	7.9	56										
3/26/11	3.177	0.003	0.003	1.733												
3/27/11	3.213	0.002	0	1.771												
3/28/11	3.153	0.007	0.001	1.715	8	57										
3/29/11	2.98	0.159	0.134	1.561	8	57		160	2,083	100	1,302				8.41	109
3/30/11	2.985	0.011	0.004	1.548	8	58										
3/31/11	2.969	0.001	0	1.526	8	58		69	878	82	1,044				9.23	117
Average Day	1.931	0.015	0.015	1.559	8.1	55	308	134	1693	160	2033	85	150	2152	16	201
Max. Day	3.217	0.216	0.187	2.054	8.2	58	308	170	2153	210	2541	85	150	2152	21	265
Min. Day	1.265	0.000	0.000	1.267	7.9	53	308	69	878	82	1044	85	150	2152	8	109
Total	59.860	0.471	0.456	48.323					16,928		20,335			2,152		2,014
4/1/11	2.919	0.176	0.146	1.505	8	59										
4/2/11	2.97	0	0	1.526												
4/3/11	3.129	0.003	0.005	1.683												
4/4/11	3.03	0	0.001	1.585	8.1	59										
4/5/11	2.994	0.192	0.161	1.581	7.9	59	272	73	963	104	1,371				9.46	125
4/6/11	2.995	0	0	1.551	7.9	60										
4/7/11	3.075	0	0.02	1.611	8	60		140	1,881	82	1,102				8.57	115
4/8/11	3.119	0.205	0.174	1.706	8	59										
4/9/11	3.166	0	0.001	1.721												
4/10/11	3.211	0.009	0.001	1.775												
4/11/11	3.119	0	0	1.675	8	60										
4/12/11	3.025	0.181	0.147	1.615	8	60		81	1,091	95	1,280				10	135
4/13/11	2.399	0	0	0.955	7.9	60										
4/14/11	1.207	0	0	1.207	8.2	58		82	825	142	1,429				14.49	146
4/15/11	1.431	0.004	0.032	1.403	8.2	58										
4/16/11	1.738	0.003	0.011	1.73												
4/17/11	1.683	0	0.005	1.678												
4/18/11	1.754	0.001	0	1.755	8	57										
4/19/11	2.051	0.02	0.031	2.04	8.1	55		120	2,042	186	3,165				16.37	279
4/20/11	1.764	0.117	0.052	1.829	8	56										
4/21/11	1.764	0	0.044	1.72	8	56		100	1,434	152	2,180	87.5	133	1,908	15.49	222
4/22/11	1.738	0.002	0.006	1.734												
4/23/11	1.69	0	0	1.69												
4/24/11	1.618	0	0	1.618												
4/25/11	1.714	0.003	0.021	1.696	8.1	56										
4/26/11	2.212	0.094	0.085	2.221	7.9	56		130	2,408	161	2,982				17.42	323
4/27/11	1.8	0	0	1.8	8	56										
4/28/11	1.637	0.003	0	1.64	8	55		110	1,505	142	1,942				15.67	214
4/29/11	1.634	0	0	1.634	8.1	56										
4/30/11	1.56	0	0	1.56												
Average Day	2.272	0.034	0.031	1.648	8.0	58	272	105	1519	133	1931	88	133	1908	13	195
Max. Day	3.211	0.205	0.174	2.221	8.2	60	272	140	2408	186	3165	88	133	1908	17	323
Min. Day	1.207	0.000	0.000	0.955	7.9	55	272	73	825	82	1102	88	133	1908	9	115
Total	68.146	1.013	0.943	49.444					12,149		15,451			1,908		1,558

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5/1/11	1.551	0.003	0	1.554												
5/2/11	2.884	0.012	0	1.064	8.1	58										
5/3/11	3.073	0.159	0.138	1.262	7.9	59	292	73	768	163	1,716				11.14	117
5/4/11	3.06	0	0	1.228	7.9	60										
5/5/11	3.011	0	0	1.179	7.9	60		76	747	79	777				8.38	82
5/6/11	2.967	0.183	0.154	1.164	8	61										
5/7/11	3.042	0	0	1.21												
5/8/11	3.059	0	0	1.227												
5/9/11	1.511	0	0	1.511	7.9	61										
5/10/11	1.225	0.002	0	1.227	8.2	60		150	1,535	222	2,272	87.8	195	1,995	19.95	204
5/11/11	1.182	0	0	1.182	8.1	60										
5/12/11	1.216	0	0	1.216	8.3	61		160	1,623	201	2,038				23.4	237
5/13/11	1.14	0	0	1.14	8.2	60										
5/14/11	1.538	0	0.035	1.503												
5/15/11	1.581	0.003	0.001	1.583												
5/16/11	1.435	0	0	1.435	8.1	61										
5/17/11	1.27	0	0	1.27	8.2	61		150	1,589	333	3,527				19.95	211
5/18/11	1.262	0	0	1.262	8.2	61										
5/19/11	1.242	0.002	0	1.244	8.2	61		160	1,660	197	2,044				20.5	213
5/20/11	1.191	0	0	1.191	8.2	60										
5/21/11	1.34	0	0.011	1.329												
5/22/11	1.499	0	0.001	1.498												
5/23/11	1.465	0	0	1.465	8.1	61										
5/24/11	1.404	0	0.018	1.386	8	64		140	1,618	158	1,826				19.1	221
5/25/11	1.791	0.003	0.022	1.772	7.9	60										
5/26/11	1.672	0	0	1.672	8.1	59		130	1,813	166	2,315				15.35	214
5/27/11	1.433	0	0	1.433	8.1	58										
5/28/11	1.402	0.003	0	1.405												
5/29/11	1.988	0	0.036	1.952												
5/30/11	1.753	0	0	1.753												
5/31/11	1.578	0.003	0	1.581	8	61										
Average Day	1.799	0.012	0.013	1.384	8.1	60	292	130	1419	190	2064	88	195	1995	17	187
Max. Day	3.073	0.183	0.154	1.952	8.3	64	292	160	1813	333	3527	88	195	1995	23	237
Min. Day	1.140	0.000	0.000	1.064	7.9	58	292	73	747	79	777	88	195	1995	8	82
Total	55.765	0.373	0.416	42.898					11,353		16,515			1,995		1,500
6/1/11	1.426	0	0	1.426	8.1	60		150	1,784	178	2,117				17.26	205
6/2/11	1.594	0	0.01	1.584	8.2	61		130	1,717	159	2,100				19.01	251
6/3/11	1.501	0.003	0.006	1.498	8	60										
6/4/11	1.408	0.002	0.002	1.408												
6/5/11	1.434	0	0	1.434												
6/6/11	1.437	0	0	1.437	8.1	62										
6/7/11	1.314	0	0	1.314	8.1	63	340	170	1,863	195	2,137	87.7	171	1,874	20.5	225
6/8/11	2.298	0	0	2.298	8.1	62										
6/9/11	2.506	0.105	0.16	2.451	7.7	63		160	3,271	211	4,313				19.05	389
6/10/11	2.827	0.267	0.228	2.866	7.7	60										
6/11/11	2.23	0	0	2.23												
6/12/11	2.094	0	0	2.094												
6/13/11	1.591	0.006	0.11	1.487	7.9	61										
6/14/11	1.757	0.049	0.059	1.747	7.9	61		110	1,603	210	3,060				14.93	218
6/15/11	1.846	0	0	1.846	7.8	62										
6/16/11	1.647	0.161	0.001	1.807	7.8	63		98	1,477	142	2,140				15	226
6/17/11	1.569	0.002	0	1.571	7.9	62										
6/18/11	1.486	0.001	0	1.487												
6/19/11	1.514	0	0	1.514												
6/20/11	1.936	0.001	0	1.937	8	62										
6/21/11	1.704	0.009	0	1.713	8	63		100	1,429	201	2,872				14.19	203
6/22/11	1.538	0	0	1.538	8	62										
6/23/11	1.457	0.008	0	1.465	8	62		110	1,344	157	1,918				20.5	250
6/24/11	1.513	0.002	0.11	1.405	8.2	62										
6/25/11	1.464	0	0.079	1.385												
6/26/11	1.498	0.002	0.015	1.485												
6/27/11	1.593	0.02	0.015	1.598	8	63										
6/28/11	1.39	0.003	0.002	1.391	8.1	63		84	974	178	2,065				19.01	221
6/29/11	1.368	0	0	1.368	8.1	63										
6/30/11	1.387	0	0	1.387	8.1	64		140	1,619	189	2,186				20.9	242
Average Day	1.678	0.021	0.027	1.672	8.0	62	340	125	1708	182	2491	88	171	1874	18	243
Max. Day	2.827	0.267	0.228	2.866	8.2	64	340	170	3271	211	4313	88	171	1874	21	389
Min. Day	1.314	0.000	0.000	1.314	7.7	60	340	84	974	142	1918	88	171	1874	14	203
Total	50.327	0.641	0.797	50.171					17,081		24,908			1,874		2,430

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
7/1/11	1.305	0.014	0.007	1.312	7.9	64										
7/2/11	1.23	0.002	0.001	1.231												
7/3/11	1.174	0	0	1.174												
7/4/11	1.203	0	0	1.203												
7/5/11	1.343	0.014	0.008	1.349	8.1	64										
7/6/11	1.242	0	0	1.242	7.8	65		120	1,243	241	2,496				21.3	221
7/7/11	1.252	0.002	0.001	1.253	8.2	64		130	1,359	211	2,205				21.7	227
7/8/11	1.202	0	0	1.202	7.8	65										
7/9/11	1.171	0	0	1.171												
7/10/11	1.287	0	0.001	1.286												
7/11/11	1.235	0.042	0	1.277	8.2	64										
7/12/11	1.044	0.159	0	1.203	8	65	348	140	1,405	221	2,217				23	231
7/13/11	1.575	0.006	0.165	1.416	7.9	65										
7/14/11	1.73	0.034	0.117	1.647	8.4	66		140	1,923	238	3,269				23.9	328
7/15/11	1.489	0	0	1.489	7.8	65										
7/16/11	1.402	0.011	0.003	1.41												
7/17/11	1.519	0	0	1.519												
7/18/11	1.494	0.036	0.001	1.529	8.2	67										
7/19/11	1.152	0.238	0.003	1.387	7.8	67		140	1,619	223	2,580	93.3	208	2,407	22.5	260
7/20/11	1.395	0	0	1.395	8	67										
7/21/11	1.618	0	0.187	1.431	8.2	68		160	1,910	240	2,864				24.3	290
7/22/11	1.763	0	0.067	1.696	8.1	67										
7/23/11	2.057	0.004	0.048	2.013												
7/24/11	1.96	0	0.011	1.949												
7/25/11	1.642	0	0.005	1.637	8	68										
7/26/11	1.351	0.009	0.01	1.35	8	68		92	1,036	182	2,049				17.99	203
7/27/11	1.339	0	0.001	1.338	8	68										
7/28/11	1.322	0	0.003	1.319	8.1	67		150	1,650	187	2,057				21.9	241
7/29/11	1.265	0	0	1.265	8.1	67										
7/30/11	1.242	0	0	1.242												
7/31/11	1.346	0	0	1.346												
Average Day	1.398	0.018	0.021	1.396	8.0	66	348	134	1518	218	2467	93	208	2407	22	250
Max. Day	2.057	0.238	0.187	2.013	8.4	68	348	160	1923	241	3269	93	208	2407	24	328
Min. Day	1.044	0.000	0.000	1.171	7.8	64	348	92	1036	182	2049	93	208	2407	18	203
Total	43.349	0.571	0.639	43.281					12,144		19,738			2,407		2,000
8/1/11	1.271	0	0	1.271	8.1	68										
8/2/11	1.259	0.018	0.005	1.272	8	68		170	1,803	227	2,408				23.3	247
8/3/11	1.167	0	0.001	1.166	8.2	68										
8/4/11	1.161	0	0.001	1.16	8.1	68		130	1,258	251	2,428				23.2	224
8/5/11	1.112	0	0	1.112	8	68										
8/6/11	1.149	0.007	0	1.156												
8/7/11	1.199	0	0	1.199												
8/8/11	1.323	0	0.012	1.311	8.2	68										
8/9/11	1.167	0	0.006	1.161	8	69	330	150	1,452	232	2,246	87.1	202	1,957	21.8	211
8/10/11	1.122	0	0	1.122	7.9	67										
8/11/11	1.124	0	0	1.124	8.2	68		170	1,594	215	2,015				24.8	232
8/12/11	1.081	0	0	1.081	8.1	68										
8/13/11	1.125	0	0	1.125												
8/14/11	1.156	0	0	1.156												
8/15/11	1.182	0	0.001	1.181	8	69		140	1,379	273	2,689				27.3	269
8/16/11	1.119	0	0	1.119												
8/17/11	1.138	0	0	1.138	8.1	69										
8/18/11	1.101	0	0	1.101	8.2	69		150	1,377	234	2,149				26.5	243
8/19/11	1.048	0	0	1.048	8.1	70										
8/20/11	1.105	0	0	1.105												
8/21/11	1.166	0.072	0.029	1.209												
8/22/11	1.202	0.002	0.025	1.179	8	69										
8/23/11	1.097	0	0	1.097	8.2	69		130	1,189	219	2,004				26.2	240
8/24/11	1.079	0	0	1.079												
8/25/11	1.076	0	0	1.076	8.2	69		150	1,346	224	2,010				26.9	241
8/26/11	1.043	0	0	1.043	8.2	69										
8/27/11	1.085	0	0	1.085												
8/28/11	1.145	0	0	1.145												
8/29/11	1.155	0	0	1.155	8.2	70										
8/30/11	1.172	0	0.028	1.144	8.1	70		150	1,431	310	2,958				26.7	255
8/31/11	1.13	0.004	0	1.134	8	70										
Average Day	1.144	0.003	0.003	1.144	8.1	69	330	149	1426	243	2323	87	202	1957	25	240
Max. Day	1.323	0.072	0.029	1.311	8.2	70	330	170	1803	310	2958	87	202	1957	27	269
Min. Day	1.043	0.000	0.000	1.043	7.9	67	330	130	1189	215	2004	87	202	1957	22	211
Total	35.459	0.103	0.108	35.454					12,830		20,907			1,957		2,163

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
9/1/11	1.113	0	0	1.113	8.2	71		84	780	286	2,655				27.4	254
9/2/11	1.068	0	0	1.068	8.2	71										
9/3/11	1.739	0	0.087	1.652												
9/4/11	1.347	0	0	1.347												
9/5/11	1.358	0	0	1.358												
9/6/11	1.284	0.013	0.006	1.291	8.2	69		170	1,830	227	2,444				23.1	249
9/7/11	1.161	0	0	1.161	8.2	69										
9/8/11	1.137	0	0	1.137	8.1	70		140	1,328	218	2,067				23.5	223
9/9/11	1.077	0	0	1.077	8	69										
9/10/11	1.116	0	0	1.116												
9/11/11	1.24	0	0	1.24												
9/12/11	1.184	0	0	1.184	8.2	69										
9/13/11	1.104	0	0	1.104	8.1	69										
9/14/11	1.078	0	0	1.078	8.2	69	368	150	1,349	229	2,059	93	213	1,915	26.9	242
9/15/11	1.073	0	0	1.073	8.2	69		150	1,342	215	1,924				26.5	237
9/16/11	1.058	0	0	1.058	8.3	69										
9/17/11	1.058	0	0	1.058												
9/18/11	1.226	0	0	1.226												
9/19/11	1.195	0.002	0	1.197	8.2	70										
9/20/11	1.083	0	0	1.083	8.2	69		140	1,265	243	2,195				25.6	231
9/21/11	1.069	0	0	1.069	8.2	70										
9/22/11	1.072	0	0	1.072	8.1	69		160	1,430	227	2,029				27.3	244
9/23/11	1.033	0	0	1.033	8.3	68										
9/24/11	1.061	0	0	1.061												
9/25/11	1.178	0	0	1.178												
9/26/11	1.134	0	0.003	1.131	8.2	69										
9/27/11	1.128	0	0	1.128	8.3	69		190	1,787	262	2,465				29	273
9/28/11	1.075	0	0	1.075	8.1	68										
9/29/11	1.073	0	0	1.073	8.1	68		200	1,790	303	2,711				32.1	287
9/30/11	1.088	0	0	1.088	8.3	68										
Average Day	1.154	0.001	0.003	1.151	8.2	69	368	154	1433	246	2283	93	213	1915	27	249
Max. Day	1.739	0.013	0.087	1.652	8.3	71	368	200	1830	303	2711	93	213	1915	32	287
Min. Day	1.033	0.000	0.000	1.033	8.0	68	368	84	780	215	1924	93	213	1915	23	223
Total	34.610	0.015	0.096	34.529					12,901		20,549			1,915		2,240
10/1/11	1.076	0	0	1.076												
10/2/11	1.127	0	0	1.127												
10/3/11	1.14	0	0	1.14	8.4	68										
10/4/11	1.045	0	0	1.045	8.2	68	360	180	1,569	252	2,196				26.7	233
10/5/11	1.037	0	0	1.037	8.1	68										
10/6/11	1.025	0	0	1.025	8.4	68		170	1,453	239	2,043				27.1	232
10/7/11	0.975	0	0	0.975	8.3	69										
10/8/11	1.023	0	0	1.023												
10/9/11	1.173	0	0	1.173												
10/10/11	1.056	0	0	1.056	8.3	69										
10/11/11	1.047	0	0	1.047	8.3	69		180	1,572	257	2,244				26.7	233
10/12/11	1.414	0	0.071	1.343	8.3	69										
10/13/11	1.316	0	0	1.316	8.2	68		120	1,317	189	2,074				21.9	240
10/14/11	1.114	0	0	1.114	8.1	68										
10/15/11	1.126	0	0	1.126												
10/16/11	1.214	0	0	1.214												
10/17/11	1.113	0	0	1.113	8.3	67										
10/18/11	1.222	0.012	0.005	1.229	8.1	67		160	1,640	264	2,706	90.5	239	2,449	27	277
10/19/11	1.053	0	0	1.053	8.4	67										
10/20/11	1.059	0	0	1.059	8.4	67		190	1,678	242	2,137				28.1	248
10/21/11	1.017	0	0	1.017	8.2	65										
10/22/11	1.068	0	0	1.068												
10/23/11	1.173	0	0	1.173												
10/24/11	1.018	0	0	1.018	8.4	67										
10/25/11	1.072	0	0	1.072	8.2	68		200	1,788	253	2,262				30.2	270
10/26/11	1.076	0	0	1.076	8.2	67										
10/27/11	1.012	0	0	1.012	8.3	67		150	1,266	286	2,414				28.1	237
10/28/11	0.97	0	0	0.97	8.4	66										
10/29/11	1.038	0	0	1.038												
10/30/11	1.126	0	0	1.126												
10/31/11	1.068	0	0	1.068	8.3	66										
Average Day	1.097	0.000	0.002	1.094	8.3	68	360	169	1535	248	2260	91	239	2449	27	246
Max. Day	1.414	0.012	0.071	1.343	8.4	69	360	200	1788	286	2706	91	239	2449	30	277
Min. Day	0.970	0.000	0.000	0.970	8.1	65	360	120	1266	189	2043	91	239	2449	22	232
Total	33.993	0.012	0.076	33.929					12,283		18,077			2,449		1,970

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
11/1/11	1.012	0	0	1.012	8	65		130	1,097	281	2,372				29.4	248
11/2/11	1.497	0.002	0.074	1.425	8.3	67		170	2,020	221	2,626				28.8	342
11/3/11	1.374	0	0.004	1.37												
11/4/11	1.204	0	0	1.204	8	64										
11/5/11	1.258	0	0	1.258												
11/6/11	1.3	0	0	1.3												
11/7/11	1.281	0	0	1.281	8.3	66										
11/8/11	1.292	0	0.013	1.279	8.2	65		170	1,813	215	2,293				26.3	281
11/9/11	1.852	0	0.031	1.821	7.9	62										
11/10/11	1.523	0	0	1.523	8.1	64	269	84	1,067	128	1,626				15.31	194
11/11/11	1.278	0.001	0	1.279	8.2	63										
11/12/11	1.323	0	0	1.323												
11/13/11	1.412	0	0	1.412												
11/14/11	1.318	0	0	1.318	8.3	65										
11/15/11	1.179	0	0	1.179	8.3	65		150	1,475	193	1,898	88.6	171	1,681	22.1	217
11/16/11	1.14	0	0	1.14	8.2	64										
11/17/11	1.129	0	0	1.129	8	64		170	1,601	189	1,780				25.6	241
11/18/11	1.084	0	0	1.084	8.2	63										
11/19/11	1.15	0	0	1.15												
11/20/11	1.281	0	0	1.281												
11/21/11	1.143	0	0	1.143	8.3	64										
11/22/11	1.107	0	0	1.107	8.1	64		150	1,385	256	2,363				27.2	251
11/23/11	1.182	0	0	1.182	8	62		150	1,479	227	2,238				27.4	270
11/24/11	1.002	0	0	1.002												
11/25/11	0.966	0	0	0.966												
11/26/11	1.167	0	0.006	1.161												
11/27/11	1.237	0	0	1.237												
11/28/11	1.171	0.003	0	1.174	8.3	63										
11/29/11	1.162	0.021	0.014	1.169	8.4	63		140	1,365	223	2,174				24.8	242
11/30/11	1.127	0	0	1.127	8.1	62										
Average Day	1.238	0.001	0.005	1.235	8.2	64	269	146	1478	215	2152	89	171	1681	25	254
Max. Day	1.852	0.021	0.074	1.821	8.4	67	269	170	2020	281	2626	89	171	1681	29	342
Min. Day	0.966	0.000	0.000	0.966	7.9	62	269	84	1067	128	1626	89	171	1681	15	194
Total	37.151	0.027	0.142	37.036					13,302		19,370			1,681		2,287
12/1/2011	1.17	0	0	1.173	8.3	64		150	1,467	212	2,074				26.7	261
12/2/2011	1.15	0	0.008	1.143	8.4	62										
12/3/2011	1.94	0	0.046	1.889												
12/4/2011	1.78	0	0	1.78												
12/5/2011	1.57	0.003	0	1.569	8.1	61										
12/6/2011	1.39	0	0	1.385	8	61	295	110	1,271	134	1,548				17.66	204
12/7/2011	1.33	0	0	1.332	8	61										
12/8/2011	1.30	0	0	1.304	8	62		150	1,631	179	1,947				20.6	224
12/9/2011	1.22	0	0	1.222	8.2	61										
12/10/2011	1.31	0	0	1.308												
12/11/2011	1.36	0.001	0	1.359												
12/12/2011	1.22	0	0	1.217	8.1	61										
12/13/2011	1.44	0	0.018	1.424	8.3	62		180	2,138	238	2,827	92	219	2,600	22	261
12/14/2011	1.84	0	0.011	1.832	7.8	61										
12/15/2011	1.66	0.003	0	1.661	8.1	60		120	1,662	144	1,995				15.07	209
12/16/2011	1.51	0.051	0	1.563	8.1	60										
12/17/2011	1.52	0	0.039	1.484												
12/18/2011	1.53	0	0	1.527												
12/19/2011	1.47	0	0	1.47	7.9	61										
12/20/2011	1.33	0	0	1.325	8.2	61		170	1,879	221	2,442				19.68	217
12/21/2011	1.32	0	0	1.324	8.2	60										
12/22/2011	1.29	0	0	1.294	8.4	59		140	1,511	187	2,018				22.7	245
12/23/2011	1.28	0	0	1.28												
12/24/2011	1.19	0.003	0	1.191												
12/25/2011	1.07	0	0	1.068												
12/26/2011	1.21	0	0	1.208												
12/27/2011	1.34	0	0	1.337	8.2	58										
12/28/2011	1.20	0	0	1.199	8.3	58		150	1,500	330	3,300				22.1	221
12/29/2011	1.23	0	0	1.232	8.3	59		200	2,055	220	2,260				23.9	246
12/30/2011	1.32	0	0	1.319												
12/31/2011	1.31	0	0	1.305												
Average Day	1.380	0.002	0.004	1.378	8.2	61	295	152	1679	207	2268	92	219	2600	21	232
Max. Day	1.935	0.051	0.046	1.889	8.4	64	295	200	2138	330	3300	92	219	2600	27	261
Min. Day	1.068	0.000	0.000	1.068	7.8	58	295	110	1271	134	1548	92	219	2600	15	204
Total	42.785	0.061	0.122	42.724					15,114		20,410			2,600		2,088

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
1/1/2012	1.22	0.003	0	1.22												
1/2/2012	1.32	0	0	1.323												
1/3/2012	1.32	0	0	1.32	8.2	58		170	1,871	211	2,323				23.9	263
1/4/2012	1.19	0	0	1.193	8.4	59										
1/5/2012	1.19	0	0	1.194	8.4	59	376	160	1,593	197	1,962				23.7	236
1/6/2012	1.16	0	0	1.164	8.4	60										
1/7/2012	1.22	0	0	1.222												
1/8/2012	1.25	0	0	1.253												
1/9/2012	1.15	0.002	0	1.155	8.4	59										
1/10/2012	1.18	0.023	0.015	1.186	8.4	59		170	1,682	230	2,275	91.7	211	2,086	25.9	256
1/11/2012	1.19	0.002	0	1.189	8.4	59										
1/12/2012	1.14	0	0	1.141	8.4	57		110	1,047	191	1,818				23.1	220
1/13/2012	1.10	0	0	1.101	8.4	57										
1/14/2012	1.20	0	0	1.198												
1/15/2012	1.21	0	0	1.212												
1/16/2012	1.35	0	0	1.347	8.4	57										
1/17/2012	1.12	0	0	1.115	8.4	58		200	1,860	230	2,139				24.5	228
1/18/2012	1.13	0	0	1.128	8.4	57										
1/19/2012	1.11	0	0	1.114	8.5	58		130	1,208	224	2,081				26.8	249
1/20/2012	1.11	0.003	0.001	1.108	8.5	57										
1/21/2012	1.20	0	0	1.201												
1/22/2012	1.31	0	0	1.311												
1/23/2012	1.33	0	0	1.33	8.3	56										
1/24/2012	1.22	0	0	1.218	8.4	58		200	2,032	228	2,316				22.8	232
1/25/2012	1.19	0	0	1.191	8.4	58										
1/26/2012	1.19	0	0	1.192	8.4	58		130	1,292	190	1,889				25.5	254
1/27/2012	1.16	0	0	1.163	8.4	57										
1/28/2012	1.26	0	0	1.264												
1/29/2012	1.33	0.003	0.001	1.329												
1/30/2012	1.42	0	0.01	1.412	8.4	58										
1/31/2012	1.43	0	0	1.425	8.2	58		110	1,307	232	2,757				20.7	246
Average Day	1.223	0.001	0.001	1.223	8.4	58	376	153	1544	215	2173	92	211	2086	24	243
Max. Day	1.425	0.023	0.015	1.425	8.5	60	376	200	2032	232	2757	92	211	2086	27	263
Min. Day	1.101	0.000	0.000	1.101	8.2	56	376	110	1047	190	1818	92	211	2086	21	220
Total	37.910	0.036	0.027	37.919					13,892		19,559			2,086		2,183
2/1/2012	1.40	0	0	1.403	8.2	58										
2/2/2012	1.33	0.002	0	1.332	8.3	57		120	1,333	188	2,088				22.5	250
2/3/2012	1.31	0	0	1.306	8.1	58										
2/4/2012	1.46	0	0	1.461												
2/5/2012	1.50	0	0	1.5												
2/6/2012	1.38	0	0	1.38	8.2	56										
2/7/2012	1.34	0	0	1.335	8.4	57	358	130	1,447	195	2,171				21.5	239
2/8/2012	1.28	0	0	1.282	8.3	56										
2/9/2012	1.30	0	0	1.299	8.3	57		120	1,300	186	2,015				24.4	264
2/10/2012	1.25	0	0	1.248	8.4	56										
2/11/2012	1.30	0	0	1.302												
2/12/2012	1.37	0.003	0	1.372												
2/13/2012	1.26	0	0	1.258	8	57										
2/14/2012	1.28	0	0	1.279	8.2	58		110	1,173	222	2,368	86.5	192	2,048	23.3	249
2/15/2012	1.33	0	0.001	1.33	8.4	57										
2/16/2012	1.28	0	0	1.281	8.4	57		170	1,816	214	2,286				24.2	259
2/17/2012	1.22	0	0	1.215	8.5	56										
2/18/2012	1.29	0.003	0	1.293												
2/19/2012	1.31	0	0	1.308												
2/20/2012	1.25	0	0	1.247												
2/21/2012	1.28	0.034	0.024	1.292	8.5	58		170	1,832	180	1,940				26.1	281
2/22/2012	1.15	0	0	1.152	8.4	57										
2/23/2012	1.29	0	0.008	1.286	8.5	57		190	2,038	199	2,134				28.4	305
2/24/2012	1.35	0.003	0.002	1.349	8.4	56										
2/25/2012	1.39	0	0	1.391												
2/26/2012	1.51	0	0.004	1.505												
2/27/2012	1.52	0	0	1.517	8.2	56										
2/28/2012	1.61	0.002	0.024	1.588	8.4	55		160	2,119	172	2,278				19.82	262
2/29/2012	1.79	0	0.001	1.786	8.3	55										
Average Day	1.356	0.002	0.002	1.355	8.3	57	358	146	1632	195	2160	87	192	2048	24	264
Max. Day	1.787	0.034	0.024	1.786	8.5	58	358	190	2119	222	2368	87	192	2048	28	305
Min. Day	1.152	0.000	0.000	1.152	8.0	55	358	110	1173	172	1940	87	192	2048	20	239
Total	39.314	0.047	0.064	39.297					13,059		17,281			2,048		2,109

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
3/1/2012	1.63	0	0	1.63	8.3	55		110	1,495	114	1,550				17.02	231
3/2/2012	1.60	0	0	1.596	8.3	54										
3/3/2012	1.64	0.003	0	1.641												
3/4/2012	1.63	0	0	1.633												
3/5/2012	1.62	0.001	0	1.621	8.1	56										
3/6/2012	1.52	0	0	1.521	8.3	56	338	130	1,649	175	2,220				18.49	235
3/7/2012	1.51	0	0.005	1.504	8.3	57										
3/8/2012	1.57	0.002	0	1.574	8.2	56		120	1,575	162	2,127				20.3	266
3/9/2012	1.47	0	0	1.467	8.3	54										
3/10/2012	1.45	0	0	1.446												
3/11/2012	1.49	0	0	1.493												
3/12/2012	1.75	0.003	0.002	1.746	8.1	56										
3/13/2012	1.41	0	0	1.405	8.1	55		130	1,523	161	1,887	83.2	134	1,570	17.82	209
3/14/2012	1.38	0	0	1.381	8.2	55										
3/15/2012	1.35	0	0	1.352	8.3	55		160	1,804	195	2,199				19.91	224
3/16/2012	1.32	0	0	1.324												
3/17/2012	1.33	0.003	0	1.337												
3/18/2012	1.41	0	0	1.414												
3/19/2012	1.41	0	0	1.413	8.3	58										
3/20/2012	1.35	0	0	1.351	8.3	58		190	2,141	187	2,107				21.6	243
3/21/2012	1.30	0	0	1.301	8.3	59										
3/22/2012	1.28	0	0	1.283	8.1	59		180	1,926	229	2,450				19.63	210
3/23/2012	1.27	0	0	1.269	8.3	57										
3/24/2012	1.32	0	0	1.316												
3/25/2012	1.38	0	0	1.383												
3/26/2012	1.29	0	0	1.294	8.3	58										
3/27/2012	1.27	0.003	0	1.27	8.2	59		140	1,483	234	2,478				21.8	231
3/28/2012	1.27	0	0	1.272	8.3	59										
3/29/2012	1.28	0	0.012	1.272	8.5	58		120	1,273	212	2,249				24.4	259
3/30/2012	1.30	0	0.002	1.295	8.2	58										
3/31/2012	1.32	0	0	1.318												
Average Day	1.423	0.000	0.001	1.423	8.3	57	338	142	1652	185	2141	83	134	1570	20	234
Max. Day	1.745	0.003	0.012	1.746	8.5	59	338	190	2141	234	2478	83	134	1570	24	266
Min. Day	1.267	0.000	0.000	1.269	8.1	54	338	110	1273	114	1550	83	134	1570	17	209
Total	44.128	0.015	0.021	44.122					14,870		19,266			1,570		2,109
4/1/2012	1.37	0	0	1.371												
4/2/2012	1.34	0	0	1.341	8.2	60										
4/3/2012	1.24	0.046	0.026	1.257	8.3	60	360	180	1,887	276	2,893				24	252
4/4/2012	1.17	0	0	1.165	8.4	59										
4/5/2012	1.18	0	0	1.183	8.3	59		170	1,677	190	1,875				24.3	240
4/6/2012	1.13	0	0	1.133												
4/7/2012	1.29	0	0	1.289												
4/8/2012	1.34	0	0	1.342												
4/9/2012	1.23	0	0	1.233	8.3	59										
4/10/2012	1.17	0	0	1.165	8.3	59		190	1,846	242	2,351	89.3	216	2,100	25.4	247
4/11/2012	1.19	0	0	1.19	8.3	60										
4/12/2012	1.14	0.003	0	1.141	8.4	60		220	2,094	214	2,036				25.9	246
4/13/2012	1.20	0	0.004	1.192	8.4	60										
4/14/2012	1.88	0.049	0.094	1.838												
4/15/2012	2.16	0	0.036	2.125												
4/16/2012	1.75	0	0	1.747	8.2	59										
4/17/2012	1.45	0	0	1.449	8.1	59		97	1,172	150	1,813				16.9	204
4/18/2012	1.42	0	0	1.421	8.1	60										
4/19/2012	1.64	0	0.022	1.619	8.3	61		140	1,890	153	2,066				20.4	275
4/20/2012	1.59	0.071	0.055	1.608	8.2	60										
4/21/2012	1.54	0	0	1.538												
4/22/2012	1.56	0	0	1.562												
4/23/2012	1.48	0	0	1.48	8.3	59										
4/24/2012	1.44	0	0	1.438	8.2	60		150	1,799	209	2,507				18.97	228
4/25/2012	1.41	0	0	1.405	8.1	61										
4/26/2012	1.26	0	0	1.262	8.3	61		160	1,684	189	1,989				21.3	224
4/27/2012	1.35	0	0	1.346	8.3	60										
4/28/2012	1.51	0	0	1.506												
4/29/2012	1.66	0	0	1.655												
4/30/2012	1.68	0	0	1.683	8.2	60										
Average Day	1.425	0.006	0.008	1.423	8.3	60	360	163	1756	203	2191	89	216	2100	22	239
Max. Day	2.161	0.071	0.094	2.125	8.4	61	360	220	2094	276	2893	89	216	2100	26	275
Min. Day	1.133	0.000	0.000	1.133	8.1	59	360	97	1172	150	1813	89	216	2100	17	204
Total	42.752	0.169	0.237	42.684					14,049		17,530			2,100		1,916

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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5/1/2012	1.43	0.024	0	1.456	7.9	60	330	140	1,700	169	2,052				16.75	203
5/2/2012	1.52	0.003	0	1.525	8.2	61										
5/3/2012	1.66	0	0.089	1.569	8.1	62		120	1,570	142	1,858				17.3	226
5/4/2012	1.54	0.002	0.003	1.536	8.3	62										
5/5/2012	1.49	0	0	1.489												
5/6/2012	1.53	0	0	1.527												
5/7/2012	1.45	0	0	1.448	8.3	61										
5/8/2012	1.39	0	0	1.387	8.3	61		100	1,157	269	3,112	92.9	250	2,891	20.8	241
5/9/2012	1.31	0	0	1.307	8.1	61										
5/10/2012	1.28	0	0	1.282	8.3	62		150	1,604	194	2,074				23.8	254
5/11/2012	1.24	0	0	1.239	8.3	63										
5/12/2012	1.31	0	0	1.31												
5/13/2012	1.31	0	0	1.306												
5/14/2012	1.33	0	0	1.334	8.3	62										
5/15/2012	1.25	0	0.001	1.253	8	63		180	1,881	243	2,539	92.9	226	2,359	23.3	243
5/16/2012	1.23	0	0.003	1.224	8.3	63										
5/17/2012	1.18	0	0	1.179	8.5	63		140	1,377	247	2,429				25.4	250
5/18/2012	1.15	0	0	1.152	8.3	63										
5/19/2012	1.20	0	0	1.198												
5/20/2012	1.27	0	0	1.268												
5/21/2012	1.25	0	0	1.249	8.3	64										
2/22/2012	1.32	0.003	0	1.323	8.3	63		200	2,207	221	2,438				26.1	288
5/23/2012	1.17	0	0	1.168	8.3	64										
5/24/2012	1.23	0	0	1.23	8.3	65		230	2,359	222	2,277				24.2	248
5/25/2012	1.11	0	0	1.107	8.4	64										
5/26/2012	1.12	0	0	1.121												
5/27/2012	1.10	0	0	1.098												
5/28/2012	1.19	0	0	1.193												
5/29/2012	1.17	0	0	1.17	8.2	65		200	1,952	232	2,264				27.2	265
5/30/2012	1.18	0	0	1.183	8.3	64										
5/31/2012	1.31	0.003	0.032	1.277	8.4	63		160	1,704	238	2,535				24.8	264
Average Day	1.297	0.001	0.004	1.294	8.3	63	330	162	1751	218	2358	93	238	2625	23	248
Max. Day	1.658	0.024	0.089	1.569	8.5	65	330	230	2359	269	3112	93	250	2891	27	288
Min. Day	1.098	0.000	0.000	1.098	7.9	60	330	100	1157	142	1858	93	226	2359	17	203
Total	40.201	0.035	0.128	40.108					17,510		23,579			5,250		2,484
6/1/2012	1.19	0	0	1.189	8.3	63										
6/2/2012	1.15	0	0	1.147												
6/3/2012	1.23	0	0	1.234												
6/4/2012	1.26	0	0	1.257	8	65										
6/5/2012	1.11	0.001	0	1.114	8.3	65	355	220	2,044	279	2,592	90	251	2,333	23.9	222
6/6/2012	1.13	0	0	1.129	8.3	65										
6/7/2012	1.11	0	0	1.112	8.2	65		210	1,948	257	2,383				27.7	257
6/8/2012	1.09	0	0	1.094	7.9	65										
6/9/2012	1.09	0	0	1.088												
6/10/2012	1.17	0	0	1.166												
6/11/2012	1.14	0.004	0	1.146	8.1	66										
6/12/2012	1.07	0	0	1.074	8.3	66		200	1,791	278	2,490				24	215
6/13/2012	1.15	0	0	1.148	8.3	65										
6/14/2012	1.09	0	0	1.09	8	65		230	2,091	240	2,182				25.2	229
6/15/2012	1.08	0	0.007	1.071	8.2	65										
6/16/2012	1.12	0	0.007	1.117												
6/17/2012	1.16	0	0	1.156												
6/18/2012	1.17	0	0	1.172	8.3	67										
6/19/2012	1.14	0	0	1.144	8.1	67		220	2,099	262	2,500				26.4	252
6/20/2012	1.17	0	0.002	1.165	8.3	67										
6/21/2012	1.11	0	0	1.114	7.9	67		180	1,672	236	2,193				25.8	240
6/22/2012	1.11	0	0	1.114	8.3	65										
6/23/2012	1.06	0	0	1.063												
6/24/2012	1.17	0	0	1.168												
6/25/2012	1.12	0	0	1.123	8	66										
6/26/2012	1.12	0.041	0.026	1.133	8.3	66		240	2,268	303	2,863				27.5	260
6/27/2012	1.11	0.012	0.005	1.116	8.2	67										
6/28/2012	1.12	0	0	1.118	8.3	68		230	2,145	244	2,275				26.2	244
6/29/2012	1.08	0	0	1.075	8.3	67										
6/30/2012	1.12	0.083	0.207	0.997												
Average Day	1.132	0.005	0.008	1.128	8.2	66	355	216	2007	262	2435	90	251	2333	26	240
Max. Day	1.257	0.083	0.207	1.257	8.3	68	355	240	2268	303	2863	90	251	2333	28	260
Min. Day	1.063	0.000	0.000	0.997	7.9	63	355	180	1672	236	2182	90	251	2333	24	215
Total	33.947	0.141	0.254	33.834					16,058		19,478			2,333		1,919

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

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7/1/2012	1.13	0	0	1.126												
7/2/2012	1.24	0	0	1.243	8.1	68										
7/3/2012	1.21	0.003	0	1.212	8.3	68	364	150	1,516	267	2,699	88.4	236	2,386	24.7	250
7/4/2012	1.04	0	0	1.043												
7/5/2012	1.09	0.015	0.006	1.099	8.1	68		195	1,787	289	2,649				29	266
7/6/2012	1.07	0.015	0.005	1.079	8.1	71										
7/7/2012	1.07	0	0	1.07												
7/8/2012	1.08	0	0	1.079												
7/9/2012	1.11	0	0	1.114	8	69										
7/10/2012	1.15	0	0	1.15	8.4	69		280	2,685	260	2,494				28.2	270
7/11/2012	1.19	0	0	1.186	8	69										
7/12/2012	1.11	0	0	1.105	8.3	69		270	2,488	305	2,811				32.7	301
7/13/2012	1.02	0	0	1.02	8.2	68										
7/14/2012	1.05	0	0	1.046												
7/15/2012	1.14	0	0	1.142												
7/16/2012	1.14	0	0	1.144	8.3	70										
7/17/2012	1.09	0	0	1.086	8.4	69		160	1,449	356	3,224				26.9	244
7/18/2012	1.15	0	0	1.146												
7/19/2012	1.18	0.003	0	1.179	8.4	70		190	1,868	241	2,370				27.7	272
7/20/2012	1.08	0	0	1.084	7.9	68										
7/21/2012	1.00	0	0	1.001												
7/22/2012	1.07	0	0	1.07												
7/23/2012	1.14	0	0	1.139	8	70										
7/24/2012	1.11	0.017	0.005	1.125	8.3	70		240	2,252	343	3,218				26.2	246
7/25/2012	1.04	0	0.01	1.029	8.1	69										
7/26/2012	1.03	0	0	1.03	8.3	69		250	2,148	229	1,967				27	232
7/27/2012	1.06	0	0	1.056	7.6	73										
7/28/2012	1.05	0	0	1.05												
7/29/2012	1.10	0	0.001	1.094												
7/30/2012	1.22	0	0	1.218	7.5	72										
7/31/2012	1.06	0.002	0	1.062	8.3	71		220	1,949	231	2,046				26.3	233
Average Day	1.103	0.002	0.001	1.104	8.1	70	364	217	2016	280	2609	88	236	2386	28	257
Max. Day	1.243	0.017	0.010	1.243	8.4	73	364	280	2685	356	3224	88	236	2386	33	301
Min. Day	1.001	0.000	0.000	1.001	7.5	68	364	150	1449	229	1967	88	236	2386	25	232
Total	34.199	0.055	0.027	34.227					18,143		23,478			2,386		2,314
8/1/2012	1.04	0	0	1.043	8	71										
8/2/2012	1.04	0	0	1.036	8.2	70		240	2,074	268	2,316				32.4	280
8/3/2012	1.01	0	0	1.009	8.2	71										
8/4/2012	1.13	0	0.044	1.086												
8/5/2012	1.12	0	0	1.119												
8/6/2012	1.19	0	0	1.193	8.2	71										
8/7/2012	1.03	0.031	0.017	1.043	8.3	70	363	160	1,392	127	1,105	88.2	112	974	28.2	245
8/8/2012	1.16	0	0.005	1.151	8.3	71										
8/9/2012	1.07	0	0	1.074	8.3	71		220	1,971	278	2,490				32.9	295
8/10/2012	1.01	0	0	1.012	8	70										
8/11/2012	1.02	0	0	1.015												
8/12/2012	1.19	0	0.024	1.161												
8/13/2012	1.26	0	0.004	1.259	8.1	70										
8/14/2012	1.16	0.028	0.018	1.169	7.9	70		180	1,755	196	1,911				26.4	257
8/15/2012	1.16	0	0.001	1.155	8.2	70		170	1,638	296	2,851				28.8	277
8/16/2012	1.26	0	0.027	1.23	8.2	69										
8/17/2012	1.09	0	0	1.085	8.3	71										
8/18/2012	1.12	0	0	1.117												
8/19/2012	1.17	0	0	1.166												
8/20/2012	1.22	0	0	1.222	8.2	71										
8/21/2012	1.18	0	0	1.175	8.2	71		210	2,058	145	1,421				27.4	269
8/22/2012	1.08	0	0	1.079	8.3	70										
8/23/2012	1.06	0	0	1.064	8.1	68		160	1,420	156	1,384				29	257
8/24/2012	1.06	0	0	1.055	8	71										
8/25/2012	1.08	0	0	1.081												
8/26/2012	1.30	0	0.029	1.275												
8/27/2012	1.21	0.002	0	1.213	7.9	72										
8/28/2012	1.19	0.001	0	1.189	8.1	72		190	1,884	202	2,003				25.3	251
8/29/2012	1.11	0	0	1.106	8.2	72										
8/30/2012	1.14	0	0	1.138	8.1	72		160	1,519	184	1,746				27.9	265
8/31/2012	1.07	0	0	1.069	8	71										
Average Day	1.126	0.002	0.005	1.122	8.1	71	363	188	1745	206	1914	88	112	974	29	266
Max. Day	1.304	0.031	0.044	1.275	8.3	72	363	240	2074	296	2851	88	112	974	33	295
Min. Day	1.009	0.000	0.000	1.009	7.9	68	363	160	1392	127	1105	88	112	974	25	245
Total	34.896	0.062	0.169	34.789					15,709		17,227			974		2,396

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Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
9/1/2012	0.99	0	0	0.99												
9/2/2012	1.01	0	0	1.011												
9/3/2012	1.16	0	0	1.159												
9/4/2012	1.21	0	0.014	1.193	8.1	71		270	2,686	255	2,537				31.3	311
9/5/2012	1.25	0	0.017	1.228	8	72										
9/6/2012	1.16	0	0.019	1.141	8.3	71	312	190	1,808	216	2,055				25.6	244
9/7/2012	1.28	0.003	0.021	1.263	8.3	70										
9/8/2012	1.18	0	0	1.178												
9/9/2012	1.27	0	0	1.265												
9/10/2012	1.19	0	0	1.194	8.2	70										
9/11/2012	1.27	0.027	0.011	1.281	8.3	71		260	2,778	220	2,350	88.6	195	2,082		
9/12/2012	1.14	0	0	1.139	8.3	71									16.79	159
9/13/2012	1.11	0	0	1.109	8	71		160	1,480	189	1,748				22.4	207
9/14/2012	1.07	0	0	1.068	8.4	70										
9/15/2012	1.08	0	0	1.084												
9/16/2012	1.20	0	0	1.197												
9/17/2012	1.33	0	0	1.326	8.3	71										
9/18/2012	1.06	0.019	0	1.079	8.3	70		150	1,350	221	1,989				26.2	236
9/19/2012	1.08	0	0.008	1.069	8.4	70										
9/20/2012	1.06	0	0	1.063	8.3	70		210	1,862	264	2,340				28.2	250
9/21/2012	1.03	0	0	1.033	8.2	69										
9/22/2012	1.07	0	0	1.071												
9/23/2012	1.18	0	0	1.184												
9/24/2012	1.20	0	0	1.196	8.4	69										
9/25/2012	1.03	0	0	1.031	8.4	70		150	1,290	222	1,909				28.2	242
9/26/2012	1.05	0	0	1.047	8.4	70										
9/27/2012	1.52	0	0	1.52	8.5	69		220	2,789	292	3,702				28.9	366
9/28/2012	1.05	0	0	1.052	8.4	70										
9/29/2012	1.06	0	0	1.064												
9/30/2012	1.18	0	0	1.179												
Average Day	1.149	0.002	0.003	1.147	8.3	70	312	201	2005	235	2329	89	195	2082	26	252
Max. Day	1.520	0.027	0.021	1.520	8.5	72	312	270	2789	292	3702	89	195	2082	31	366
Min. Day	0.990	0.000	0.000	0.990	8.0	69	312	150	1290	189	1748	89	195	2082	17	159
Total	34.455	0.049	0.090	34.414					16,042		18,631			2,082		2,016
10/1/2012	1.148	0	0	1.148	8.1	69.										
10/2/2012	1.026	0	0	1.026	8.4	70.	404	210.	1,797	257.	2,199				23.00	197
10/3/2012	1.027	0	0	1.027	8.4	69.										
10/4/2012	0.991	0	0	0.991	8.4	69.		200.	1,653	230.	1,901				26.60	220
10/5/2012	0.969	0	0	0.969	8.5	69.										
10/6/2012	1.019	0	0	1.019												
10/7/2012	1.147	0	0	1.147												
10/8/2012	1.136	0	0	1.136	8.4	68.										
10/9/2012	1.010	0	0	1.010	8.3	69.		220.	1,853	259.	2,182	90.3	234	1,970	29.30	247
10/10/2012	0.993	0	0	0.993	8.4	68.										
10/11/2012	0.995	0	0	0.995	8.5	69.		250.	2,075	286.	2,373				30.80	256
10/12/2012	0.987	0	0	0.987	8.1	68.										
10/13/2012	1.178	0	0.036	1.142												
10/14/2012	1.407	0.002	0.029	1.380												
10/15/2012	1.245	0	0	1.245	8.4	67.										
10/16/2012	1.091	0	0	1.091	8.	68.		240.	2,184	308.	2,802				24.20	220
10/17/2012	1.085	0	0	1.084	8.4	69.										
10/18/2012	1.170	0	0	1.167	8.3	68.		180.	1,752	259.	2,521				29.90	291
10/19/2012	1.144	0	0	1.144	8.3	69.										
10/20/2012	1.183	0	0	1.183												
10/21/2012	1.216	0	0	1.216												
10/22/2012	1.337	0	0.031	1.306	8.2	69.										
10/23/2012	1.337	0	0.012	1.325	8.1	68.		230.	2,542	221.	2,442				25.60	283
10/24/2012	1.156	0	0	1.156	8.1	68.										
10/25/2012	1.152	0.002	0	1.154	8.	69.		200.	1,925	220.	2,117				19.50	188
10/26/2012	1.092	0	0	1.092	8.2	66.										
10/27/2012	1.143	0	0	1.143												
10/28/2012	1.185	0	0	1.185												
10/29/2012	1.135	0	0	1.135	8.3	67.										
10/30/2012	1.061	0.032	0	1.093	8.4	67.		130.	1,185	244.	2,224				25.00	228
10/31/2012	1.026	0	0	1.026	8.4	66.										
Average Day	1.122	0.001	0.004	1.120	8.3	68	404	207	1885	254	2307	90	234	1970	26	237
Max. Day	1.407	0.032	0.036	1.380	8.5	70	404	250	2542	308	2802	90	234	1970	31	291
Min. Day	0.969	0.000	0.000	0.969	8.0	66	404	130	1185	220	1901	90	234	1970	20	188
Total	34.791	0.036	0.112	34.715					16,965		20,762			1,970		2,129

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11/1/2012	1.11	0	0.02	1.094	8.3	65		190	1,734	224	2,044				25.6	234
11/2/2012	1.02	0.001	0	1.024	8.4	67										
11/3/2012	1.09	0	0	1.089												
11/4/2012	1.17	0	0	1.172												
11/5/2012	1.14	0	0	1.137	8.1	65										
11/6/2012	1.08	0	0.005	1.071	8.2	68	406	190	1,697	193	1,724				24.9	222
11/7/2012	1.06	0	0	1.055	8.4	66										
11/8/2012	1.03	0	0	1.034	8.1	66		150	1,294	152	1,311				25.9	223
11/9/2012	1.04	0	0	1.036	8.4	66										
11/10/2012	1.10	0	0	1.099												
11/11/2012	1.81	0	0.063	1.745												
11/12/2012	1.64	0	0	1.641	8.2	65										
11/13/2012	1.22	0	0	1.223	8.5	65		150	1,530	161	1,642	87.6	141	1,439	21.9	223
11/14/2012	1.20	0.002	0	1.203	8.3	65										
11/15/2012	1.14	0	0	1.142	8.4	65		190	1,810	157	1,495				21.6	206
11/16/2012	1.10	0	0	1.1	8.5	64										
11/17/2012	1.19	0	0	1.191												
11/18/2012	1.29	0	0	1.288												
11/19/2012	1.26	0	0.001	1.26	8.4	65										
11/20/2012	1.20	0	0	1.198	8.5	65		250	2,498	249	2,488				23.4	234
11/21/2012	1.22	0	0	1.218	8.4	64		250	2,540	271	2,753				24.3	247
11/22/2012	1.06	0	0	1.064												
11/23/2012	1.04	0	0	1.038												
11/24/2012	1.07	0	0	1.071												
11/25/2012	1.19	0	0	1.191												
11/26/2012	1.14	0	0	1.14	7.9	63										
11/27/2012	1.11	0.003	0	1.116	8.3	63		180	1,675	286	2,662				28.2	262
11/28/2012	1.05	0	0	1.052	8.3	64										
11/29/2012	1.06	0	0	1.056	8.4	63		120	1,057	202	1,779				22.4	197
11/30/2012	1.02	0	0	1.016	8.3	64										
Average Day	1.162	0.000	0.003	1.159	8.3	65	406	186	1759	211	1989	88	141	1439	24	228
Max. Day	1.808	0.003	0.063	1.745	8.5	68	406	250	2540	286	2753	88	141	1439	28	262
Min. Day	1.016	0.000	0.000	1.016	7.9	63	406	120	1057	152	1311	88	141	1439	22	197
Total	34.847	0.006	0.089	34.764					15,833		17,898			1,439		2,049
12/1/2012	1.11	0	0	1.109												
12/2/2012	1.26	0	0	1.259												
12/3/2012	1.23	0	0	1.229	8.3	65										
12/4/2012	1.03	0	0	1.026	8.5	64	384	240	2,054	253	2,165				27.9	239
12/5/2012	1.04	0	0	1.038	8.4	64										
12/6/2012	1.05	0	0	1.05	8.4	64		260	2,277	238	2,084				28.1	246
12/7/2012	1.10	0	0	1.096	8.3	64										
12/8/2012	1.10	0	0	1.098												
12/9/2012	1.21	0	0	1.208												
12/10/2012	1.28	0	0	1.277	8.4	62										
12/11/2012	1.06	0.033	0.021	1.071	8.5	62		170	1,518	180	1,608	89.4	161	1,437	24.7	221
12/12/2012	1.04	0	0	1.044	8.3	63										
12/13/2012	1.05	0	0	1.046	8.5	63		280	2,443	260	2,268				19.77	172
12/14/2012	1.04	0	0.005	1.038	8.3	62										
12/15/2012	1.17	0	0.004	1.164												
12/16/2012	1.20	0	0	1.204												
12/17/2012	1.20	0	0	1.199	8.4	63										
12/18/2012	1.07	0	0	1.072	8.5	62		170	1,520	194	1,734				29.4	263
12/19/2012	1.07	0	0.001	1.068	8.4	63										
12/20/2012	1.22	0	0	1.216	8.2	59		167	1,694	164	1,663				29.2	296
12/21/2012	1.16	0.012	0.008	1.163												
12/22/2012	1.11	0	0	1.113												
12/23/2012	1.08	0	0	1.078												
12/24/2012	1.01	0	0	1.011												
12/25/2012	0.95	0	0	0.954												
12/26/2012	1.17	0	0	1.171	8.4	59		330	3,223	304	2,969				31.2	305
12/27/2012	1.08	0.028	0.021	1.087	8.5	55		220	1,994	238	2,158				25.3	229
12/28/2012	1.06	0.012	0.009	1.067	8.4	60										
12/29/2012	1.07	0	0	1.065												
12/30/2012	1.11	0	0	1.108												
12/31/2012	1.12	0	0	1.117												
Average Day	1.111	0.003	0.002	1.111	8.4	62	384	230	2090	229	2081	89	161	1437	27	246
Max. Day	1.277	0.033	0.021	1.277	8.5	65	384	330	3223	304	2969	89	161	1437	31	305
Min. Day	0.954	0.000	0.000	0.954	8.2	55	384	167	1518	164	1608	89	161	1437	20	172
Total	34.430	0.085	0.069	34.446					16,722		16,649			1,437		1,971

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1/1/2013	1.119	0	0	1.119												
1/2/2013	1.233	0	0	1.233	8.5	59		190	1,954	178	1,830				30.3	312
1/3/2013	1.073	0	0	1.073	8.4	60	377	200	1,790	247	2,210				27.8	249
1/4/2013	1.043	0	0	1.043	8.5	61										
1/5/2013	1.131	0.002	0.001	1.132												
1/6/2013	1.174	0	0	1.174												
1/7/2013	1.201	0	0	1.201	8.5	60										
1/8/2013	1.224	0	0	1.224	8.2	60		250	2,552	250	2,552	86.4	216	2,205	30.5	311
1/9/2013	1.258	0	0	1.258	8.3	60										
1/10/2013	1.020	0	0	1.02	8.4	60		200	1,701	271	2,305				28.1	239
1/11/2013	1.155	0.014	0.046	1.123	8.2	59										
1/12/2013	1.382	0.003	0	1.385												
1/13/2013	1.363	0	0	1.363												
1/14/2013	1.253	0	0	1.253	8.3	56										
1/15/2013	1.139	0	0	1.139	8.5	59		180	1,710	246	2,337				24	228
1/16/2013	1.114	0	0	1.114	8.5	59										
1/17/2013	1.139	0	0	1.139	8.5	59		180	1,710	145	1,377				26.4	251
1/18/2013	1.124	0	0	1.124	8.5	59										
1/19/2013	1.144	0	0	1.144												
1/20/2013	1.187	0.002	0	1.189												
1/21/2013	1.266	0	0	1.266	8.5	56										
1/22/2013	1.112	0.047	0.035	1.124	8.8	58		220	2,062	290	2,719				28.6	268
1/23/2013	1.070	0	0	1.07	8.4	59										
1/24/2013	1.064	0.3	0.236	1.128	8.6	58		210	1,976	293	2,756				28.4	267
1/25/2013	1.031	0	0.012	1.019	8.5	57										
1/26/2013	1.145	0	0	1.145												
1/27/2013	1.297	0	0.001	1.296												
1/28/2013	1.274	0	0	1.274	8.5	57										
1/29/2013	1.494	0	0.01	1.484	8.2	55		220	2,723	244	3,020				24.4	302
1/30/2013	1.390	0.024	0.015	1.399	8.3	55										
1/31/2013	1.254	0	0	1.254	8.2	57		190	1,987	256	2,677				22.6	236
Average Day	1.189	0.013	0.011	1.191	8.4	58	377	204	2016	242	2378	86	216	2205	27	266
Max. Day	1.494	0.300	0.236	1.484	8.8	61	377	250	2723	293	3020	86	216	2205	31	312
Min. Day	1.020	0.000	0.000	1.019	8.2	55	377	180	1701	145	1377	86	216	2205	23	228
Total	36.873	0.392	0.356	36.909					20,165		23,784			2,205		2,663
2/1/2013	1.181	0	0	1.181	8.4	56.										
2/2/2013	1.242	0	0	1.242												
2/3/2013	1.287	0	0	1.287												
2/4/2013	1.271	0	0	1.271	8.4	58.										
2/5/2013	1.215	0	0	1.215	8.5	57.	366	220.	2,229	234.	2,371	89.3	209	2,117	23.8	241
2/6/2013	1.245	0	0.003	1.242	8.3	57.										
2/7/2013	1.864	0	0.027	1.837	8.2	56.		200.	3,064	265.	4,060				26.8	411
2/8/2013	1.462	0	0	1.462												
2/9/2013	1.467	0.003	0.002	1.468												
2/10/2013	2.179	0	0.026	2.153												
2/11/2013	1.573	0	0	1.573	8.3	55.										
2/12/2013	1.458	0	0	1.458	8.3	55.		150.	1,824	139.	1,690				21.1	257
2/13/2013	1.504	0	0	1.504	8.4	56.										
2/14/2013	1.357	0	0	1.357	8.4	57.		110.	1,245	187.	2,116				21.3	241
2/15/2013	1.307	0	0	1.307	8.4	56.										
2/16/2013	1.335	0	0	1.335												
2/17/2013	1.343	0	0	1.343												
2/18/2013	1.299	0	0	1.299												
2/19/2013	1.324	0.002	0.001	1.325	8.3	56.		190.	2,100	259.	2,862				26.5	293
2/20/2013	1.177	0	0	1.177	8.4	56.										
2/21/2013	1.173	0	0	1.173	8.6	56.		170.	1,663	248.	2,426				31.6	309
2/22/2013	1.162	0	0	1.162	8.4	55.										
2/23/2013	1.206	0	0	1.206												
2/24/2013	1.245	0	0	1.245												
2/25/2013	1.184	0	0	1.184	8.4	56.										
2/26/2013	1.274	0	0	1.274	8.4	56.		200.	2,125	211.	2,242				27.9	296
2/27/2013	1.157	0	0	1.157	8.4	56.										
2/28/2013	1.167	0	0	1.167	8.3	57.		170.	1,655	161.	1,567				26.7	260
Average Day	1.345	0.000	0.002	1.343	8.4	56	366	176	1988	213	2417	89	209	2117	26	288
Max. Day	2.179	0.003	0.027	2.153	8.6	58	366	220	3064	265	4060	89	209	2117	32	411
Min. Day	1.157	0.000	0.000	1.157	8.2	55	366	110	1245	139	1567	89	209	2117	21	241
Total	37.658	0.005	0.059	37.604					15,905		19,335			2,117		2,308

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
3/1/2013	1.200	0	0	1.200												
3/2/2013	1.273	0	0	1.273												
3/3/2013	1.356	0	0	1.356												
3/4/2013	1.387	0	0	1.387	8.4	56	333									
3/5/2013	1.242	0	0.002	1.245	8.4	56		200	2,077	216	2,243	88.4	191	1,983	23.30	242
3/6/2013	1.170	0	0.018	1.182	8.1	56										
3/7/2013	1.169	0	0	1.169	8.2	56		220	2,145	212	2,067				23.80	232
3/8/2013	1.181	0	0.001	1.180												
3/9/2013	2.954	0.058	0.101	2.911												
3/10/2013	3.321	0.106	0.142	3.285												
3/11/2013	2.365	0.118	0.129	2.354	7.9	51										
3/12/2013	1.812	0.006	0.004	1.814	8.1	53		120	1,815	115	1,740				9.86	149
3/13/2013	1.657	0	0	1.657	8	54										
3/14/2013	1.584	0.003	0	1.587	8.2	54		170	2,250	165	2,184				16.29	216
3/15/2013	1.533	0	0	1.533												
3/16/2013	1.476	0	0	1.476												
3/17/2013	1.471	0	0	1.471												
3/18/2013	1.449	0	0	1.449	8.3	53										
3/19/2013	1.372	0	0	1.372	7.9	50		220	2,517	201	2,300				17.42	199
3/20/2013	1.295	0	0	1.295	8.3	53										
3/21/2013	1.347	0	0	1.347	8.3	53		180	2,022	188	2,112				16.94	190
3/22/2013	1.250	0	0	1.250	8	53										
3/23/2013	1.290	0	0	1.290												
3/24/2013	1.414	0	0	1.414												
3/25/2013	1.427	0.002	0.001	1.428	8.4	55										
3/26/2013	1.376	0	0	1.376	8.3	54		230	2,639	229	2,628				19.82	227
3/27/2013	1.354	0	0	1.354	8.3	55										
3/28/2013	1.348	0	0	1.348	8.3	55		140	1,574	171	1,922				25.00	281
3/29/2013	1.341	0	0	1.341												
3/30/2013	1.379	0	0	1.379												
3/31/2013	1.350	0	0	1.350												
Average Day	1.521	0.011	0.013	1.518	8.2	54	333	185	2130	187	2149	88	191	1983	19	217
Max. Day	3.321	0.118	0.142	3.285	8.4	56	333	230	2639	229	2628	88	191	1983	25	281
Min. Day	1.169	0.000	0.000	1.169	7.9	50	333	120	1574	115	1740	88	191	1983	10	149
Total	47.143	0.328	0.398	47.073					17,040		17,196			1,983		1,737
4/1/2013	1.518	0.000	0.000	1.518	8.3	55										
4/2/2013	1.301	0.000	0.000	1.301	8.4	55	416	170	1,845	355	3,852	40.0	142	1,541	16.63	180
4/3/2013	1.234	0.000	0.000	1.234	8.4	56										
4/4/2013	1.215	0.000	0.000	1.215	8.4	56		160	1,621	214	2,168				20.00	203
4/5/2013	1.239	0.000	0.000	1.239	8.4	57										
4/6/2013	1.289	0.000	0.000	1.289												
4/7/2013	1.393	0.000	0.012	1.381												
4/8/2013	1.935	0.003	0.036	1.902	8.2	55										
4/9/2013	2.427	0.036	0.006	2.457	8.0	55		130	2,664	156	3,197				15.07	309
4/10/2013	3.751	0.089	0.120	3.720	7.8	52										
4/11/2013	2.869	0.000	0.001	2.868	8.1	53		71	1,698	106	2,535				5.60	134
4/12/2013	2.390	0.006	0.070	2.326	8.0	54										
4/13/2013	2.046	0.000	0.000	2.046												
4/14/2013	2.170	0.000	0.015	2.155												
4/15/2013	2.229	0.003	0.000	2.232	8.0	55										
4/16/2013	1.929	0.096	0.078	1.947	8.1	57		110	1,786	121	1,965				12.39	201
4/17/2013	3.995	3.941	0.021	7.915	8.0	55										
4/18/2013	4.009	0.745	0.081	4.673	7.7	50		29	1,130	131	5,105				5.14	200
4/19/2013	4.195	0.327	1.365	3.157	7.8	50										
4/20/2013	4.030	0.150	1.491	2.689												
4/21/2013	3.563	0.053	1.277	2.339												
4/22/2013	2.032	0.139	0.169	2.002	7.9	55										
4/23/2013	1.783	0.001	0.002	1.782	8.1	55		120	1,783	135	2,006				10.72	159
4/24/2013	1.676	0.000	0.000	1.676	8.1	55										
4/25/2013	1.603	0.002	0.000	1.605	8.1	56		180	2,409	161	2,155				14.62	196
4/26/2013	1.574	0.000	0.000	1.574	8.1	57										
4/27/2013	1.540	0.002	0.000	1.542												
4/28/2013	1.609	0.000	0.000	1.609												
4/29/2013	1.647	0.000	0.000	1.647	8.2	58										
4/30/2013	1.512	0.000	0.000	1.512	8.2	59		160	2,018	209	2,636				15.60	197
Average Day	2.190	0.186	0.158	2.218	8.1	55	416	126	1884	176	2847	40	142	1541	13	198
Max. Day	4.195	3.941	1.491	7.915	8.4	59	416	180	2664	355	5105	40	142	1541	20	309
Min. Day	1.215	0.000	0.000	1.215	7.7	50	416	29	1130	106	1965	40	142	1541	5	134
Total	65.703	5.593	4.744	66.552					16,955		25,620			1,541		1,779

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
5/1/2013	1.425	0.001	0.000	1.426	8.3	58										
5/2/2013	1.443	0.000	0.006	1.437	8.2	56	369	190	2,277	179	2,145				21.90	262
5/3/2013	2.833	0.146	0.068	2.911	8.1	56										
5/4/2013	3.685	0.043	0.130	3.598												
5/5/2013	2.938	0.003	0.082	2.859												
5/6/2013	2.201	0.002	0.000	2.203	7.9	56										
5/7/2013	2.048	0.001	0.000	2.049	8.0	56		100	1,709	128	2,187	87.5	112	1,914	12.39	212
5/8/2013	1.810	0.000	0.000	1.810												
5/9/2013	1.775	0.002	0.000	1.777	7.4	58		140	2,075	178	2,638				16.41	243
5/10/2013	1.633	0.002	0.000	1.635	8.1	57										
5/11/2013	1.634	0.000	0.000	1.634												
5/12/2013	1.630	0.001	0.000	1.631												
5/13/2013	1.660	0.002	0.000	1.662	8.2	58										
5/14/2013	1.621	0.000	0.000	1.621	8.2	58		130	1,757	240	3,245				18.75	253
5/15/2013	1.430	0.000	0.000	1.430	8.2	60										
5/16/2013	1.446	0.001	0.000	1.447	8.2	58		150	1,810	198	2,389				19.14	231
5/17/2013	1.353	0.000	0.000	1.353	8.2	59										
5/18/2013	1.379	0.002	0.000	1.381												
5/19/2013	1.486	0.003	0.009	1.480												
5/20/2013	1.494	0.001	0.000	1.495	8.1	61										
5/21/2013	1.314	0.020	0.012	1.322	8.3	60		180	1,985	220	2,426				22.50	248
5/22/2013	1.318	0.000	0.000	1.318	8.0	61										
5/23/2013	1.302	0.057	0.042	1.317	8.3	60		240	2,636	315	3,460				25.10	276
5/24/2013	1.293	0.000	0.003	1.290	8.3	60										
5/25/2013	1.635	0.000	0.036	1.599												
5/26/2013	2.854	0.097	0.134	2.817												
5/27/2013	2.554	0.001	0.037	2.518												
5/28/2013	2.233	0.051	0.039	2.245	7.9	60										
5/29/2013	1.927	0.000	0.000	1.927	8.0	62		70	1,125	171	2,748				13.68	220
5/30/2013	1.797	0.002	0.001	1.798	8.1	61		85	1,275	119	1,784				13.55	203
5/31/2013	1.673	0.059	0.043	1.689	8.1	61										
Average Day	1.833	0.016	0.021	1.828	8.1	59	369	143	1850	194	2558	88	112	1914	18	239
Max. Day	3.685	0.146	0.134	3.598	8.3	62	369	240	2636	315	3460	88	112	1914	25	276
Min. Day	1.293	0.000	0.000	1.290	7.4	56	369	70	1125	119	1784	88	112	1914	12	203
Total	56.824	0.497	0.642	56.679					16,649		23,023			1,914		2,149
6/1/2013	1.608	0.000	0.000	1.608												
6/2/2013	1.631	0.000	0.000	1.631												
6/3/2013	1.578	0.000	0.000	1.578	8.1	61										
6/4/2013	1.451	0.001	0.000	1.452	8.2	60										
6/5/2013	1.459	0.000	0.000	1.459	8.0	63	364	150	1,825	161	1,959	88.2	142	1,728	18.54	226
6/6/2013	1.426	0.000	0.000	1.426	8.2	61		150	1,784	197	2,343				19.05	227
6/7/2013	1.389	0.000	0.000	1.389	8.2	60										
6/8/2013	1.336	0.002	0.000	1.338												
6/9/2013	1.420	0.000	0.000	1.420												
6/10/2013	1.445	0.000	0.000	1.445	8.1	61										
6/11/2013	1.359	0.000	0.000	1.359	8.2	63		230	2,607	238	2,698				14.26	162
6/12/2013	1.311	0.000	0.000	1.311	8.0	63										
6/13/2013	1.276	0.000	0.000	1.276	8.3	63		180	1,916	133	1,415				21.30	227
6/14/2013	1.244	0.036	0.028	1.252	8.1	67										
6/15/2013	1.300	0.000	0.000	1.300												
6/16/2013	1.323	0.000	0.000	1.323												
6/17/2013	1.325	0.002	0.000	1.327	8.1	60										
6/18/2013	1.261	0.000	0.000	1.261	8.1	60										
6/19/2013	1.261	0.000	0.000	1.261	8.2	64		180	1,893	229	2,408				17.22	181
6/20/2013	1.342	0.000	0.000	1.342	8.2	64		190	2,127	245	2,742				20.00	224
6/21/2013	1.281	0.000	0.000	1.281	8.4	64										
6/22/2013	1.220	0.000	0.000	1.220												
6/23/2013	1.305	0.000	0.000	1.305												
6/24/2013	2.094	0.000	0.067	2.027	8.1	66										
6/25/2013	2.009	0.036	0.019	2.026	7.9	64		120	2,028	170	2,872				39.00	659
6/26/2013	2.322	0.000	0.000	2.322	7.7	64										
6/27/2013	1.801	0.000	0.000	1.801	8.0	63		61	916	107	1,607				9.31	140
6/28/2013	1.658	0.000	0.000	1.658	7.9	64										
6/29/2013	1.667	0.000	0.006	1.661												
6/30/2013	1.628	0.001	0.000	1.629												
Average Day	1.491	0.003	0.004	1.490	8.1	63	364	158	1887	185	2256	88	142	1728	20	256
Max. Day	2.322	0.036	0.067	2.322	8.4	67	364	230	2607	245	2872	88	142	1728	39	659
Min. Day	1.220	0.000	0.000	1.220	7.7	60	364	61	916	107	1415	88	142	1728	9	140
Total	44.730	0.078	0.120	44.688					15,095		18,045			1,728		2,044

NORTH LIBERTY WWTP -- PLANT OPERATING DATA

Date	Processed Flow MGD	EQ Pumped MGD	EQ Returned MGD	Raw Influent Flow MGD	Influent pH	Influent Temp F.	Influent Alkalinity (mg/L as CaCO3)	Influent CBOD5 (mg/L)	Influent CBOD5 (lbs/d)	Influent TSS (mg/L)	Influent TSS (lbs/d)	Influent VSS (%)	Influent VSS (mg/L)	Influent VSS (lb/d)	Influent NH3-N (mg/L)	Influent NH3-N (lbs/d)
7/1/2013	1.575	0.000	0.000	1.575	7.7	64										
7/2/2013	1.483	0.000	0.000	1.483	8.0	65	355	130	1,608	176	2,177	86.9	153	1,892	14.93	185
7/3/2013	1.371	0.000	0.000	1.371	8.2	64		160	1,829	183	2,092				17.1	196
7/4/2013	1.300	0.000	0.000	1.300												
7/5/2013	1.296	0.000	0.000	1.296	8.2	63										
7/6/2013	1.293	0.000	0.000	1.293												
7/7/2013	1.400	0.000	0.000	1.400												
7/8/2013	1.534	0.001	0.000	1.535	8.2	66										
7/9/2013	1.421	0.000	0.011	1.410	8.0	66		170	1,999	280	3,293				18.88	222
7/10/2013	1.342	0.004	0.000	1.346	8.1	70										
7/11/2013	1.270	0.000	0.000	1.270	8.0	66		190	2,012	264	2,796				15.74	167
7/12/2013	1.248	0.000	0.000	1.248	8.3	65										
7/13/2013	1.305	0.000	0.000	1.305												
7/14/2013	1.338	0.000	0.000	1.338												
7/15/2013	1.460	0.000	0.000	1.460	8.1	67										
7/16/2013	1.278	0.000	0.000	1.278	8.2	69		220	2,345	229	2,441				21.0	224
7/17/2013	1.237	0.001	0.000	1.238	8.3	68										
7/18/2013	1.364	0.000	0.000	1.364	8.0	68		180	2,048	233	2,651				22.8	259
7/19/2013	1.209	0.000	0.000	1.209	7.8	68										
7/20/2013	1.176	0.000	0.000	1.176												
7/21/2013	1.268	0.000	0.000	1.268												
7/22/2013	1.337	0.000	0.000	1.337	8.1	65										
7/23/2013	1.168	0.000	0.000	1.168	8.2	64		200	1,948	233	2,270				21.70	211
7/24/2013	1.197	0.000	0.000	1.197	8.1	67										
7/25/2013	1.378	0.000	0.000	1.378	8.2	68		300	3,448	224	2,574				22.10	254
7/26/2013	1.555	0.000	0.000	1.555	8.0	67										
7/27/2013	1.364	0.000	0.000	1.364												
7/28/2013	1.394	0.000	0.000	1.394												
7/29/2013	1.366	0.000	0.000	1.366	8.0	64										
7/30/2013	1.309	0.000	0.055	1.254	8.1	65										
7/31/2013	1.259	0.039	0.030	1.268	8.1	66		190	2,009	183	1,935				24.40	258
Average Day	1.339	0.001	0.003	1.337	8.1	66	355	193	2139	223	2470	87	153	1892	20	220
Max. Day	1.575	0.039	0.055	1.575	8.3	70	355	300	3448	280	3293	87	153	1892	24	259
Min. Day	1.168	0.000	0.000	1.168	7.7	63	355	130	1608	176	1935	87	153	1892	15	167
Total	41.495	0.045	0.096	41.444					19,247		22,229			1,892		1,976

APPENDIX C

ACTIVATED SLUDGE MODEL

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements
2489-11A.300

Date: 10/19/12
Revised: 9/28/2013

Model Calibration: June 9, 2011 -- including denit. & membrane aer. credit

June 9, 2011

Flow =	2.506	MGD	MLSS =	14,952	
BOD =	3271	lbs/d	Temp. =	63	deg. F
TSS =	4313	lbs/d		17	deg. C
Ammonia =	389	lb/d	Influent VSS/TSS =	0.45	
TKN =	622	lb/d	Average DO in Basin =	1	mg/L
			Target air demand =	1300	scfm

(peak BOD load = peak day load * 1.1)

MODEL INPUTS:

Flow	2.51	mgd	Sludge age	23.9	days
Basin temperature	17	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	1.87%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3192	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.662	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3598.1	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	172.2	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4313	#/day			
	206.4	mg/L	Alpha	0.420886	
TKN	622	#/day	Beta	0.95	
	29.8	mg/L	Residual DO	1	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.45		(0.65- Effective Saturation Depth	32.5%	tank depth
VSS	1940.85	#/day	Field elevation	730	ft
	92.9	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.8117		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.83	mg/L	Effluent BOD	1.83	mg/L
Active Microbial VSS (Ma)	1046.9	mg/L	BOD O2 uptake (method 1)	25.9	mg/L/hr
Lysed Cell VSS (Me)	1948.2	mg/L		172.98	#/hr
Inert Influent VSS (Mi)	2778.6	mg/L	TKN O2 uptake (method 1)	16.8	mg/L/hr
Inert, Inorganic SS (Mf)	8789.8	mg/L		111.86	#/hr
MLSS (BOD)	14563.5	mg/L	Total O2 uptake (method 1)	42.7	mg/L/hr
				284.8	#/hr
Unmetabolized NH3 (F-N)	0.038	mg/L			
Active N-Microbial VSS (Ma-N)	135.9	mg/L	Denitrification O2 Credit (method 1)	33.56	#/hr
Lysed N-Cell VSS (Me)	252.9	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	38.9	mg/L	Total O2 from Aeration System	157.3	#/hr
MLSS (NH3)	427.7	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	14991.2	mg/L	C^*_{ST} (O2 saturation at T)	9.65	mg/L
MLVSS (total)	6162.6	mg/L	Water vapor pressure at basin T	0.28	psi
% Volatile	41.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.088	0.2-0.6 for com	SOR/AOR	2.87	
Total WAS Volatiles	1721.8	#/day			
Total WAS	4188.5	#/day	Air temperature	40.0	°C
WAS Flow	33501	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	10.02	mgd			

Standard O2 Rate Req'd (SOR)	451.2	#/hr
(method 1)	10830	#/day
SCFM required	1300	scfm
ACFM at air temperature (mth 1)	1492	acfm

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PHASE 1
Design Case 1: AWW Flow, Peak Load, Summer

Flow =	2.61	MGD	
BOD =	4466	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	6237	lbs/d	
TKN =	1234	lb/d	

MODEL INPUTS:

Flow	2.61	mgd		Sludge age	10.2	days
Basin temperature	20	°C		Effluent SS	0	mg/L
Number of Basins	2	each		RAS/WAS Concentration	0.77%	
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3071	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	7.370	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	4912.6	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	226.1	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	6237	#/day				
	287.1	mg/L		Alpha	0.551299	
TKN	1234	#/day		Beta	0.95	
	56.8	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4989.6	#/day		Field elevation	730	ft
	229.7	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.03	mg/L	Effluent BOD	2.03	mg/L
Active Microbial VSS (Ma)	1068.8	mg/L	BOD O2 uptake (method 1)	33.3	mg/L/hr
Lysed Cell VSS (Me)	1046.6	mg/L		222.42	#/hr
Inert Influent VSS (Mi)	3051.2	mg/L	TKN O2 uptake (method 1)	32.9	mg/L/hr
Inert, Inorganic SS (Mf)	2118.5	mg/L		219.30	#/hr
MLSS (BOD)	7285.1	mg/L	Total O2 uptake (method 1)	66.2	mg/L/hr
				441.7	#/hr
Unmetabolized NH3 (F-N)	0.061	mg/L			
Active N-Microbial VSS (Ma-N)	201.3	mg/L	Denitrification O2 Credit (method 1)	65.79	#/hr
Lysed N-Cell VSS (Me)	197.1	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	39.8	mg/L	Total O2 from Aeration System	281.9	#/hr
MLSS (NH3)	438.3	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7723.5	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5565.1	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.132	0.2-0.6 for com	SOR/AOR	2.47	
Total WAS Volatiles	3640.2	#/day			
Total WAS	5052.0	#/day	Air temperature	40.0	°C
WAS Flow	78431	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	13.03	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1088.9	#/hr
(method 1)	26133	#/day
SCFM required	3137	scfm
ACFM at air temperature (mth 1)	3599	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	695.0	#/hr
(method 1)	16679	#/day
SCFM required	2002	scfm
ACFM at air temperature (mth 1)	2297	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	857.2	#/hr
(method 1)	20572	#/day
SCFM required	2469	scfm
ACFM at air temperature (mth 1)	2833	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	926.7	#/hr
(method 1)	22241	#/day
SCFM required	2670	scfm
ACFM at air temperature (mth 1)	3063	acfm

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PHASE 1
Design Case 2: ADW Flow, Peak Load, Summer

Flow =	1.79	MGD	
BOD =	4466	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	6237	lbs/d	
TKN =	1234	lb/d	

MODEL INPUTS:

Flow	1.79	mgd		Sludge age	10.2	days
Basin temperature	20	°C		Effluent SS	0	mg/L
Number of Basins	2	each		RAS/WAS Concentration	0.77%	
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4459	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	10.702	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	4912.6	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	328.3	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	6237	#/day				
	416.9	mg/L		Alpha	0.551016	
TKN	1234	#/day		Beta	0.95	
	82.5	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4989.6	#/day		Field elevation	730	ft
	333.5	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.03	mg/L	Effluent BOD	2.03	mg/L
Active Microbial VSS (Ma)	1071.8	mg/L	BOD O2 uptake (method 1)	33.4	mg/L/hr
Lysed Cell VSS (Me)	1049.5	mg/L		223.04	#/hr
Inert Influent VSS (Mi)	3051.2	mg/L	TKN O2 uptake (method 1)	32.9	mg/L/hr
Inert, Inorganic SS (Mf)	2119.1	mg/L		219.37	#/hr
MLSS (BOD)	7291.6	mg/L	Total O2 uptake (method 1)	66.3	mg/L/hr
				442.4	#/hr
Unmetabolized NH3 (F-N)	0.061	mg/L			
Active N-Microbial VSS (Ma-N)	201.4	mg/L	Denitrification O2 Credit (method 1)	65.81	#/hr
Lysed N-Cell VSS (Me)	197.2	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	39.9	mg/L	Total O2 from Aeration System	282.6	#/hr
MLSS (NH3)	438.5	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7730.1	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5571.1	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.132	0.2-0.6 for com	SOR/AOR	2.47	
Total WAS Volatiles	3644.2	#/day			
Total WAS	5056.4	#/day	Air temperature	40.0	°C
WAS Flow	78431	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	8.97	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1091.1	#/hr
(method 1)	26188	#/day
SCFM required	3143	scfm
ACFM at air temperature (mth 1)	3607	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	697.0	#/hr
(method 1)	16728	#/day
SCFM required	2008	scfm
ACFM at air temperature (mth 1)	2304	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	859.3	#/hr
(method 1)	20623	#/day
SCFM required	2475	scfm
ACFM at air temperature (mth 1)	2840	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	928.8	#/hr
(method 1)	22292	#/day
SCFM required	2676	scfm
ACFM at air temperature (mth 1)	3070	acfm

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PHASE 1
Design Case 3: AWW Flow, Peak Month, Summer

Flow =	2.61	MGD	
BOD =	2770	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	3260	lbs/d	
TKN =	540	lb/d	

MODEL INPUTS:

Flow	2.61	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.77%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3071	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.370	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3047	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.2	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3260	#/day			
	150.1	mg/L	Alpha	0.551766	
TKN	540	#/day	Beta	0.95	
	24.9	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2608	#/day	Field elevation	730	ft
	120.0	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.26	mg/L	Effluent BOD	1.26	mg/L
Active Microbial VSS (Ma)	723.0	mg/L	BOD O2 uptake (method 1)	22.0	mg/L/hr
Lysed Cell VSS (Me)	1388.2	mg/L		147.06	#/hr
Inert Influent VSS (Mi)	3127.1	mg/L	TKN O2 uptake (method 1)	14.6	mg/L/hr
Inert, Inorganic SS (Mf)	2165.6	mg/L		97.18	#/hr
MLSS (BOD)	7403.8	mg/L	Total O2 uptake (method 1)	36.6	mg/L/hr
				244.2	#/hr
Unmetabolized NH3 (F-N)	0.027	mg/L			
Active N-Microbial VSS (Ma-N)	96.1	mg/L	Denitrification O2 Credit (method 1)	29.15	#/hr
Lysed N-Cell VSS (Me)	184.5	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	28.1	mg/L	Total O2 from Aeration System	121.1	#/hr
MLSS (NH3)	308.6	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7712.5	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5518.9	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.6%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.46	
Total WAS Volatiles	1841.1	#/day			
Total WAS	2572.9	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	13.03	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	601.6	#/hr
(method 1)	14437	#/day
SCFM required	1733	scfm
ACFM at air temperature (mth 1)	1988	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	298.2	#/hr
(method 1)	7158	#/day
SCFM required	859	scfm
ACFM at air temperature (mth 1)	986	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	370.0	#/hr
(method 1)	8881	#/day
SCFM required	1066	scfm
ACFM at air temperature (mth 1)	1223	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	529.8	#/hr
(method 1)	12714	#/day
SCFM required	1526	scfm
ACFM at air temperature (mth 1)	1751	acfm

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PHASE 1
Design Case 4: AWW Flow, Peak Month, Winter

Flow =	2.61	MGD
BOD =	2770	lbs/d (peak BOD load = BOD load * 1.1)
TSS =	3260	lbs/d
TKN =	540	lb/d

MODEL INPUTS:

Flow	2.61	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.84%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3071	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.370	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3047	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.2	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3260	#/day			
	150.1	mg/L	Alpha	0.521869	
TKN	540	#/day	Beta	0.95	
	24.9	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2608	#/day	Field elevation	730	ft
	120.0	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.86	mg/L	Effluent BOD	2.86	mg/L
Active Microbial VSS (Ma)	1465.8	mg/L	BOD O2 uptake (method 1)	20.0	mg/L/hr
Lysed Cell VSS (Me)	1221.9	mg/L		133.50	#/hr
Inert Influent VSS (Mi)	3127.1	mg/L	TKN O2 uptake (method 1)	14.3	mg/L/hr
Inert, Inorganic SS (Mf)	2223.2	mg/L		95.45	#/hr
MLSS (BOD)	8038.0	mg/L	Total O2 uptake (method 1)	34.3	mg/L/hr
				229.0	#/hr
Unmetabolized NH3 (F-N)	0.061	mg/L			
Active N-Microbial VSS (Ma-N)	196.8	mg/L	Denitrification O2 Credit (method 1)	28.63	#/hr
Lysed N-Cell VSS (Me)	164.1	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	36.1	mg/L	Total O2 from Aeration System	106.3	#/hr
MLSS (NH3)	397.0	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	8435.0	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	6175.7	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.2%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.50	
Total WAS Volatiles	2060.2	#/day			
Total WAS	2813.9	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	13.03	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	572.5	#/hr
(method 1)	13739	#/day
SCFM required	1649	scfm
ACFM at air temperature (mth 1)	1892	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	265.8	#/hr
(method 1)	6380	#/day
SCFM required	766	scfm
ACFM at air temperature (mth 1)	879	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	337.4	#/hr
(method 1)	8098	#/day
SCFM required	972	scfm
ACFM at air temperature (mth 1)	1115	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	500.9	#/hr
(method 1)	12021	#/day
SCFM required	1443	scfm
ACFM at air temperature (mth 1)	1656	acfm

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PHASE 1
Design Case 5: ADW Flow, Peak Month, Summer

Flow =	1.79	MGD	
BOD =	2770	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	3260	lbs/d	
TKN =	540	lb/d	

MODEL INPUTS:

Flow	1.79	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.77%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4459	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	10.702	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3047	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	203.6	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3260	#/day			
	217.9	mg/L	Alpha	0.551485	
TKN	540	#/day	Beta	0.95	
	36.1	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2608	#/day	Field elevation	730	ft
	174.3	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.26	mg/L	Effluent BOD	1.26	mg/L
Active Microbial VSS (Ma)	725.0	mg/L	BOD O2 uptake (method 1)	22.1	mg/L/hr
Lysed Cell VSS (Me)	1392.1	mg/L		147.47	#/hr
Inert Influent VSS (Mi)	3127.1	mg/L	TKN O2 uptake (method 1)	14.6	mg/L/hr
Inert, Inorganic SS (Mf)	2166.1	mg/L		97.21	#/hr
MLSS (BOD)	7410.3	mg/L	Total O2 uptake (method 1)	36.7	mg/L/hr
				244.7	#/hr
Unmetabolized NH3 (F-N)	0.027	mg/L			
Active N-Microbial VSS (Ma-N)	96.1	mg/L	Denitrification O2 Credit (method 1)	29.16	#/hr
Lysed N-Cell VSS (Me)	184.6	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	28.1	mg/L	Total O2 from Aeration System	121.5	#/hr
MLSS (NH3)	308.7	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7719.1	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5524.9	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.6%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.46	
Total WAS Volatiles	1843.1	#/day			
Total WAS	2575.1	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	8.97	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	603.0	#/hr
(method 1)	14471	#/day
SCFM required	1737	scfm
ACFM at air temperature (mth 1)	1993	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	299.5	#/hr
(method 1)	7187	#/day
SCFM required	863	scfm
ACFM at air temperature (mth 1)	990	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	371.3	#/hr
(method 1)	8912	#/day
SCFM required	1070	scfm
ACFM at air temperature (mth 1)	1227	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	531.1	#/hr
(method 1)	12746	#/day
SCFM required	1530	scfm
ACFM at air temperature (mth 1)	1755	acfm

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PHASE 1
Design Case 6: ADW Flow, Peak Month, Winter

Flow =	1.79	MGD
BOD =	2770	lbs/d (peak BOD load = BOD load * 1.1)
TSS =	3260	lbs/d
TKN =	540	lb/d

MODEL INPUTS:

Flow	1.79	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.85%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4459	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	10.702	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3047	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	203.6	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3260	#/day			
	217.9	mg/L	Alpha	0.521097	
TKN	540	#/day	Beta	0.95	
	36.1	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2608	#/day	Field elevation	730	ft
	174.3	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.88	mg/L	Effluent BOD	2.88	mg/L
Active Microbial VSS (Ma)	1475.2	mg/L	BOD O2 uptake (method 1)	20.1	mg/L/hr
Lysed Cell VSS (Me)	1229.7	mg/L		134.35	#/hr
Inert Influent VSS (Mi)	3127.1	mg/L	TKN O2 uptake (method 1)	14.3	mg/L/hr
Inert, Inorganic SS (Mf)	2224.9	mg/L		95.52	#/hr
MLSS (BOD)	8056.9	mg/L	Total O2 uptake (method 1)	34.5	mg/L/hr
				229.9	#/hr
Unmetabolized NH3 (F-N)	0.061	mg/L			
Active N-Microbial VSS (Ma-N)	197.0	mg/L	Denitrification O2 Credit (method 1)	28.66	#/hr
Lysed N-Cell VSS (Me)	164.2	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	36.1	mg/L	Total O2 from Aeration System	107.2	#/hr
MLSS (NH3)	397.3	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	8454.2	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	6193.2	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.3%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.50	
Total WAS Volatiles	2066.0	#/day			
Total WAS	2820.3	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	8.97	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	575.6	#/hr
(method 1)	13815	#/day
SCFM required	1658	scfm
ACFM at air temperature (mth 1)	1903	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	268.5	#/hr
(method 1)	6444	#/day
SCFM required	773	scfm
ACFM at air temperature (mth 1)	887	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	340.2	#/hr
(method 1)	8166	#/day
SCFM required	980	scfm
ACFM at air temperature (mth 1)	1125	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	503.9	#/hr
(method 1)	12093	#/day
SCFM required	1452	scfm
ACFM at air temperature (mth 1)	1665	acfm

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PHASE 1
Design Case 7: Average Flow & Load, Summer

Flow =	1.96	MGD	
BOD =	2103	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	2547	lbs/d	
TKN =	433	lb/d	

MODEL INPUTS:

Flow	1.96	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.60%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4086	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	9.806	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	2313.3	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	141.7	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	2547	#/day			
	156.0	mg/L	Alpha	0.630386	
TKN	433	#/day	Beta	0.95	
	26.5	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2037.6	#/day	Field elevation	730	ft
	124.8	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	0.96	mg/L	Effluent BOD	0.96	mg/L
Active Microbial VSS (Ma)	550.1	mg/L	BOD O2 uptake (method 1)	16.8	mg/L/hr
Lysed Cell VSS (Me)	1056.3	mg/L		111.90	#/hr
Inert Influent VSS (Mi)	2443.2	mg/L	TKN O2 uptake (method 1)	11.7	mg/L/hr
Inert, Inorganic SS (Mf)	1687.6	mg/L		77.94	#/hr
MLSS (BOD)	5737.2	mg/L	Total O2 uptake (method 1)	28.5	mg/L/hr
				189.8	#/hr
Unmetabolized NH3 (F-N)	0.021	mg/L			
Active N-Microbial VSS (Ma-N)	77.1	mg/L	Denitrification O2 Credit (method 1)	23.38	#/hr
Lysed N-Cell VSS (Me)	148.0	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	22.5	mg/L	Total O2 from Aeration System	72.5	#/hr
MLSS (NH3)	247.6	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	5984.7	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	4274.6	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.4%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.081	0.2-0.6 for com	SOR/AOR	2.16	
Total WAS Volatiles	1426.0	#/day			
Total WAS	1996.5	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	9.79	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	409.3	#/hr
(method 1)	9822	#/day
SCFM required	1179	scfm
ACFM at air temperature (mth 1)	1353	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	156.2	#/hr
(method 1)	3749	#/day
SCFM required	450	scfm
ACFM at air temperature (mth 1)	516	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	206.6	#/hr
(method 1)	4959	#/day
SCFM required	595	scfm
ACFM at air temperature (mth 1)	683	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	358.9	#/hr
(method 1)	8612	#/day
SCFM required	1034	scfm
ACFM at air temperature (mth 1)	1186	acfm

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PHASE 1
Design Case 8: Average Flow & Load, Winter

Flow =	1.96	MGD	
BOD =	2103	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	2547	lbs/d	
TKN =	433	lb/d	

MODEL INPUTS:

				Sludge age	20.0	days
Flow	1.96	mgd		Effluent SS	0	mg/L
Basin temperature	8	°C		RAS/WAS Concentration	0.65%	
Number of Basins	2	each				
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4086	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	9.806	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	2313.3	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	141.7	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	2547	#/day				
	156.0	mg/L		Alpha	0.603751	
TKN	433	#/day		Beta	0.95	
	26.5	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2037.6	#/day		Field elevation	730	ft
	124.8	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.18	mg/L	Effluent BOD	2.18	mg/L
Active Microbial VSS (Ma)	1118.5	mg/L	BOD O2 uptake (method 1)	15.3	mg/L/hr
Lysed Cell VSS (Me)	932.4	mg/L		101.87	#/hr
Inert Influent VSS (Mi)	2443.2	mg/L	TKN O2 uptake (method 1)	11.5	mg/L/hr
Inert, Inorganic SS (Mf)	1732.1	mg/L		76.58	#/hr
MLSS (BOD)	6226.2	mg/L	Total O2 uptake (method 1)	26.7	mg/L/hr
				178.5	#/hr
Unmetabolized NH3 (F-N)	0.049	mg/L			
Active N-Microbial VSS (Ma-N)	157.9	mg/L	Denitrification O2 Credit (method 1)	22.97	#/hr
Lysed N-Cell VSS (Me)	131.6	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	29.0	mg/L	Total O2 from Aeration System	61.5	#/hr
MLSS (NH3)	318.5	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	6544.7	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	4783.6	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.1%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.072	0.2-0.6 for com	SOR/AOR	2.16	
Total WAS Volatiles	1595.8	#/day			
Total WAS	2183.3	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	9.79	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	385.7	#/hr
(method 1)	9256	#/day
SCFM required	1111	scfm
ACFM at air temperature (mth 1)	1275	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	132.9	#/hr
(method 1)	3189	#/day
SCFM required	383	scfm
ACFM at air temperature (mth 1)	439	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	182.5	#/hr
(method 1)	4381	#/day
SCFM required	526	scfm
ACFM at air temperature (mth 1)	603	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	336.0	#/hr
(method 1)	8065	#/day
SCFM required	968	scfm
ACFM at air temperature (mth 1)	1111	acfm

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2489-11A.300 Revised: 9/28/2013

PHASE 1A
Design Case 1: AWW Flow, Peak Load, Summer

Flow =	3.26	MGD	
BOD =	5594	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	7806	lbs/d	
TKN =	1531	lb/d	

MODEL INPUTS:

Flow	3.26	mgd	Sludge age	10.2	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.97%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.2457	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	5.897	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	6153.4	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	226.6	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	7806	#/day			
	287.5	mg/L	Alpha	0.474934	
TKN	1531	#/day	Beta	0.95	
	56.4	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	6244.8	#/day	Field elevation	730	ft
	230.0	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.53	mg/L	Effluent BOD	2.53	mg/L
Active Microbial VSS (Ma)	1335.8	mg/L	BOD O2 uptake (method 1)	41.7	mg/L/hr
Lysed Cell VSS (Me)	1308.0	mg/L		277.97	#/hr
Inert Influent VSS (Mi)	3818.8	mg/L	TKN O2 uptake (method 1)	40.8	mg/L/hr
Inert, Inorganic SS (Mf)	2651.1	mg/L		272.01	#/hr
MLSS (BOD)	9113.6	mg/L	Total O2 uptake (method 1)	82.4	mg/L/hr
				550.0	#/hr
Unmetabolized NH3 (F-N)	0.075	mg/L			
Active N-Microbial VSS (Ma-N)	249.7	mg/L	Denitrification O2 Credit (method 1)	81.60	#/hr
Lysed N-Cell VSS (Me)	244.5	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	49.4	mg/L	Total O2 from Aeration System	374.4	#/hr
MLSS (NH3)	543.7	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	9657.3	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	6956.8	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.0%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.133	0.2-0.6 for com	SOR/AOR	2.86	
Total WAS Volatiles	4550.6	#/day			
Total WAS	6317.0	#/day	Air temperature	40.0	°C
WAS Flow	78431	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	16.28	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1573.7	#/hr
(method 1)	37770	#/day
SCFM required	4534	scfm
ACFM at air temperature (mth 1)	5202	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	1071.3	#/hr
(method 1)	25710	#/day
SCFM required	3086	scfm
ACFM at air temperature (mth 1)	3541	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	1304.8	#/hr
(method 1)	31314	#/day
SCFM required	3759	scfm
ACFM at air temperature (mth 1)	4313	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	1340.2	#/hr
(method 1)	32166	#/day
SCFM required	3861	scfm
ACFM at air temperature (mth 1)	4430	acfm

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PHASE 1A
Design Case 2: ADW Flow, Peak Load, Summer

Flow =	1.91	MGD	
BOD =	5594	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	7806	lbs/d	
TKN =	1531	lb/d	

MODEL INPUTS:

Flow	1.91	mgd		Sludge age	10.2	days
Basin temperature	20	°C		Effluent SS	0	mg/L
Number of Basins	2	each		RAS/WAS Concentration	0.97%	
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4191	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	10.058	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	6153.4	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	386.5	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	7806	#/day				
	490.3	mg/L		Alpha	0.474429	
TKN	1531	#/day		Beta	0.95	
	96.2	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	6244.8	#/day		Field elevation	730	ft
	392.2	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.54	mg/L	Effluent BOD	2.54	mg/L
Active Microbial VSS (Ma)	1342.0	mg/L	BOD O2 uptake (method 1)	41.9	mg/L/hr
Lysed Cell VSS (Me)	1314.1	mg/L		279.26	#/hr
Inert Influent VSS (Mi)	3818.8	mg/L	TKN O2 uptake (method 1)	40.8	mg/L/hr
Inert, Inorganic SS (Mf)	2652.3	mg/L		272.16	#/hr
MLSS (BOD)	9127.1	mg/L	Total O2 uptake (method 1)	82.6	mg/L/hr
				551.4	#/hr
Unmetabolized NH3 (F-N)	0.075	mg/L			
Active N-Microbial VSS (Ma-N)	249.9	mg/L	Denitrification O2 Credit (method 1)	81.65	#/hr
Lysed N-Cell VSS (Me)	244.7	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	49.5	mg/L	Total O2 from Aeration System	375.8	#/hr
MLSS (NH3)	544.0	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	9671.1	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	6969.3	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.132	0.2-0.6 for com	SOR/AOR	2.86	
Total WAS Volatiles	4558.8	#/day			
Total WAS	6326.1	#/day	Air temperature	40.0	°C
WAS Flow	78431	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	9.55	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1579.5	#/hr
(method 1)	37909	#/day
SCFM required	4550	scfm
ACFM at air temperature (mth 1)	5221	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	1076.4	#/hr
(method 1)	25834	#/day
SCFM required	3101	scfm
ACFM at air temperature (mth 1)	3558	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	1310.3	#/hr
(method 1)	31447	#/day
SCFM required	3775	scfm
ACFM at air temperature (mth 1)	4331	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	1345.7	#/hr
(method 1)	32296	#/day
SCFM required	3877	scfm
ACFM at air temperature (mth 1)	4448	acfm

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PHASE 1A

Design Case 3: AWW Flow, Peak Month, Summer

Flow =	3.26	MGD	
BOD =	3470	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	4080	lbs/d	
TKN =	670	lb/d	

MODEL INPUTS:

Flow	3.26	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.96%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.2457	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	5.897	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3817	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.6	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4080	#/day			
	150.2	mg/L	Alpha	0.475377	
TKN	670	#/day	Beta	0.95	
	24.7	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3264	#/day	Field elevation	730	ft
	120.2	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.57	mg/L	Effluent BOD	1.57	mg/L
Active Microbial VSS (Ma)	903.7	mg/L	BOD O2 uptake (method 1)	27.5	mg/L/hr
Lysed Cell VSS (Me)	1735.1	mg/L		183.81	#/hr
Inert Influent VSS (Mi)	3913.7	mg/L	TKN O2 uptake (method 1)	18.1	mg/L/hr
Inert, Inorganic SS (Mf)	2709.9	mg/L		120.54	#/hr
MLSS (BOD)	9262.4	mg/L	Total O2 uptake (method 1)	45.6	mg/L/hr
				304.4	#/hr
Unmetabolized NH3 (F-N)	0.033	mg/L			
Active N-Microbial VSS (Ma-N)	119.2	mg/L	Denitrification O2 Credit (method 1)	36.16	#/hr
Lysed N-Cell VSS (Me)	228.8	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	34.8	mg/L	Total O2 from Aeration System	174.2	#/hr
MLSS (NH3)	382.8	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	9645.2	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	6900.5	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.5%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.86	
Total WAS Volatiles	2302.0	#/day			
Total WAS	3217.6	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	16.28	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	870.1	#/hr
(method 1)	20882	#/day
SCFM required	2506	scfm
ACFM at air temperature (mth 1)	2876	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	498.0	#/hr
(method 1)	11951	#/day
SCFM required	1435	scfm
ACFM at air temperature (mth 1)	1646	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	601.3	#/hr
(method 1)	14432	#/day
SCFM required	1732	scfm
ACFM at air temperature (mth 1)	1988	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	766.7	#/hr
(method 1)	18401	#/day
SCFM required	2209	scfm
ACFM at air temperature (mth 1)	2534	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements Date: 10/19/12
2489-11A.300 Revised: 9/28/2013

PHASE 1A
Design Case 4: AWW Flow, Peak Month, Winter

Flow =	3.26	MGD
BOD =	3470	lbs/d (peak BOD load = BOD load * 1.1)
TSS =	4080	lbs/d
TKN =	670	lb/d

MODEL INPUTS:

Flow	3.26	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	1.05%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.2457	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	5.897	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3817	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.6	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4080	#/day			
	150.2	mg/L	Alpha	0.443798	
TKN	670	#/day	Beta	0.95	
	24.7	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3264	#/day	Field elevation	730	ft
	120.2	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	3.57	mg/L	Effluent BOD	3.57	mg/L
Active Microbial VSS (Ma)	1826.9	mg/L	BOD O2 uptake (method 1)	24.9	mg/L/hr
Lysed Cell VSS (Me)	1522.9	mg/L		166.39	#/hr
Inert Influent VSS (Mi)	3913.7	mg/L	TKN O2 uptake (method 1)	17.7	mg/L/hr
Inert, Inorganic SS (Mf)	2781.0	mg/L		118.36	#/hr
MLSS (BOD)	10044.5	mg/L	Total O2 uptake (method 1)	42.7	mg/L/hr
				284.7	#/hr
Unmetabolized NH3 (F-N)	0.076	mg/L			
Active N-Microbial VSS (Ma-N)	244.0	mg/L	Denitrification O2 Credit (method 1)	35.51	#/hr
Lysed N-Cell VSS (Me)	203.4	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	44.7	mg/L	Total O2 from Aeration System	155.2	#/hr
MLSS (NH3)	492.2	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	10536.8	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	7711.0	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.2%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.94	
Total WAS Volatiles	2572.4	#/day			
Total WAS	3515.1	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	16.28	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	837.2	#/hr
(method 1)	20093	#/day
SCFM required	2412	scfm
ACFM at air temperature (mth 1)	2767	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	456.4	#/hr
(method 1)	10954	#/day
SCFM required	1315	scfm
ACFM at air temperature (mth 1)	1509	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	560.8	#/hr
(method 1)	13460	#/day
SCFM required	1616	scfm
ACFM at air temperature (mth 1)	1854	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	732.8	#/hr
(method 1)	17587	#/day
SCFM required	2111	scfm
ACFM at air temperature (mth 1)	2422	acfm

ACTIVATED SLUDGE MODEL

North Liberty WWTP Improvements Date: 10/19/12

2489-11A.300 Revised: 9/28/2013

PHASE 1A

Design Case 5: ADW Flow, Peak Month, Summer

Flow =	2.24	MGD	
BOD =	3470	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	4080	lbs/d	
TKN =	670	lb/d	

MODEL INPUTS:

				Sludge age	20.0	days
Flow	2.24	mgd		Effluent SS	0	mg/L
Basin temperature	20	°C		RAS/WAS Concentration	0.97%	
Number of Basins	2	each				
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3568	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	8.564	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3817	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	204.1	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4080	#/day				
	218.2	mg/L		Alpha	0.475	
TKN	670	#/day		Beta	0.95	
	35.8	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3264	#/day		Field elevation	730	ft
	174.6	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.58	mg/L	Effluent BOD	1.58	mg/L
Active Microbial VSS (Ma)	906.8	mg/L	BOD O2 uptake (method 1)	27.6	mg/L/hr
Lysed Cell VSS (Me)	1741.1	mg/L		184.45	#/hr
Inert Influent VSS (Mi)	3913.7	mg/L	TKN O2 uptake (method 1)	18.1	mg/L/hr
Inert, Inorganic SS (Mf)	2710.8	mg/L		120.59	#/hr
MLSS (BOD)	9272.5	mg/L	Total O2 uptake (method 1)	45.7	mg/L/hr
				305.0	#/hr
Unmetabolized NH3 (F-N)	0.033	mg/L			
Active N-Microbial VSS (Ma-N)	119.2	mg/L	Denitrification O2 Credit (method 1)	36.18	#/hr
Lysed N-Cell VSS (Me)	228.9	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	34.8	mg/L	Total O2 from Aeration System	174.9	#/hr
MLSS (NH3)	383.0	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	9655.5	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	6909.9	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.6%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.86	
Total WAS Volatiles	2305.1	#/day			
Total WAS	3221.1	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	11.21	mgd			

No credit for denitrification or membrane aeration			Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	872.7	#/hr	Standard O2 Rate Req'd (SOR)	500.3	#/hr
(method 1)	20946	#/day	(method 1)	12007	#/day
SCFM required	2514	scfm	SCFM required	1441	scfm
ACFM at air temperature (mth 1)	2885	acfm	ACFM at air temperature (mth 1)	1654	acfm

Credit for membrane aeration only			Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	603.8	#/hr	Standard O2 Rate Req'd (SOR)	769.2	#/hr
(method 1)	14491	#/day	(method 1)	18462	#/day
SCFM required	1739	scfm	SCFM required	2216	scfm
ACFM at air temperature (mth 1)	1996	acfm	ACFM at air temperature (mth 1)	2543	acfm

ACTIVATED SLUDGE MODEL

North Liberty WWTP Improvements Date: 10/19/12

2489-11A.300 Revised: 9/28/2013

PHASE 1A

Design Case 6: ADW Flow, Peak Month, Winter

Flow =	2.24	MGD	
BOD =	3470	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	4080	lbs/d	
TKN =	670	lb/d	

MODEL INPUTS:

Flow	2.24	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	1.06%	
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3568	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	8.564	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3817	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	204.1	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4080	#/day			
	218.2	mg/L	Alpha	0.442779	
TKN	670	#/day	Beta	0.95	
	35.8	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3264	#/day	Field elevation	730	ft
	174.6	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	3.60	mg/L	Effluent BOD	3.60	mg/L
Active Microbial VSS (Ma)	1841.5	mg/L	BOD O2 uptake (method 1)	25.1	mg/L/hr
Lysed Cell VSS (Me)	1535.1	mg/L		167.71	#/hr
Inert Influent VSS (Mi)	3913.7	mg/L	TKN O2 uptake (method 1)	17.8	mg/L/hr
Inert, Inorganic SS (Mf)	2783.7	mg/L		118.47	#/hr
MLSS (BOD)	10073.9	mg/L	Total O2 uptake (method 1)	42.9	mg/L/hr
				286.2	#/hr
Unmetabolized NH3 (F-N)	0.076	mg/L			
Active N-Microbial VSS (Ma-N)	244.3	mg/L	Denitrification O2 Credit (method 1)	35.54	#/hr
Lysed N-Cell VSS (Me)	203.6	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	44.8	mg/L	Total O2 from Aeration System	156.6	#/hr
MLSS (NH3)	492.7	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	10566.6	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	7738.1	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.2%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.95	
Total WAS Volatiles	2581.4	#/day			
Total WAS	3525.0	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	11.21	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	843.4	#/hr
(method 1)	20241	#/day
SCFM required	2430	scfm
ACFM at air temperature (mth 1)	2788	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	461.6	#/hr
(method 1)	11079	#/day
SCFM required	1330	scfm
ACFM at air temperature (mth 1)	1526	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	566.4	#/hr
(method 1)	13593	#/day
SCFM required	1632	scfm
ACFM at air temperature (mth 1)	1872	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	738.6	#/hr
(method 1)	17727	#/day
SCFM required	2128	scfm
ACFM at air temperature (mth 1)	2441	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements Date: 10/19/12
2489-11A.300 Revised: 9/28/2013

PHASE 1A
Design Case 7: Average Flow & Load, Summer

Flow =	2.45	MGD	
BOD =	2635	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	3187	lbs/d	
TKN =	537	lb/d	

MODEL INPUTS:

			Sludge age	20.0	days
Flow	2.45	mgd	Effluent SS	0	mg/L
Basin temperature	20	°C	RAS/WAS Concentration	0.75%	
Number of Basins	2	each			
Volume per Basin	0.4	mg			
Basin volume	0.800	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3268	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.843	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	2898.5	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	142.0	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3187	#/day			
	156.1	mg/L	Alpha	0.561528	
TKN	537	#/day	Beta	0.95	
	26.3	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2549.6	#/day	Field elevation	730	ft
	124.9	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.20	mg/L	Effluent BOD	1.20	mg/L
Active Microbial VSS (Ma)	688.1	mg/L	BOD O2 uptake (method 1)	21.0	mg/L/hr
Lysed Cell VSS (Me)	1321.2	mg/L		139.97	#/hr
Inert Influent VSS (Mi)	3057.1	mg/L	TKN O2 uptake (method 1)	14.5	mg/L/hr
Inert, Inorganic SS (Mf)	2111.6	mg/L		96.64	#/hr
MLSS (BOD)	7178.1	mg/L	Total O2 uptake (method 1)	35.5	mg/L/hr
				236.6	#/hr
Unmetabolized NH3 (F-N)	0.026	mg/L			
Active N-Microbial VSS (Ma-N)	95.6	mg/L	Denitrification O2 Credit (method 1)	28.99	#/hr
Lysed N-Cell VSS (Me)	183.5	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	27.9	mg/L	Total O2 from Aeration System	113.6	#/hr
MLSS (NH3)	307.0	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7485.0	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5345.5	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.4%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.081	0.2-0.6 for com	SOR/AOR	2.42	
Total WAS Volatiles	1783.3	#/day			
Total WAS	2497.0	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	12.24	mgd			

No credit for denitrification or membrane aeration			Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	572.6	#/hr	Standard O2 Rate Req'd (SOR)	275.0	#/hr
(method 1)	13743	#/day	(method 1)	6599	#/day
SCFM required	1650	scfm	SCFM required	792	scfm
ACFM at air temperature (mth 1)	1893	acfm	ACFM at air temperature (mth 1)	909	acfm

Credit for membrane aeration only			Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	345.1	#/hr	Standard O2 Rate Req'd (SOR)	502.5	#/hr
(method 1)	8284	#/day	(method 1)	12059	#/day
SCFM required	994	scfm	SCFM required	1448	scfm
ACFM at air temperature (mth 1)	1141	acfm	ACFM at air temperature (mth 1)	1661	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements Date: 10/19/12
2489-11A.300 Revised: 9/28/2013

PHASE 1A
Design Case 8: Average Flow & Load, Winter

Flow =	2.45	MGD	
BOD =	2635	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	3187	lbs/d	
TKN =	537	lb/d	

MODEL INPUTS:

Flow	2.45	mgd		Sludge age	20.0	days
Basin temperature	8	°C		Effluent SS	0	mg/L
Number of Basins	2	each		RAS/WAS Concentration	0.82%	
Volume per Basin	0.4	mg				
Basin volume	0.800	mg		BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3268	days		BOD Synthesis Factor (Ks)	12.7	1/hour
	7.843	hours		Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	2898.5	#/day		NH3 Metabolism Factor (Km-N)	127	1/hour
	142.0	mg/L		NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	3187	#/day				
	156.1	mg/L		Alpha	0.532295	
TKN	537	#/day		Beta	0.95	
	26.3	mg/L		Residual DO	2	mg/L
TKN Portion to be oxidized	100%			Diffuser depth	19	feet
VSS/TSS	0.8		(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	2549.6	#/day		Field elevation	730	ft
	124.9	mg/L		Relative humidity	70.0%	
				Standard Oxygen Transfer Eff.	33%	
				Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.73	mg/L	Effluent BOD	2.73	mg/L
Active Microbial VSS (Ma)	1396.1	mg/L	BOD O2 uptake (method 1)	19.1	mg/L/hr
Lysed Cell VSS (Me)	1163.8	mg/L		127.15	#/hr
Inert Influent VSS (Mi)	3057.1	mg/L	TKN O2 uptake (method 1)	14.2	mg/L/hr
Inert, Inorganic SS (Mf)	2166.7	mg/L		94.93	#/hr
MLSS (BOD)	7783.6	mg/L	Total O2 uptake (method 1)	33.3	mg/L/hr
				222.1	#/hr
Unmetabolized NH3 (F-N)	0.061	mg/L			
Active N-Microbial VSS (Ma-N)	195.8	mg/L	Denitrification O2 Credit (method 1)	28.48	#/hr
Lysed N-Cell VSS (Me)	163.2	mg/L	Credit for Membrane Aeration	94.00	#/hr
Inert, N-Inorganic SS (Mf)	35.9	mg/L	Total O2 from Aeration System	99.6	#/hr
MLSS (NH3)	394.8	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	8178.4	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	5975.9	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.1%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.073	0.2-0.6 for com	SOR/AOR	2.45	
Total WAS Volatiles	1993.6	#/day			
Total WAS	2728.3	#/day	Air temperature	40.0	°C
WAS Flow	40000	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	12.24	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	544.4	#/hr
(method 1)	13066	#/day
SCFM required	1568	scfm
ACFM at air temperature (mth 1)	1799	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	244.2	#/hr
(method 1)	5860	#/day
SCFM required	703	scfm
ACFM at air temperature (mth 1)	807	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	314.0	#/hr
(method 1)	7536	#/day
SCFM required	905	scfm
ACFM at air temperature (mth 1)	1038	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	474.6	#/hr
(method 1)	11390	#/day
SCFM required	1367	scfm
ACFM at air temperature (mth 1)	1569	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements Date: 10/25/12
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PHASE 2
Design Case 1: AWW Flow, Peak Load, Summer

Flow =	4.43	MGD	
BOD =	7626	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	10638	lbs/d	
TKN =	2152	lb/d	(includes 50 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	4.43	mgd	Sludge age	10.2	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.78%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3057	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.337	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	8388.6	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	227.1	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	10638	#/day			
	288.0	mg/L	Alpha	0.54823	
TKN	2152	#/day	Beta	0.95	
	58.3	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	8510.4	#/day	Field elevation	730	ft
	230.4	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.04	mg/L	Effluent BOD	2.04	mg/L
Active Microbial VSS (Ma)	1078.3	mg/L	BOD O2 uptake (method 1)	33.6	mg/L/hr
Lysed Cell VSS (Me)	1055.9	mg/L		379.77	#/hr
Inert Influent VSS (Mi)	3074.9	mg/L	TKN O2 uptake (method 1)	33.9	mg/L/hr
Inert, Inorganic SS (Mf)	2135.2	mg/L		382.44	#/hr
MLSS (BOD)	7344.2	mg/L	Total O2 uptake (method 1)	67.5	mg/L/hr
				762.2	#/hr
Unmetabolized NH3 (F-N)	0.062	mg/L			
Active N-Microbial VSS (Ma-N)	207.5	mg/L	Denitrification O2 Credit (method 1)	114.73	#/hr
Lysed N-Cell VSS (Me)	203.1	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	41.1	mg/L	Total O2 from Aeration System	522.2	#/hr
MLSS (NH3)	451.7	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7795.8	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5619.6	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.132	0.2-0.6 for com	SOR/AOR	2.48	
Total WAS Volatiles	6221.4	#/day			
Total WAS	8630.7	#/day	Air temperature	40.0	°C
WAS Flow	132745	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	22.15	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1889.5	#/hr
(method 1)	45347	#/day
SCFM required	5443	scfm
ACFM at air temperature (mth 1)	6245	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	1294.4	#/hr
(method 1)	31064	#/day
SCFM required	3729	scfm
ACFM at air temperature (mth 1)	4278	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	1578.8	#/hr
(method 1)	37890	#/day
SCFM required	4548	scfm
ACFM at air temperature (mth 1)	5218	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	1605.0	#/hr
(method 1)	38521	#/day
SCFM required	4624	scfm
ACFM at air temperature (mth 1)	5305	acfm

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PHASE 2
Design Case 2: ADW Flow, Peak Load, Summer

Flow =	3.05	MGD	
BOD =	7626	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	10638	lbs/d	
TKN =	2152	lb/d	(includes 50 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	3.05	mgd	Sludge age	10.2	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.78%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4439	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	10.654	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	8388.6	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	329.8	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	10638	#/day			
	418.2	mg/L	Alpha	0.547945	
TKN	2152	#/day	Beta	0.95	
	84.6	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	8510.4	#/day	Field elevation	730	ft
	334.6	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.05	mg/L	Effluent BOD	2.05	mg/L
Active Microbial VSS (Ma)	1081.3	mg/L	BOD O2 uptake (method 1)	33.7	mg/L/hr
Lysed Cell VSS (Me)	1058.8	mg/L		380.84	#/hr
Inert Influent VSS (Mi)	3074.9	mg/L	TKN O2 uptake (method 1)	33.9	mg/L/hr
Inert, Inorganic SS (Mf)	2135.8	mg/L		382.57	#/hr
MLSS (BOD)	7350.8	mg/L	Total O2 uptake (method 1)	67.6	mg/L/hr
				763.4	#/hr
Unmetabolized NH3 (F-N)	0.062	mg/L			
Active N-Microbial VSS (Ma-N)	207.5	mg/L	Denitrification O2 Credit (method 1)	114.77	#/hr
Lysed N-Cell VSS (Me)	203.2	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	41.1	mg/L	Total O2 from Aeration System	523.3	#/hr
MLSS (NH3)	451.8	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7802.6	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5625.7	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	72.1%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.132	0.2-0.6 for com	SOR/AOR	2.48	
Total WAS Volatiles	6228.2	#/day			
Total WAS	8638.2	#/day	Air temperature	40.0	°C
WAS Flow	132745	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	15.25	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1893.4	#/hr
(method 1)	45442	#/day
SCFM required	5454	scfm
ACFM at air temperature (mth 1)	6258	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	1297.9	#/hr
(method 1)	31150	#/day
SCFM required	3739	scfm
ACFM at air temperature (mth 1)	4290	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	1582.6	#/hr
(method 1)	37981	#/day
SCFM required	4559	scfm
ACFM at air temperature (mth 1)	5231	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	1608.7	#/hr
(method 1)	38610	#/day
SCFM required	4634	scfm
ACFM at air temperature (mth 1)	5317	acfm

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PHASE 2
Design Case 3: AWW Flow, Peak Month, Summer

Flow =	4.43	MGD	
BOD =	4730	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	5560	lbs/d	
TKN =	960	lb/d	(includes 40 lbs/d from dewatering filterate)

MODEL INPUTS:

			Sludge age	20.0	days
Flow	4.43	mgd	Effluent SS	0	mg/L
Basin temperature	20	°C	RAS/WAS Concentration	0.78%	
Number of Basins	2	each			
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3057	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.337	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	5203	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.9	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	5560	#/day			
	150.5	mg/L	Alpha	0.548574	
TKN	960	#/day	Beta	0.95	
	26.0	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4448	#/day	Field elevation	730	ft
	120.4	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.27	mg/L	Effluent BOD	1.27	mg/L
Active Microbial VSS (Ma)	729.4	mg/L	BOD O2 uptake (method 1)	22.2	mg/L/hr
Lysed Cell VSS (Me)	1400.5	mg/L		251.11	#/hr
Inert Influent VSS (Mi)	3151.2	mg/L	TKN O2 uptake (method 1)	15.3	mg/L/hr
Inert, Inorganic SS (Mf)	2182.5	mg/L		172.76	#/hr
MLSS (BOD)	7463.5	mg/L	Total O2 uptake (method 1)	37.5	mg/L/hr
				423.9	#/hr
Unmetabolized NH3 (F-N)	0.028	mg/L			
Active N-Microbial VSS (Ma-N)	100.9	mg/L	Denitrification O2 Credit (method 1)	51.83	#/hr
Lysed N-Cell VSS (Me)	193.8	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	29.5	mg/L	Total O2 from Aeration System	246.7	#/hr
MLSS (NH3)	324.2	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7787.7	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5575.8	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.6%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.48	
Total WAS Volatiles	3148.2	#/day			
Total WAS	4397.1	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	22.15	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1050.1	#/hr
(method 1)	25201	#/day
SCFM required	3025	scfm
ACFM at air temperature (mth 1)	3471	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	611.2	#/hr
(method 1)	14668	#/day
SCFM required	1761	scfm
ACFM at air temperature (mth 1)	2020	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	739.6	#/hr
(method 1)	17750	#/day
SCFM required	2131	scfm
ACFM at air temperature (mth 1)	2445	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	921.7	#/hr
(method 1)	22120	#/day
SCFM required	2655	scfm
ACFM at air temperature (mth 1)	3046	acfm

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PHASE 2
Design Case 4: AWW Flow, Peak Month, Winter

Flow =	4.43	MGD	
BOD =	4730	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	5560	lbs/d	
TKN =	960	lb/d	(includes 40 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	4.43	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.85%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.3057	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	7.337	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	5203	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	140.9	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	5560	#/day			
	150.5	mg/L	Alpha	0.518454	
TKN	960	#/day	Beta	0.95	
	26.0	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4448	#/day	Field elevation	730	ft
	120.4	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.89	mg/L	Effluent BOD	2.89	mg/L
Active Microbial VSS (Ma)	1478.7	mg/L	BOD O2 uptake (method 1)	20.2	mg/L/hr
Lysed Cell VSS (Me)	1232.7	mg/L		227.94	#/hr
Inert Influent VSS (Mi)	3151.2	mg/L	TKN O2 uptake (method 1)	15.0	mg/L/hr
Inert, Inorganic SS (Mf)	2240.6	mg/L		169.69	#/hr
MLSS (BOD)	8103.2	mg/L	Total O2 uptake (method 1)	35.2	mg/L/hr
				397.6	#/hr
Unmetabolized NH3 (F-N)	0.064	mg/L			
Active N-Microbial VSS (Ma-N)	206.7	mg/L	Denitrification O2 Credit (method 1)	50.91	#/hr
Lysed N-Cell VSS (Me)	172.3	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	37.9	mg/L	Total O2 from Aeration System	221.4	#/hr
MLSS (NH3)	417.0	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	8520.2	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	6241.6	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.3%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.52	
Total WAS Volatiles	3524.1	#/day			
Total WAS	4810.6	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	22.15	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1000.8	#/hr
(method 1)	24018	#/day
SCFM required	2883	scfm
ACFM at air temperature (mth 1)	3308	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	557.2	#/hr
(method 1)	13373	#/day
SCFM required	1605	scfm
ACFM at air temperature (mth 1)	1842	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	685.3	#/hr
(method 1)	16448	#/day
SCFM required	1974	scfm
ACFM at air temperature (mth 1)	2265	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	872.6	#/hr
(method 1)	20943	#/day
SCFM required	2514	scfm
ACFM at air temperature (mth 1)	2884	acfm

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PHASE 2
Design Case 5: ADW Flow, Peak Month, Summer

Flow =	3.05	MGD	
BOD =	4730	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	5560	lbs/d	
TKN =	960	lb/d	(includes 40 lbs/d from dewatering filtrate)

MODEL INPUTS:

Flow	3.05	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.78%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4439	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	10.654	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	5203	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	204.5	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	5560	#/day			
	218.6	mg/L	Alpha	0.548291	
TKN	960	#/day	Beta	0.95	
	37.7	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4448	#/day	Field elevation	730	ft
	174.9	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	1.27	mg/L	Effluent BOD	1.27	mg/L
Active Microbial VSS (Ma)	731.5	mg/L	BOD O2 uptake (method 1)	22.3	mg/L/hr
Lysed Cell VSS (Me)	1404.4	mg/L		251.81	#/hr
Inert Influent VSS (Mi)	3151.2	mg/L	TKN O2 uptake (method 1)	15.3	mg/L/hr
Inert, Inorganic SS (Mf)	2183.1	mg/L		172.82	#/hr
MLSS (BOD)	7470.1	mg/L	Total O2 uptake (method 1)	37.6	mg/L/hr
				424.6	#/hr
Unmetabolized NH3 (F-N)	0.028	mg/L			
Active N-Microbial VSS (Ma-N)	101.0	mg/L	Denitrification O2 Credit (method 1)	51.84	#/hr
Lysed N-Cell VSS (Me)	193.9	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	29.5	mg/L	Total O2 from Aeration System	247.5	#/hr
MLSS (NH3)	324.3	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	7794.4	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	5581.9	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.6%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.083	0.2-0.6 for com	SOR/AOR	2.48	
Total WAS Volatiles	3151.6	#/day			
Total WAS	4400.9	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	15.25	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1052.5	#/hr
(method 1)	25260	#/day
SCFM required	3032	scfm
ACFM at air temperature (mth 1)	3479	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	613.3	#/hr
(method 1)	14720	#/day
SCFM required	1767	scfm
ACFM at air temperature (mth 1)	2027	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	741.8	#/hr
(method 1)	17804	#/day
SCFM required	2137	scfm
ACFM at air temperature (mth 1)	2452	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	924.0	#/hr
(method 1)	22176	#/day
SCFM required	2662	scfm
ACFM at air temperature (mth 1)	3054	acfm

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PHASE 2
Design Case 6: ADW Flow, Peak Month, Winter

Flow =	3.05	MGD	
BOD =	4730	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	5560	lbs/d	
TKN =	960	lb/d	(includes 40 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	3.05	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.85%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4439	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	10.654	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	5203	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	204.5	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	5560	#/day			
	218.6	mg/L	Alpha	0.517676	
TKN	960	#/day	Beta	0.95	
	37.7	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	4448	#/day	Field elevation	730	ft
	174.9	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.91	mg/L	Effluent BOD	2.91	mg/L
Active Microbial VSS (Ma)	1488.2	mg/L	BOD O2 uptake (method 1)	20.3	mg/L/hr
Lysed Cell VSS (Me)	1240.6	mg/L		229.41	#/hr
Inert Influent VSS (Mi)	3151.2	mg/L	TKN O2 uptake (method 1)	15.0	mg/L/hr
Inert, Inorganic SS (Mf)	2242.4	mg/L		169.82	#/hr
MLSS (BOD)	8122.3	mg/L	Total O2 uptake (method 1)	35.4	mg/L/hr
				399.2	#/hr
Unmetabolized NH3 (F-N)	0.064	mg/L			
Active N-Microbial VSS (Ma-N)	206.9	mg/L	Denitrification O2 Credit (method 1)	50.94	#/hr
Lysed N-Cell VSS (Me)	172.5	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	37.9	mg/L	Total O2 from Aeration System	222.9	#/hr
MLSS (NH3)	417.3	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	8539.6	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	6259.3	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.3%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.074	0.2-0.6 for com	SOR/AOR	2.52	
Total WAS Volatiles	3534.1	#/day			
Total WAS	4821.6	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	15.25	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	1006.3	#/hr
(method 1)	24151	#/day
SCFM required	2899	scfm
ACFM at air temperature (mth 1)	3326	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	562.0	#/hr
(method 1)	13487	#/day
SCFM required	1619	scfm
ACFM at air temperature (mth 1)	1857	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	690.4	#/hr
(method 1)	16569	#/day
SCFM required	1989	scfm
ACFM at air temperature (mth 1)	2282	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	877.9	#/hr
(method 1)	21069	#/day
SCFM required	2529	scfm
ACFM at air temperature (mth 1)	2902	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements Date: 10/25/12
2489-11A.300 Revised: 1/9/2014

PHASE 2
Design Case 7: Average Flow & Load, Summer

Flow =	3.33	MGD	
BOD =	3592	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	4343	lbs/d	
TKN =	778	lb/d	(includes 40 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	3.33	mgd	Sludge age	20.0	days
Basin temperature	20	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.60%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4066	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	9.759	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3951.2	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	142.3	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4343	#/day			
	156.4	mg/L	Alpha	0.627425	
TKN	778	#/day	Beta	0.95	
	28.0	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3474.4	#/day	Field elevation	730	ft
	125.1	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	1.0000		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	0.97	mg/L	Effluent BOD	0.97	mg/L
Active Microbial VSS (Ma)	555.2	mg/L	BOD O2 uptake (method 1)	16.9	mg/L/hr
Lysed Cell VSS (Me)	1065.9	mg/L		191.12	#/hr
Inert Influent VSS (Mi)	2461.4	mg/L	TKN O2 uptake (method 1)	12.4	mg/L/hr
Inert, Inorganic SS (Mf)	1700.5	mg/L		140.04	#/hr
MLSS (BOD)	5783.0	mg/L	Total O2 uptake (method 1)	29.3	mg/L/hr
				331.2	#/hr
Unmetabolized NH3 (F-N)	0.023	mg/L			
Active N-Microbial VSS (Ma-N)	81.8	mg/L	Denitrification O2 Credit (method 1)	42.01	#/hr
Lysed N-Cell VSS (Me)	157.1	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	23.9	mg/L	Total O2 from Aeration System	163.8	#/hr
MLSS (NH3)	262.8	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	6045.8	mg/L	C^*_{ST} (O2 saturation at T)	9.08	mg/L
MLVSS (total)	4321.4	mg/L	Water vapor pressure at basin T	0.34	psi
% Volatile	71.5%		$C^*_{\infty 20}$	10.53	mg/L
F/M ratio	0.081	0.2-0.6 for com	SOR/AOR	2.17	
Total WAS Volatiles	2440.0	#/day			
Total WAS	3413.6	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	16.65	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	717.3	#/hr
(method 1)	17215	#/day
SCFM required	2066	scfm
ACFM at air temperature (mth 1)	2371	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	354.8	#/hr
(method 1)	8516	#/day
SCFM required	1022	scfm
ACFM at air temperature (mth 1)	1173	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	445.8	#/hr
(method 1)	10700	#/day
SCFM required	1284	scfm
ACFM at air temperature (mth 1)	1474	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	626.3	#/hr
(method 1)	15031	#/day
SCFM required	1804	scfm
ACFM at air temperature (mth 1)	2070	acfm

ACTIVATED SLUDGE MODEL
North Liberty WWTP Improvements
2489-11A.300

Date: 10/25/12
Revised: 1/9/2014

PHASE 2
Design Case 8: Average Flow & Load, Winter

Flow =	3.33	MGD	
BOD =	3592	lbs/d	(peak BOD load = BOD load * 1.1)
TSS =	4343	lbs/d	
TKN =	778	lb/d	(includes 40 lbs/d from dewatering filterate)

MODEL INPUTS:

Flow	3.33	mgd	Sludge age	20.0	days
Basin temperature	8	°C	Effluent SS	0	mg/L
Number of Basins	2	each	RAS/WAS Concentration	0.66%	
Volume per Basin	0.677	mg			
Basin volume	1.354	mg	BOD Metabolism Factor (Km)	15	1/hour
Detention time	0.4066	days	BOD Synthesis Factor (Ks)	12.7	1/hour
	9.759	hours	Endogenous Decay Factor (Ke)	0.02	1/hour
BOD	3951.2	#/day	NH3 Metabolism Factor (Km-N)	127	1/hour
	142.3	mg/L	NH3 Synthesis Factor (Ks-N)	80	1/hour
TSS	4343	#/day			
	156.4	mg/L	Alpha	0.600509	
TKN	778	#/day	Beta	0.95	
	28.0	mg/L	Residual DO	2	mg/L
TKN Portion to be oxidized	100%		Diffuser depth	19	feet
VSS/TSS	0.8	(0.65-	Effective Saturation Depth	32.5%	tank depth
VSS	3474.4	#/day	Field elevation	730	ft
	125.1	mg/L	Relative humidity	70.0%	
			Standard Oxygen Transfer Eff.	33%	
			Air temperature	104	°F

MODEL OUTPUTS:

Temperature correction factor	0.4342		Nitri. BOD	0.00	mg/L
Unmetabolized BOD5 (F)	2.20	mg/L	Effluent BOD	2.20	mg/L
Active Microbial VSS (Ma)	1128.7	mg/L	BOD O2 uptake (method 1)	15.4	mg/L/hr
Lysed Cell VSS (Me)	940.9	mg/L		173.99	#/hr
Inert Influent VSS (Mi)	2461.4	mg/L	TKN O2 uptake (method 1)	12.2	mg/L/hr
Inert, Inorganic SS (Mf)	1745.3	mg/L		137.60	#/hr
MLSS (BOD)	6276.4	mg/L	Total O2 uptake (method 1)	27.6	mg/L/hr
				311.6	#/hr
Unmetabolized NH3 (F-N)	0.052	mg/L			
Active N-Microbial VSS (Ma-N)	167.6	mg/L	Denitrification O2 Credit (method 1)	41.28	#/hr
Lysed N-Cell VSS (Me)	139.7	mg/L	Credit for Membrane Aeration	125.33	#/hr
Inert, N-Inorganic SS (Mf)	30.7	mg/L	Total O2 from Aeration System	145.0	#/hr
MLSS (NH3)	338.1	mg/L			
			Site atmospheric pressure (20C)	14.32	psi
MLSS (total)	6614.5	mg/L	C^*_{ST} (O2 saturation at T)	11.86	mg/L
MLVSS (total)	4838.4	mg/L	Water vapor pressure at basin T	0.15	psi
% Volatile	73.1%		$C^*_{\infty 20}$	10.52	mg/L
F/M ratio	0.072	0.2-0.6 for com	SOR/AOR	2.17	
Total WAS Volatiles	2731.8	#/day			
Total WAS	3734.7	#/day	Air temperature	40.0	°C
WAS Flow	67700	gpd	Water vapor pressure at air T	1.08	psi
RAS Flow	16.65	mgd			

No credit for denitrification or membrane aeration		
Standard O2 Rate Req'd (SOR)	677.1	#/hr
(method 1)	16249	#/day
SCFM required	1950	scfm
ACFM at air temperature (mth 1)	2238	acfm

Credit for denitrification & membrane aeration		
Standard O2 Rate Req'd (SOR)	315.0	#/hr
(method 1)	7560	#/day
SCFM required	907	scfm
ACFM at air temperature (mth 1)	1041	acfm

Credit for membrane aeration only		
Standard O2 Rate Req'd (SOR)	404.7	#/hr
(method 1)	9713	#/day
SCFM required	1166	scfm
ACFM at air temperature (mth 1)	1338	acfm

Credit for denitrification only		
Standard O2 Rate Req'd (SOR)	587.4	#/hr
(method 1)	14096	#/day
SCFM required	1692	scfm
ACFM at air temperature (mth 1)	1941	acfm

APPENDIX D

FLOW EQUALIZATION BASIN
SIZING ANALYSIS

FLOW EQUALIZATION SIZING
North Liberty WWTP Improvements
2489-11A.300

Peak 7 Day Flow Period ==> April 2013

	Apr-13		Phase I				Phase IA				Phase II				Phase III			
			MBR Peak Day Flow = 3.388 MGD				MBR Peak Day Flow = 4.235 MGD				MBR Peak Day Flow = 6.310 MGD				MBR Peak Day Flow = 12.620 MGD			
	Q (MGD)	Ratio	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)
1	2.868	0.36	2.868				3.144				3.643				5.510			
2	2.326	0.29	2.326				2.550				2.955				4.469			
3	2.046	0.26	2.046				2.243				2.599				3.931			
4	2.155	0.27	2.155				2.363				2.737				4.140			
5	2.232	0.28	2.232				2.447				2.835				4.288			
6	1.947	0.25	1.947				2.135				2.473				3.741			
7	7.915	1.00	7.915	4.527		4.527	8.678	4.443		4.443	10.054	3.744		3.744	15.206	2.586		2.586
8	4.673	0.59	4.673	1.285		5.812	5.123	0.888		5.331	5.936		0.374	3.370	8.978		3.642	0.000
9	3.157	0.40	3.157		0.231	5.581	3.461		0.774	4.557	4.010		2.300	1.070	6.065			
10	2.689	0.34	2.689		0.699	4.882	2.948		1.287	3.270	3.416		2.894	0.000	5.166			
11	2.339	0.30	2.339		1.049	3.833	2.564		1.671	1.599	2.971				4.494			
12	2.002	0.25	2.002		1.386	2.447	2.195		2.040	0.000	2.543				3.846			
13	1.782	0.23	1.782		1.606	0.841	1.954				2.264				3.424			
14	1.676	0.21	1.676		1.712	0.000	1.837				2.129				3.220			

Next Highest 7 Day Flow Period ==> August 2009

	Aug-09		Phase I				Phase IA				Phase II				Phase III			
			MBR Peak Day Flow = 3.388 MGD				MBR Peak Day Flow = 4.235 MGD				MBR Peak Day Flow = 6.310 MGD				MBR Peak Day Flow = 12.620 MGD			
			Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)	Q (MGD)	Pumped To EQ (MGD)	EQ Return Flow (MGD)	Cumm. EQ (MG)
1	1.571	0.381	3.017				3.308				3.833				5.797			
2	1.378	0.334	2.647				2.902				3.362				5.085			
3	1.295	0.314	2.487				2.727				3.159				4.778			
4	1.413	0.343	2.714				2.975				3.447				5.214			
5	1.476	0.358	2.835				3.108				3.601				5.446			
6	3.143	0.763	6.037	2.649		2.649	6.618	2.383		2.383	7.668	1.358		1.358	11.597			
7	4.121	1.000	7.915	4.527		7.176	8.678	4.443		6.826	10.054	3.744		5.102	15.206	2.586		2.586
8	2.564	0.622	4.925	1.537		8.712	5.399	1.164		7.990	6.255		0.055	5.047	9.461		3.159	0.000
9	2.080	0.505	3.995	0.607		9.319	4.380	0.145		8.135	5.075		1.235	3.812	7.675			
10	1.750	0.425	3.361		0.027	9.292	3.685		0.550	7.584	4.269		2.041	1.771	6.457			
11	1.668	0.405	3.204		0.184	9.108	3.512		0.723	6.862	4.069		2.241	0.000	6.155			
12	1.476	0.358	2.835		0.553	8.555	3.108		1.127	5.735	3.601				5.446			
13	1.458	0.354	2.800		0.588	7.967	3.070		1.165	4.570	3.557				5.380			
14	1.437	0.349	2.760		0.628	7.339	3.026		1.209	3.361	3.506				5.302			

APPENDIX E

AEROBIC DIGESTION MODEL

Aerobic Digester Design Calculations SJT

North Liberty WWTP Improvements Date 10/27/2012

2489-11A.300 Revised 12/31/2013

PHASE I

Design Case 1: Peak Month WAS, summer, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T\text{-}w} = M_{T\text{-}Dinf}$	2575	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	1843	#/day	- active mass in waste activated sludge
Influent VSS/TSS	72%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	30	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	74.5	days	
Q_D	15438	gpd	- net liquid quantity influent to digester

Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	104	°F	

MODEL OUTPUTS:

Temperature correction factor	2.0042		
Ma_{Dw}	25.4	#/day	- active mass wasted from digester
Delta M_v	1454.1	#/day	
$M_{T\text{-}Dw}$	388.9	#/day	- net change in VSS
VSS destruction	78.9%		- total solids wasted from digester
TSS in digester	8706	mg/L	

O_2 for mass destruction	83.01	#/hour
O_2 for nitrification	34.30	#/hour
Total oxygen required	117.31	#/hour
	12.24	mg/L/hr

Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	7.57	mg/L	SAV equation
Water vapor pressure at basin T	0.62	psi	SAV equation
$C^*_{\infty 20}$	10.43	mg/L	MOP 63 eq. 4
SOR/AOR	1.62		MOP 63 eq. 14
Air temperature	40.0	°C	
Water vapor pressure at air T	1.08	psi	

Standard O2 Rate Req'd (SOR)	190.2	#/hr	
	4565	#/day	
SCFM required	1822	scfm	MOP 63 p. 48
	11.9	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	2090	acfm	MOP 63 p. 49
	13.6	acfm/1,000 cf	

Aerobic Digester Design Calculations		SJT
North Liberty WWTP Improvements	Date	10/27/2012
2489-11A.300	Revised	12/31/2013

PHASE I

Design Case 2: Peak Month WAS, winter, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T\text{-}w} = M_{T\text{-}Dinf}$	2820	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	2066	#/day	- active mass in waste activated sludge
Influent VSS/TSS	73%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	10	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	68.0	days	
Q_D	16906	gpd	- net liquid quantity influent to digester

Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	30	°F	

MODEL OUTPUTS:

Temperature correction factor	0.4989		
Ma_{Dw}	119.5	#/day	- active mass wasted from digester
Delta M_v	1557.2	#/day	
$M_{T\text{-}Dw}$	508.8	#/day	- net change in VSS
VSS destruction	76.2%		- total solids wasted from digester
TSS in digester	8956	mg/L	

O_2 for mass destruction	88.89	#/hour	
O_2 for nitrification	36.74	#/hour	
Total oxygen required	125.63	#/hour	
	13.11	mg/L/hr	

Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	11.30	mg/L	SAV equation
Water vapor pressure at basin T	0.17	psi	SAV equation
$C^*_{\infty 20}$	10.39	mg/L	MOP 63 eq. 4
SOR/AOR	1.67		MOP 63 eq. 14
Air temperature	-1.1	°C	
Water vapor pressure at air T	0.10	psi	

Standard O2 Rate Req'd (SOR)	209.6	#/hr	
	5029	#/day	
SCFM required	1999	scfm	MOP 63 p. 48
	13.0	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	1897	acfm	MOP 63 p. 49
	12.3	acfm/1,000 cf	

Aerobic Digester Design Calculations SJT
North Liberty WWTP Improvements Date 10/27/2012
2489-11A.300 Revised 12/31/2013

PHASE IA
Design Case 1: Peak Month WAS, summer, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T-w} = M_{T-Dinf}$	3221	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	2305	#/day	- active mass in waste activated sludge
Influent VSS/TSS	72%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	30	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	59.6	days	
Q_D	19311	gpd	- net liquid quantity influent to digester
Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	104	°F	

MODEL OUTPUTS:

Temperature correction factor	2.0042		
Ma_{Dw}	39.5	#/day	- active mass wasted from digester
Delta M_v	1812.4	#/day	
M_{T-Dw}	492.6	#/day	- net change in VSS
VSS destruction	78.6%		- total solids wasted from digester
TSS in digester	8747	mg/L	
O_2 for mass destruction	103.46	#/hour	
O_2 for nitrification	42.76	#/hour	
Total oxygen required	146.21	#/hour	
	15.26	mg/L/hr	
Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	7.57	mg/L	SAV equation
Water vapor pressure at basin T	0.62	psi	SAV equation
$C^*_{\infty 20}$	10.43	mg/L	MOP 63 eq. 4
SOR/AOR	1.62		MOP 63 eq. 14
Air temperature	40.0	°C	
Water vapor pressure at air T	1.08	psi	

Standard O2 Rate Req'd (SOR)	237.1	#/hr	
	5690	#/day	
SCFM required	2271	scfm	MOP 63 p. 48
	14.8	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	2605	acfm	MOP 63 p. 49
	16.9	acfm/1,000 cf	

Aerobic Digester Design Calculations SJT
North Liberty WWTP Improvements Date 10/27/2012
2489-11A.300 Revised 12/31/2013

PHASE IA
Design Case 2: Peak Month WAS, winter, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T\text{-}w} = M_{T\text{-}Dinf}$	3525	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	2581	#/day	- active mass in waste activated sludge
Influent VSS/TSS	73%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	10	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	54.4	days	
Q_D	21133	gpd	- net liquid quantity influent to digester
Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	30	°F	

MODEL OUTPUTS:

Temperature correction factor	0.4989		
Ma_{Dw}	183.9	#/day	- active mass wasted from digester
Delta M_v	1917.7	#/day	
$M_{T\text{-}Dw}$	663.3	#/day	- net change in VSS
VSS destruction	75.0%		- total solids wasted from digester
TSS in digester	9120	mg/L	
O_2 for mass destruction	109.47	#/hour	
O_2 for nitrification	45.24	#/hour	
Total oxygen required	154.71	#/hour	
	16.14	mg/L/hr	
Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	11.30	mg/L	SAV equation
Water vapor pressure at basin T	0.17	psi	SAV equation
$C^*_{\infty 20}$	10.39	mg/L	MOP 63 eq. 4
SOR/AOR	1.67		MOP 63 eq. 14
Air temperature	-1.1	°C	
Water vapor pressure at air T	0.10	psi	
Standard O2 Rate Req'd (SOR)	258.1	#/hr	
	6194	#/day	
SCFM required	2462	scfm	MOP 63 p. 48
	16.0	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	2336	acfm	MOP 63 p. 49
	15.2	acfm/1,000 cf	

Aerobic Digester Design Calculations SJT
North Liberty WWTP Improvements Date 10/27/2012
2489-11A.300 Revised 12/31/2013

PHASE II
Design Case 1: Peak Month WAS, summer, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T\text{-}w} = M_{T\text{-}Dinf}$	4393	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	3145	#/day	- active mass in waste activated sludge
Influent VSS/TSS	72%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	30	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	43.7	days	
Q_D	26337	gpd	- net liquid quantity influent to digester
Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	104	°F	

MODEL OUTPUTS:

Temperature correction factor	2.0042		
Ma_{Dw}	73.1	#/day	- active mass wasted from digester
Delta M_v	2457.5	#/day	
$M_{T\text{-}Dw}$	687.5	#/day	- net change in VSS
VSS destruction	78.1%		- total solids wasted from digester
TSS in digester	8812	mg/L	
O_2 for mass destruction	140.28	#/hour	
O_2 for nitrification	57.98	#/hour	
Total oxygen required	198.26	#/hour	
	20.69	mg/L/hr	
Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	7.57	mg/L	SAV equation
Water vapor pressure at basin T	0.62	psi	SAV equation
$C^*_{\infty 20}$	10.43	mg/L	MOP 63 eq. 4
SOR/AOR	1.62		MOP 63 eq. 14
Air temperature	40.0	°C	
Water vapor pressure at air T	1.08	psi	
Standard O2 Rate Req'd (SOR)	321.5	#/hr	
	7715	#/day	
SCFM required	3079	scfm	MOP 63 p. 48
	20.0	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	3533	acfm	MOP 63 p. 49
	23.0	acfm/1,000 cf	

Aerobic Digester Design Calculations SJT
North Liberty WWTP Improvements Date 10/27/2012
2489-11A.300 Revised 12/31/2013

PHASE II
Design Case 2: Peak Month WAS, winter, parallel flow

MODEL INPUTS:

Ke	0.48	/day	- endogenous metabolism factor at 20 degrees C
$M_{T-w} = M_{T-Dinf}$	4812	#/day	- waste biological solids loading on digester
$Ma_w = Ma_{Dinf}$	3525	#/day	- active mass in waste activated sludge
Influent VSS/TSS	73%		
$C_w = C_D$	20000	mg/L	- digester sludge SS concentration
Basin temperature	10	°C	
Basin 1 volume	0.575	mg	
Basin 2 volume	0.575	mg	
Total volume	1.150	mg	
Total liquid detention time	39.9	days	
Q_D	28849	gpd	- net liquid quantity influent to digester
Alpha	0.72		0.6 fine bubble, .72 jet, 0.85 cb
Beta	0.95		
Residual DO	1	mg/L	
Diffuser depth	19	feet	
Effective Saturation Depth	30.0%	tank depth --->	Coarse bubble = 26-34%
Field elevation	730	ft	Fine bubble = 21-44%
Relative humidity	70.0%		Low speed surface aeration = 5-7%
Standard Oxygen Transfer Eff.	10.0%		Coarse bubble diffuser
Air temperature	30	°F	

MODEL OUTPUTS:

Temperature correction factor	0.4989		
Ma_{Dw}	334.2	#/day	- active mass wasted from digester
Delta M_v	2552.6	#/day	
M_{T-Dw}	972.4	#/day	- net change in VSS
VSS destruction	72.4%		- total solids wasted from digester
TSS in digester	9391	mg/L	
O_2 for mass destruction	145.71	#/hour	
O_2 for nitrification	60.22	#/hour	
Total oxygen required	205.93	#/hour	
	21.49	mg/L/hr	
Site atmospheric pressure (20C)	14.32	psi	M&E equation
C^*_{ST} (O2 saturation at T)	11.30	mg/L	SAV equation
Water vapor pressure at basin T	0.17	psi	SAV equation
$C^*_{\infty 20}$	10.39	mg/L	MOP 63 eq. 4
SOR/AOR	1.67		MOP 63 eq. 14
Air temperature	-1.1	°C	
Water vapor pressure at air T	0.10	psi	
Standard O2 Rate Req'd (SOR)	343.5	#/hr	
	8244	#/day	
SCFM required	3290	scfm	MOP 63 p. 48
	21.4	scfm/1,000 cf	(20-40 scfm/1,000cf typical for mixing)
ACFM at air temperature (mth 1)	3122	acfm	MOP 63 p. 49
	20.3	acfm/1,000 cf	

APPENDIX F

RATE AND BUDGET PROJECTIONS

Wastewater Utility, 2013 Facility Plan Improvements; Rate & Budget Projections

	FY 12 Audited	FY 13 Budget	FY 14 Budget	FY 15 Estimated	FY 16 Estimated	FY 17 Estimated	FY 18 Estimated	FY 19 Estimated	FY 20 Estimated	FY 21 Estimated	FY 22 Estimated	FY 23 Estimated	FY 24 Estimated	FY 25 Estimated
Budget Inflation Rate		2.30%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Number of Accounts	6,596	6,748	6,883	7,021	7,161	7,304	7,450	7,599	7,751	7,906	8,064	8,226	8,390	8,558
Gallons Sold	295,681,000	309,746,544	315,941,475	322,260,304	328,705,510	335,279,621	341,985,213	348,824,917	355,801,416	362,917,444	370,175,793	377,579,309	385,130,895	392,833,513
Proposed Rate Increase	**0%**	**8%**	**5%**	**15%**	**15%**	**10%**	**7%**	**7%**	**5%**	**2%**	**2%**	**0%**	**0%**	**0%**
Base Rate	$21.82	$23.57	$23.57	$27.10	$31.17	$34.28	$36.68	$39.25	$41.21	$42.04	$42.88	$42.88	$42.88	$42.88
Rate/1000 Gallons	$3.74	$4.04	$4.24	$4.88	$5.61	$6.17	$6.60	$7.06	$7.42	$7.57	$7.72	$7.72	$7.72	$7.72
Revenues														
Wastewater Sales	$2,585,237	$2,832,298	$2,936,071	$3,444,011	$4,039,825	$4,532,683	$4,946,970	$5,399,124	$5,782,461	$6,016,073	$6,259,122	$6,384,304	$6,511,991	$6,642,230
Sales Tax	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Connection Fees/Permits	$57,775	$65,000	$65,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
Use of Money	$3,514	$1,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
Miscellaneous	$1,955	$500	$0	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700	$15,700
Transfers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Accounts Receivable/Payable	($40,454)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Wastewater Utility Revenues	**$2,608,027**	**$2,898,798**	**$3,003,071**	**$3,506,711**	**$4,102,525**	**$4,595,383**	**$5,009,670**	**$5,461,824**	**$5,845,161**	**$6,078,773**	**$6,321,822**	**$6,447,004**	**$6,574,691**	**$6,704,930**
Expenditures														
Budget Inflation Rate		9.12%	4.18%	5.00%	15.00%	15.00%	15.00%	15.00%	10.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Personnel Services	$413,531	$440,420	$510,992	$536,542	$617,023	$709,576	$816,013	$938,415	$1,032,256	$1,083,869	$1,138,062	$1,194,965	$1,254,714	$1,317,449
Services & Commodities	$620,909	$690,500	$748,775	$786,214	$904,146	$1,039,768	$1,195,733	$1,375,093	$1,512,602	$1,588,232	$1,667,644	$1,751,026	$1,838,577	$1,930,506
Capital	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Transfers														
Equipment Revolving	$40,000	$30,000	$25,000	$187,500	$0	$0	$0	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Capital Reserve	$145,000	$212,000	$239,000	$185,000	$117,000	$117,000	$117,000	$117,000	$125,000	$225,000	$225,000	$225,000	$225,000	$225,000
Debt	$1,042,863	$1,087,640	$1,040,109	$1,032,923	$1,041,896	$1,039,776	$1,046,702	$1,047,996	$1,047,848	$1,048,213	$1,047,410	$1,051,430	$905,610	$905,345
Billing & Accounting	$233,063	$262,287	$272,708	$283,616	$294,961	$306,759	$319,030	$331,791	$345,063	$358,865	$373,220	$388,149	$403,674	$419,821
Sewer Study Projects														
(1) Short Term Projects	$0	$0	$0	$136,588	$149,338	$147,488	$150,418	$147,972	$150,200	$147,043	$148,589	$149,736	$150,572	$151,072
(2) East Trunk Sewer	$0	$0	$0	$362,039	$395,247	$390,530	$395,251	$394,077	$391,949	$394,056	$395,107	$390,225	$394,815	$393,475
(3) WWTP Expansion	$0	$0	$0	$0	$869,342	$948,380	$948,360	$948,080	$948,540	$948,720	$948,620	$948,360	$947,800	$947,940
(4) Mid/Long Term Projects	$0	$0	$0	$0	$0	$0	$0	$157,524	$171,103	$174,068	$171,688	$174,008	$170,840	$172,396
Total Wastewater Utility Expenditures	**$2,495,366**	**$2,722,847**	**$2,836,584**	**$3,510,422**	**$4,388,953**	**$4,699,277**	**$4,988,506**	**$5,507,947**	**$5,774,561**	**$6,018,066**	**$6,165,340**	**$6,322,899**	**$6,341,602**	**$6,513,005**
Net Change in Fund Balance	**$112,661**	**$175,951**	**$166,487**	**($3,711)**	**($286,428)**	**($103,894)**	**$21,164**	**($46,124)**	**$70,601**	**$60,707**	**$156,482**	**$124,106**	**$233,088**	**$191,925**
Beginning Fund Balance	$689,996	$802,657	$978,608	$1,145,095	$1,141,384	$854,956	$751,061	$772,225	$726,102	$796,702	$857,409	$1,013,891	$1,137,996	$1,371,085
Ending Fund Balance	$802,657	$978,608	$1,145,095	$1,141,384	$854,956	$751,061	$772,225	$726,102	$796,702	$857,409	$1,013,891	$1,137,996	$1,371,085	$1,563,010
% Reserved	32.17%	35.94%	40.37%	32.51%	19.48%	15.98%	15.48%	13.18%	13.80%	14.25%	16.45%	18.00%	21.62%	24.00%
Total Personnel Costs	$413,531	$440,420	$510,992	$536,542	$617,023	$709,576	$816,013	$938,415	$1,032,256	$1,083,869	$1,138,062	$1,194,965	$1,254,714	$1,317,449
% of Wastewater Utility Expenditures	16.57%	16.17%	18.01%	15.28%	14.06%	15.10%	16.36%	17.04%	17.88%	18.01%	18.46%	18.90%	19.79%	20.23%
Debt Service Coverage (Net Revenue/All Debt)														
Actual	1.51	1.63	1.68	1.43	1.05	1.13	1.18	1.17	1.22	1.26	1.30	1.29	1.35	1.35
Required	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Difference	0.31	0.43	0.48	0.23	(0.15)	(0.07)	(0.02)	(0.03)	0.02	0.06	0.10	0.09	0.15	0.15

Increase on consumption rate only

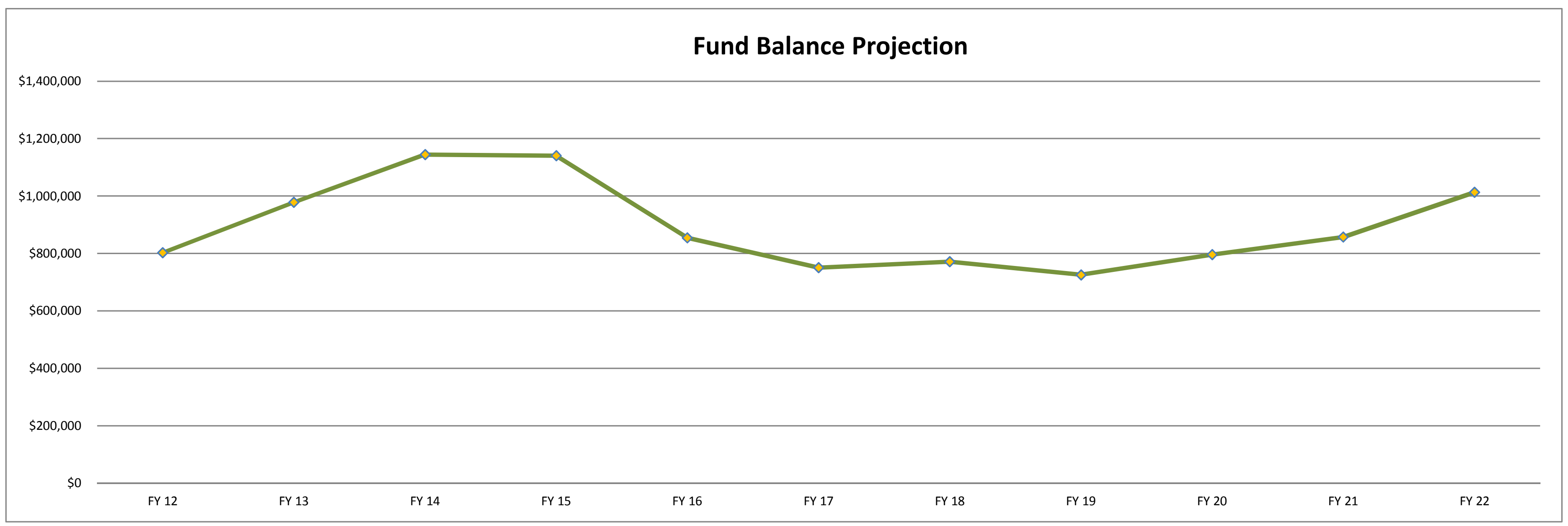
Update: June 14, 2013

Wastewater Utility, 2013 Facility Plan Improvements; Rate & Budget Projections

Wastewater Rate Increase Analysis

Monthly Wastewater Costs Based on Usage

Consumption in Gallons		FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25
	3,000	$29.30	$31.64	$32.05	$36.86	$42.38	$46.62	$49.89	$53.38	$56.05	$57.17	$58.31	$58.31	$58.31	$58.31
	5,000	$36.78	$39.72	$40.53	$46.61	$53.60	$58.96	$63.09	$67.50	$70.88	$72.30	$73.74	$73.74	$73.74	$73.74
	8,000	$48.00	$51.84	$53.25	$61.24	$70.43	$77.47	$82.89	$88.70	$93.13	$94.99	$96.89	$96.89	$96.89	$96.89
	11,000	$59.22	$63.96	$65.98	$75.87	$87.25	$95.98	$102.70	$109.89	$115.38	$117.69	$120.04	$120.04	$120.04	$120.04
	15,000	$74.18	$80.11	$82.94	$95.38	$109.69	$120.66	$129.11	$138.14	$145.05	$147.95	$150.91	$150.91	$150.91	$150.91
Additional Wastewater Cost/Month	**3,000**		$2.34	$0.40	$4.81	$5.53	$4.24	$3.26	$3.49	$2.67	$1.12	$1.14	$0.00	$0.00	$0.00
	5,000		$2.94	$0.81	$6.08	$6.99	$5.36	$4.13	$4.42	$3.38	$1.42	$1.45	$0.00	$0.00	$0.00
	8,000		$3.84	$1.41	$7.99	$9.19	$7.04	$5.42	$5.80	$4.43	$1.86	$1.90	$0.00	$0.00	$0.00
	11,000		$4.74	$2.02	$9.90	$11.38	$8.73	$6.72	$7.19	$5.49	$2.31	$2.35	$0.00	$0.00	$0.00
	15,000		$5.93	$2.83	$12.44	$14.31	$10.97	$8.45	$9.04	$6.91	$2.90	$2.96	$0.00	$0.00	$0.00
Additional Wastewater Cost/Year	**3,000**		$28.13	$4.85	$57.69	$66.34	$50.86	$39.16	$41.90	$32.03	$13.45	$13.72	$0.00	$0.00	$0.00
	5,000		$35.31	$9.69	$72.95	$83.90	$64.32	$49.53	$52.99	$40.50	$17.01	$17.35	$0.00	$0.00	$0.00
	8,000		$46.08	$16.96	$95.86	$110.24	$84.51	$65.08	$69.63	$53.22	$22.35	$22.80	$0.00	$0.00	$0.00
	11,000		$56.85	$24.24	$118.76	$136.57	$104.71	$80.62	$86.27	$65.93	$27.69	$28.25	$0.00	$0.00	$0.00
	15,000		$71.21	$33.93	$149.30	$171.69	$131.63	$101.35	$108.45	$82.89	$34.81	$35.51	$0.00	$0.00	$0.00



-Summary of Projects-

(1) Short Term Projects: Sewer line replacement/addition, referred to in Fox study as segments 0 to 8, 8 to 10 and 40 to 40-4; total cost estimated at $1.4 million.

(2) East Trunk Sewer: Installation of an east trunk sewer to serve basins 1 and 2 as detailed in the study; total cost estimated at $4 million.

(3) Mid/Long Term Projects: Sewer line replacement/addition, referred to in Fox study as segments 11 to 13, 13 to 21, 23 to 25, 8 to 8-2 and 8-2 to 8-9; total estimated cost $1.71 million.

(4) WWTP Expansion: Phase 2 of the MBR wastewater treatment plant; total estimated cost $15.3 million.

Update: June 14, 2013